MYOFUNCTIONAL APPLIANCES

Myofunctional Appliances

Dr. Boudhayan Maiti &

Dr Moupriya Bera Maiti

Medical and Research Publications

Myofunctional Appliances

1. Dr. Boudhayan Maiti MDS, Consultant Orthodontist.

2. Dr Moupriya Bera Maiti MDS, Specialized in Root Canal Treatment.

ACKNOWLEDGEMENT

I cash in on this opportunity to put across my sincere, most genuine and earnest gratitude towards my mentor and guru **Prof. Dr. Neeraj Alladwar ,** whose proficient guidance and parental support took me through the smooth accomplishmentof this dissertation. He always found time to discuss my work and shaped me as a researcher. I am indebted to him for endowing me with all of his incessant supports, prop-up and the encouragement , which facilitated me the most during my work.

I would like to extend my sincere thanks to **Dr. Shirish Goel , Dr. Saurabh Sharma and Dr. Vikas Agrawal**, Readers , Department of Orthodontics And Dentofacial Orthopedics,for his constant support and guidance.

Department Of Orthodontics And Dentofacial Orthopedics at Maitri Dental College of Dentistry and Research Center is the place of endeavour and skin to a shrine for me. The highly regarded and esteemed faculties of the department upgraded my knowledge and made me capable of accomplishing this task, giving it , its honest importance. Constant encouragement of my honourable teachers **Dr. Tanuj Chaudhary** and **Dr. Jayant Chandrakar** always been evident. The staff of the department always turned up to be warm, cordial and helpful;and created an environment of conviviality and bonhomie making my sojourn in the department- a memorable juncture.

I extend my honest thanks to my seniors, **Dr Priyanka Randive, Dr Bhawana Chandrakar,and Dr Arti Mishra** for their togetherness is unforgettable.

I can never forget the wonderful time spent with my colleagues **Dr Tanusha Mahobia and Dr Rameshwar Sonwani** who were always there whenever I needed.

I extend my honest thanks to my juniors, **Dr Veethika Jha, Dr Priyanka Kumari, and Dr Champak Poul** for their cooperation and their togetherness is unforgettable.

Any kind or amount of appreciation /acknowlegdement to my respected parents **Mr. Balai Chandra Maiti and Mrs Rekha Maiti** and also to my lovely sister **Dr Ashabari Maiti** would be mentioning too less, because for me , they throughout their life have truly exemplified the meaning of 'selfless' love and care. The most important person in life is my wife ,**Dr Moupriya Bera Maiti** , without her love and constant guidance it would have not be possible to do such great work . I want to mention my dearesr daughter ,**Miss Archisha Maiti**, for her constant love . The greatest gift they gave me is their trust, they believe in me . it is only because of them that I could accomplish whatever little I have achieved in my life.

Last but not the least; I thank almighty for providing my courage and spirit to accomplish this exigent task.

Dr. Boudhayan Maiti

"kind words can be short and easy to speak,

But their echoes are truly endless"'

TABLE OF CONTENTS

INTRODUCTION

CHAPTER:1 INTRODUCTION

1.1 INTRODUCTION

The term "Functional Appliances" refer to a variety of removable and fixed appliances designed to alter the arrangement of various muscle groups that influence the function and position of the mandible in order to transmit forces to the dentition and the basal bone. Typically, these muscular forces are generated by altering the mandibular position sagittally and vertically, resulting in orthodontic and orthopedic changes.

Functional appliances have been used since the 1930s. Despite this relatively long history, there continues to be much controversy relating to their use, method of action, and effectiveness. Although there are a number of functional appliances used by clinicians, this review will emphasize the activator, and the functional regulator used to correct Class II malocclusions.

Functional appliances as they are sometimes referred to are appliances that depend upon the oro-facial musculature for their action. In contrast to active removable appliances that make use of active components like springs, elastics and screws, the force component of functional appliances are derived from the orofacial musculature. These appliances transmit, eliminate or guide the natural forces of the musculature.

Functional appliances are used for growth modification procedures that are aimed at intercepting and treating jaw discrepancies. They can bring about the following changes:

1. An increase or decrease in jaw size
2. A change in spatial relationship of the jaws
3. Change in direction of growth of the jaws
4. Acceleration of desirable growth

Functional appliances are defined as loose fitting or passive appliances,which harness natural forces of the oro- facial musculature that are transmitted of the teeth and alveolar bone through the medium of the appliances.

The theoretical basis of functional treatment in general is the principle that a 'new pattern of function' dictated by the appliances , leads to the development of a corresponding 'new morphologic pattern' . The new pattern of function can refer to different functional components of the orofacial system, for example, the tounge , the lips, the facial and masticatory muscles, the ligaments, and the periosteum. Depending on the type of appliances, its proponent puts more emphasis on one of these different functional components. The 'new morphologic pattern' includes a different arrangement of the teeth within the jaws, an improvement of the occlusion ,and an altered relation of the jaws. It also includes changes in the amount and direction of growth of the jaws and differences in the facial size and proportions.

Most orthodontics (especially in America) think functional appliances as a relatively recent development in orthodontic history. But as early as 1880, Norman W. Kingsley experimented with appliances (bite plate) associated with technique known as "jumping the bite".

A functional appliance harnesses the natural forces and transmits it to the teeth and alveolar bone in a pre determined direction.

Myofunctional appliance is a removable type of appliance where the appliance becomes active by muscle force[1].

Feature: This is orthopaedic in nature. This appliance is an oral screen. Loosely fitted in the oral cavity.

Synonyms:

a) Monoblock - as myofunctional appliance has joined both upper and lower bases plates.

b) Activator (More popular) - As activates the musculature.

c) Anderson- As initially applied by the Anderson.

d) Frankel appliance or Functional regulator

e) Norwegian appliance[2]

Purpose: It is mainly used for correction of skeletal discrepancy (basal bone/ arch relationship) and to some extent dental anomalies.

How does it work?

It works by muscle force and act on the T.M joint area in the condylar head 4 & fossa by giving stimulation on bone forming cell.

Over the century,a variety of different functional appliances became available. Each proponent of the different functional appliances has conceived more or lesshis own concept and working hypothesis. E.G

1)Andresen, Haulp, Petrik, Herren, and Harvold for the activator.

2)Balters for the Bionator

3)Frankel for the functional regulator

4)Pancherz for the Herbst appliances

This is a comprehensive list of functional appliances that are used in the field of Orthodontics, or better on **Functional Orthodontics**. The functional appliances can be divided into fixed and removable. The fixed functional appliances have to be bonded to the teeth by an Orthodontist in his practice. A removable functional appliance does not need to be bonded on the teeth and can be removed by the patient. A removable appliance is usually used by patients who have high degree of compliance with their orthodontic treatment. Patients whose compliance is decreased and may not respond to a functional appliance therapy, a fixed appliance is indicated.

Both fixed and removable functional appliances can be used to correct a malocclusion in 3 planes of spaces: Anterior-Posterior, Vertical and Transverse. In the Anterior-Posterior dimension, appliances such as Class II and Class III are used. Appliances used in transverse dimension are utilized to expand either the maxillary or the mandibular arch. Appliances used in vertical dimension are used to correct open or deep bite.

Fixed functional appliances are effective in the management of Class II malocclusion. This is the only successful bite-jumping treatment for noncompliant, postpubertal patients that does not require orthognathic surgery at a later stage Fixed functional appliances are reported to correct Class II skeletal problems by encouraging mandibular growth and by eliciting dentoalveolar effects.

Mandibular displacement was first demonstrated by Herbst in 1934. Further clinical and cephalometric studies have supported this finding. These studies have shown an anterior displacement of the mandible and a posterosuperior displacement of the maxilla similar to the effects seen from headgear treatment. Hu et al and Zhou et al reported tensile stress in the posterior condylar region with compressive stresses in the anterior region. The changes in the condyle are assumed to be a result of mechanical stimulus of the fibrocartilage layer of the condyle, such as for long bones with similar structure. Thus the stress from fixed functional appliances should be studied to further explore the association with morphologic changes of the dentoalveolar complex. These investigations will help to further elucidate the mechanism of remodeling of the mandible and provide clinical indications for fixed functional appliance therapy.

Although many clinical studies have investigated the displacement and stress caused by fixed functional treatment, a recent study by Ulusoy and Darendeliler tried to quantify and explain the stress distribution pattern. Finite element models (FEMs) have been successfully used to study stress and strain, making it practicable to show stress distribution and displacement in living structures as induced by various appliances. The present FEM study was designed to investigate the displacement and stress distribution exerted by a fixed functional appliance on various craniofacial structures[3].

1.2 HISTORY

Functional appliances are considered to be primarily orthopedic tools to influence the facial skeleton of the growing child in the condylar and sutural areas. However, these appliances also exert orthodontic effects on the dentoalveolar area.

The history of the functional appliance can be traced back to 1879, when Norman Kingsley introduced the "bite-jumping" appliance. In the early 1900s, parallel development began in the United States and Europe in fixed and functional techniques, respectively, but the Atlantic Ocean was a geographic barrier that restricted the sharing of knowledge and experience in these philosophies. The only exception to this was the fixed functional appliance designed by Herbst. The monobloc, developed by Robin in 1902, is generally considered the forerunner of removable functional appliances, but the activator developed in Norway by Andresen in the 1920s was the first functional appliance to be widely accepted, becoming the basis of the "Norwegian system" of treatment. Both the appliance system and its theoretical underpinnings were improved and extended elsewhere in Europe, particularly by the German school led by Häupl, Bimler, and Balters. It would be after midcentury before functional appliances were reintroduced into American orthodontics.

For many years, the exclusive province of dentofacial orthopedics was Europe, while North America was firmly rooted in Angle's fixed appliance philosophy, yet it was Norman W. Kingsley who first (1879) used forward positioning of the mandible in orthodontic treatment. Kingsley's removable plate with molar clasps might be considered the prototype of functional appliances, having a continuous labial wire and a bite plane extending posteriorly. As he described it, "The object was not to protrude the lower teeth, but to change or jump the bite in the case of an excessively retreating lower jaw." Edward H. Angle used a pair of interlocking rings, soldered to opposing first molar bands, much along the lines of today's mandibular anterior repositioning appliance , to force the mandible forward. The Oliver guide plane was another functional adjunct from this side of theAtlantic serving that purpose .As a result of studies on a dolphin's tail fin, Wilhelm Roux is credited as the first to study the influences of natural forces and functional stimulation on form (1883) . His work became the foundation of both general orthopedic and functional dental orthopedic principles. Later, Karl Häupl saw the potential of Roux's hypothesis and explained how functional appliances work through the activity of the orofacial muscles.

Historical evidence suggests that facial sutures were influenced as early as 1803 by **Fox** through the application of extraoral force.

In 1867, **Culman** proposed classical 'trajectoral theory' which was later on adopted by **Wolff** (1873) and named it as Wolff's law. According to them, trabeculae of cancellous bone are orientated along the lines of principal stress corresponding with the lines of maximum and minimum loading. This arrangement is consistent with obtaining maximum strength with minimum material.

This 'trajectoral theory' / Wolf's law highlighted one important concept that **there is definite relationship between form and function** .

Taking one step further, **Roux and His** (1874) enunciated the doctrine of the "physiology of the plastic," indicating that **biologic structure is alterable and could be intentionally changed.**

Roux framed these findings in his working hypothesis " **shaking of bone** " which later became the background of both general orthopedic and functional dental orthopedic procedures. Because mandible is freely functioning osseous structure , its position in space (sagittally, transversely, and vertically) can be altered easily by muscular apparatus attached to it.

Keeping in mind all the previous hypotheses, ('trajetoral theory', 'shaking the bone') it can be assumed that this altered function of mandible may lead to new form. This possibility of influencing the mandibular growth by changing itsposition / function by altering the structure of the TMJ has fascinatedorthodontists for many years.

In 1880, **Kingsley** introduced the term and concept of "jumping the bite" for patients with mandibular retrusion. He inserted a vulcanite palatalplate consisting of an anterior incline that guided the mandible to a forward position when the patient closed on it. This maneuver corrected the sagittal relationship and opened new vista in orthodontics.

At the beginning of the 20 th century, the form and function philosophy was common to both **Angle** and **Robin** , the founders of modern fixed and functional appliance techniques.

Further evolution occurred differently across the Atlantic. Fixed technique continued to develop in America under the strong influence of Angle.

Functional technique evolved in Europe under the leadership of Robin, Kingsley and Vigo Andersen.

In 1902, Robin constructed *monobloc, (* as he called it because it was a single block of vulcanite) to position the mandible forward in patients with glossoptosis and severe mandibular retrognathism who risked occluding their airways with tongue. (The problem, usually associated with cleft palate, is known as Pierre Robin syndrome). Robin noted that forward mandibular posture reduced this hazard and also led to significant improvement in the jaw relationship.

Kingsley's ideas and effectiveness of monobloc in keeping the mandible forward influenced the development of functional jaw orthopedics.

In 1908, Impressed **Andresen** developed a mobile, loose-fitting appliance that transferred functioning muscle stimuli to the jaws, teeth, and supporting tissues.The progenitor of the appliance was a modified Kingsley plate that Andresen used as a retainer over summer vacation for his daughter after heremoved fixed appliances used to correct a distocclusion. Seeing thecontinued improvement with this retainer, he called it a ***biomechanic working retainer.***

When Andresen moved from Denmark to Norway (1930's), he became associated with professor Haupl at the University of Oslo. Haupl, a periodontist and histologist, was impressed with results obtained by Andresen's functioning retainer. Familiar with the work of Roux, who subscribed to the shaking the bonding substance of bone hypothesis, Haupl believed this was a clinical validation of the concept. By the time Andresen and Haupl teamed up to write about their appliance, they called it an ***activator*** , because of its ability to activate the muscle forces[4].

Fig- Viggo Anderesn (1870-1950) and Karl Haupl (1893-1960)

Häupl enthusiastically explained the supposition that only muscle stimuli are adequate influences, creating adaptational changes in the periodontal tissues and the alveolar bone. Many orthodontists were convinced that only tissue-preserving treatments such as that provided by the activator should be used. The application of mechanical force was considered unbiologic and a technical error.

The convictions of European orthodontists were upheld by the research of **Oppenheim** , who published his investigations under the title *Crisis in Orthodontics* (1933). He noted the potential tissue-damaging side effects of heavy orthodontic forces.[5]

This strengthened the working hypothesis of Haupl, who opposed the use of artificial, mechanically produced forces on oral tissues. For many schools throughout Europe, the activator became the one universal appliance.European orthodontists even considered active removable appliances with screws and springs dangerous to the teeth and investing tissues.

Activator enjoyed popularity for almost 4 decades until **Reitan** showed in his 1951 thesis that no special histological results evolved from the use of activator when compared with histological findings in PDL under influence of mechanical forces.He also questioned the Roux's "shaking of the bones" hypothesis, terming it speculative.

Subsequent research by Benninghoff and Pauwels in general orthopedics and many investigators such as Weinmann and Sicher Moss, Petrovic, Moyers,McNamara, and Sander supported the Reitan attack on the "special quality of efficiency" claimed for activators by Haupl.

These investigations opened field for others to develop new appliances with something additional to justify their 'functional appliances'.Other reasons which promoted new research for other appliances were the bulkiness of the activator and its limitation to only nighttime wear, hence not using the greatest potential of functional growth guidance forces which are active during day time.

During sleep, function is obviously minimal or nonexistent; hence using the *term functional appliance* to describe an activator is not completely correct in the strict sense.

In response to these criticism, **BaIters (** 1960) developed Bionator, an appliance less bulky and more elastic, modifications that improve the efficiency of the activator and facilitate daytime use.

At the same time, **Bimler** (1964) was also working in the same direction with a skeletonized activator and came up with Bimler's appliance. Thereafter, numerous modifications of activator appeared with innovations. Most of these modifications came with force delivering elements (springs and screws).

Hence, soon after the death of Andresen (1953), severe violation of his principles occurred. Both Andresen and Haupl were strictly against the any other force except the physiologic force delivered by muscles.

But unlike simple modifications of previous work; a new, significant and logical advancement in functional appliances came in the form of functional regulator by Professor **Rolf Frankel** . Introduction of Frankel appliance to orthodontic world is the best example of communication gap between Europe and America. Dr. McNamara is credited for introducing functional regulator to orthodontics. The appliance was designated as FR-1, FR-2, and FR-3 for treating class I, class II and class III malocclusions.[6]

After graduation, Dr. McNamara applied for Ph.D. in anatomy (Michigan university) and as part of curriculum, sent copies of his Ph.D. thesis “functional protrusion experiments in monkeys” to various related authorities. Tom Graber suggested him that Professor Rolf Frankel might be interested in his experimental work, so he sent one copy to prof. Frankel also. Several months later, Professor Frankel wrote to dr. McNamara stating that “he felt that he had shown experimentally what he had been doing clinically for about 15 years”.!!

Professor Rolf Frankel designed his functional regulators based on:

· Kraus’s “screening” therapy (1956).
· Moss’s Functional matrix hypothesis (1969)
· Donnelly, Swoope and Moffett’s periosteal pull theory (1973).

Based on Kraus concept, Professor Rolf Frankel designed various **screening** elements in his appliance in form of buccal shield, lip pads. Same screening shields helps to expand oral capsule, which is inaccordance with Moss’s **functional matrix** hypothesis.

A force which elevates periosteum from bone causes periosteal bone deposition; and a force compressing periosteum against bone causes periosteal bone resorption. (**periosteal pull** theory) Because of cumbersome design and long duration of treatment (2-3years), patient cooperation with functional regulator appliance was poor.

According to Graber, these factors were most important for decline in popularity of functional regulators.

In **1977, William Clark** introduced new appliance which he named Twin Block because of presence of dual bite block which resembled Artur Martin Schwarz double plates that he developed in 1950s.

Fig: William Clark

According to Clark’s concept, forces of mastication are most activefunctional forces applied through the muscles of masticatory apparatus.Therefore, Patients should eat with appliance in mouth and powerful forces of occlusion will be guided as corrective forces for dental and skeletalcorrection.

In 1977, Pancherz resurrected the 70 years old Herbst appliance for use as an experimental tool in clinical research. In 1909, Herbst originally presented a fixed-bite Jumping device called *Scharnier,* or joint. But under the strong influence of activator, Herbst appliance could not catch up.

In 1979, Pancherz started using this appliance routinely for correction of classII skeletal and dental malrelationship. The Herbst appliance keeps the mandible continuously in a protruded position, eliminating patient compliance factor for success. One of the significant disadvantage of Herbst appliance is rigidity which significantly restrict lateral jaw movements.

In an attempt to overcome this problem, **Jasper (1987)** introduced new, flexible device, Jasper jumper. Jasper claimed that efficiency of Jasper jumper is as good as Herbst appliance and affords much more freedom to mandibular movement.

This flexible, fixed functional appliance was forerunner of Forsus,churro jumper etc…….

At the same time, various authors started using magnets as a source of force instead of springs as used in forsus, churro jumper etc.

Magnetic activator device (MAD) for correction of Class II, Division 1 malocclusions was developed by Darendeliler (1993).

Although today various functional appliances are being developed, but the prototype appliances for study purposes are :

- Activator and it's modifications including bionator
- Functional regulator
- Twin block
- Herbst and it's modifications

1.3 CLASSIFICATION OF FUNCTIONAL APPLIANCES

Myofunctional appliances in orthodontics are the appliances which take help from the muscles to act on the desired treatment plan ,as the name suggests the muscles are used to bring out desired function .

A. **PROFFIT** classified it as

1. Tooth borne passive appliances:

They have no intrinsic force generating components such as springs or screws. They depend on the soft tissue stretch and muscular activity to produce the desired treatment results. Examples: Activator ,Bionator, Herbst appliance

2. Tooth borne active appliances:

These appliances provide instrinsic force for transverse or antero-posterior changes . Example: Expansion screws ,Springs

3. Tissue borne passive appliances:

These are mostly located in the vestibule and have little or no contact with the dentition . Example: the Functional Regulator of Frankel

B. Based on whether the appliance is removable or fixed:

1. Removable functional appliances :

They are the fuctional appliances that can be removed and inserted into the mouth by the patient at will. Example: Activator, Bionator , Frankel appliance

2. Fixed functional appliances:

They are functional appliances that are fitted on to the teeth and cannot be removed at will by the patient Example: Herbst appliance and Jasper jumper

3. Semi –fixed functional appliances

They are functional appliances that have certain components fixed Example: Den holtz ,bass appliance, Lip bumper

C. Depending on the degree of displacement of the mandible— **GRABER and NEUMANN:**

1. Myotonic appliances

They are the functional appliance that depend on the muscle mass for their action. Example: Bimler's appliance, Harvold's Activator, Herren's Activator

2. Myodynamic appliances

Thet are functional appliances that depend on the muscle activity for their function. Example: Activator

D. Based on their functions—GRABER and NEUMANN

1. GROUP I

Appliances which transmits muscle force to the teeth.

Example: Oral Screen , Inclined Plane

2. GROUP II

Appliances which reposition the mandible

Example: Activator , Bionator

3. GROUP III

Appliances which reposition the mandible by acting on the vestibule

Example: Frankel appliances, Vestibular screen [7]

E. Based on the components that each appliance incorporates given by **VIG and VIG:**

1. Bite planes-produce differential eruptions
2. Lip/Cheek shields- which alters the linguofacial muscle balance
3. Working bite –which effects the mandibular posture

1.4 ADVANTAGES AND DISADVANTAGES OF FUNCTIONAL APPLIANCE

Advantages of functional appliances

1. It is possible to eliminate abnormal perioral muscle functions which interfere with normal bone growth.
2. Treatment can be started as early as in mixed dentition stage.
3. These appliances; do not have any side effects of mechanotherapy; such as enamel decalcification; chronic inflammation of gingiva; root resorption; e.t.c.
4. It requires less chair side time with less frequent adjustments.
5. It is easier to maintain oral hygiene.
6. It is acceptable to many patients; because it is generally worn at night time.
7. Frequency of the patient's visits is less.
8. Economic way delivering care to a large number of patients. [8]

Limitations of Functional appliances:

1. They can be used to correct basal bone/arch relationship and cannot be used for correcting dental malocclusion.

2. It is not useful in managing adult patents where the active growth is completed.

3. It requires a final phase of fixed appliance therapy to achieve final detailing or final alignment of tooth position.

4. The result of treatment is totally dependent upon the patient's cooperation.

5. They have a tendency to increase the lower facial height and hence, they cannot be used in patients with backward rotating mandible

1.5 INDICATIONS FOR FUNCTIONAL APPLIANCES IN CLASS II DIVISION 1 MALOCCLUSIONS

1. classic functional appliances cases

   Some cases such as mild class II skeletal pattern, proclined upper incisors and no anterior or premolar crowding. The functional appliances in these cases is offering the potential for longer hours of wear than headgear and thus faster or more certain correction.

2. Interceptive treatment

   Functional appliances are frequently advocated for early treatment. This is partly because a growth enhancing effect is felt by some to be more likely at a younger age, partly because early treatment with fixed appliances is clearly problematic before the permanent teeth have erupted and partly to reduce the overjet early and reduce the chances of incisal trauma

3. Compromise treatment

   Some cases are not suitable for fixed appliances treatment because of poor oral hygiene. A functional appliances can offer an acceptable degree of occlusal and facial improvement.

4. Anchorage reinforcement

   Functional appliances are also a traditional means of gaining anchorage at the start of case requiring fixed appliances, turning a testing class II molar relationship and frequently use and preferring them to headgear , because of greater compliance and effectiveness.

1.6 MODE OF ACTION OF FUNCTIONAL APPLIANCES

All functional appliances take advantage of interaction between **mechanical function** and **morphologic pattern** and use common mechanisms of bone turnover, rhythm, activation, resorption, and formation for their action. These effects are produced because of their ability to alter the stomatognathic muscle balance.

Forces **modulated** by functional appliance are:

- Primary
- Secondary

Primary forces include various forces acting on the dentition from the tongue, lips, and cheeks. (Natural forces) A primary objective of functional appliances is to take advantage of these natural forces and **transmit** them to selected areas for desired change.

Secondary forces are the reactionary forces developed in the target tissue in response to primary forces via functional appliance. In simple words; primary forces are converted into secondary force which bring about desired changes.

It is important to consider that functional are used both tooth movement and skeletal change (through growth modification) Simple and best example of functional appliance for tooth movement would be lip bumper. Lip bumper transmit lip force (primary) to the periodontal ligament in form of pressure/force (secondary). This secondary force cause distalization of molar (desired effect)

For growth modification, functional appliances transmit forces (from muscles or viscoelastic stretch of soft tissue) to the condylar region and thereby, inducing new bone formation or glenoid fossa remodeling.

Characteristics of forces produced by functional appliance:

The **duration** of force in most functional appliance treatment is interrupted because the appliance is usually not worn constantly but only for 12 to 16 hours per day. Clark full-time-wear appliances and bonded Herbst and Jasper jumper appliances are exceptions.

The **magnitude** of force is small in functional appliance therapy. In fact, their ability to deliver light and physiologic force was one of the main reason for initial popularity of functional appliances.

1.7 TREATMENT PLANNING

With regard to force, two treatment principles can be differentiated:

- force application
- force elimination

In **force application** , compressive stress and strain act on the structures involved, resulting in a primary alteration in form with a secondary adaptation in function. Most of the fixed and removable functional appliances work on this principle.

In **force elimination**, abnormal and restrictive environmental influences are eliminated, allowing optimal development.

The lip bumper and Frankel buccal shields employ force elimination.

Function is rehabilitated and followed by a secondary adaptation in form.

All functional appliances are assemblies of a few simple components. Each component has a desired function and is generally incorporated for a specific purpose. The currently used appliances are made of combinations from three basic functional components. They are bite planes ,shields or screens and construction or working bite. These components produce skeletal and dentoalveolar changes by acting on the following:

1. Eruption (bite planes)
2. Linguofacial muscle balance(shields or screens)

3. Mandibular repositioning(construction or working bite)

During the elimination of pressure, a tensile strain can arise as a result of the viscoelastic displacement of periosteum and the bone forming response in affected areas.

Tension can be more effective than pressure because most bony structures are designed to resist pressure but not tension.

Apart from tooth movement, the main objective of using functional appliance is to harmonize skeletal bases by influencing mandibular growth.

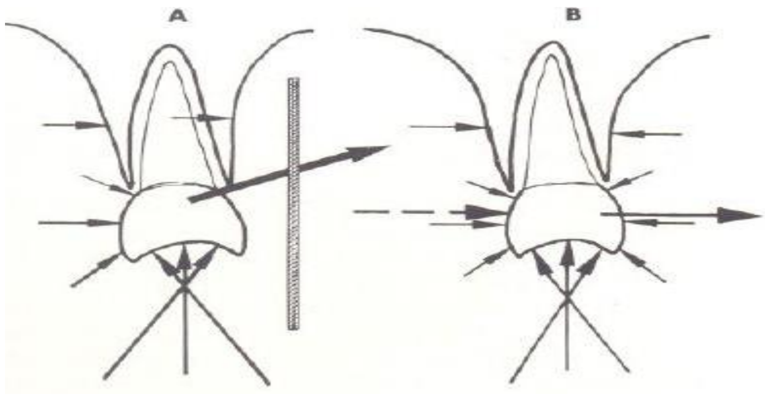


Fig:Various possibilities for tooth movement. Natural

Forces are effective on the teeth from all direction.

The details of these components are given below:

A. BITE PLANES

Bite planes may be flat or inclined, and anterioir or posterior,which contactsingle or multiple teeth. Although they are usually thought of as blocks of acrylic resin, they may in fact be made of wire or any other suitable material. Recent research indicates that relatively low forces,if applied either continuosly or intermittently, are capable if impeding the eruption of teeth. Apically directed forces may therefore be expected to impede or arrest eruption, other forces may produce tipping or eruptive deflection from the starting axial inclination.

A flat anterior bite plane of sufficient dimensions to disocclude the posterior teeth may be expected to have several effects. These effects may comprise all of the following:

1. Differential eruption of the posterior teeth
2. Noneruptions, relative or absolute intrusions of incisors
3. Incisor overbite reduction
4. Disocclusion with removable of intercuspation may well be responsible for any additional increments of mandibular growth

5. Unimpeded posterior eruption may also result in a downward and backward mandibular rotation that tends to increase anterior vertical lower facial height and reduces the prognathism of the mandible.

Inclined planes may be designed to provide guide planes for the labiolingual mechanical eruptive displacement of incisors or the buccolingual deflection of erupting posterior teeth.

B. SHIELDS OR SCREENS

Vestibular shields or oral screens and lip pads have been used to shield the muscles away thereby allowing unrestricted growth of the jaws and dentoalveolar structures. They are also used to transmit muscle forces on to the dentoalveolar structures.

C .CONSTRUCTION OR WORKING BITE

All of the functional appliances are constructed to a 'construction' or 'working' bite registration . Such registrations of maxillomandibular relationships are based on the assumption that by displacing the mandible from its rest position, and thus stretching the muscles attached to it , reflex activity tends to restore the mandible to a postural position that was originally determined by the unstretched muscles. Hence , most construction bites are taken at a vertical dimensions that is beyond the freeway space or interocclusal clearance. In addition to this increase in the vertical dimension, the construction bite may also displace the mandible in the sagittal and transverse planes.

1.8 CHANGES DURING ACTION OF FUNCTIONAL APPLIANCES

Functional appliances are capable of producing the following changes:

1. Orthopaedic changes
2. Dentoalveolar changes
3. Muscular changes

Various theories/hypothesis have been put forward to explain how functional appliances stimulate mandibular growth.

Muscular Hypothesis

A muscular functional component seems to have an important influence on mandibular growth, both natural and induced by functional appliance. This concept was formulated as **"muscular hypothesis"** to provide theoretical basis for mode of action of activator.

According to this hypothesis, myotatic reflex activity of protractor muscles, especially lateral pterygoid, keep mandible in forward direction, stimulating the growth of mandible.

Rees (1952) reported that lateral pterygoid and other muscles and tendons, including those of the deep masseter and temporalis, attach to the articular disk region.

Attachments of the LPM to the condylar head or articular disk may be expected to cause condylar growth by drawing the mandibular head forward.

Grude (1952) suggested that such adaptation is possible only with a small bite opening (within physiologic rest position). If muscles are stretched too much, then clasp knife response will take over the myotactic reflex.

The correlation between condylar growth and lateral pterygoid muscle hyperactivity was a constant finding in the animal studies of McNamara, Petrovic and Stutzmann. (1970s, 1980s). According these authors, an appliance rigidly holding the mandible in an anteriorly displaced position does not activate these muscles and hence, does not stimulate condylar growth.

How these muscles are activated?

This involves neuromuscular interaction where constant sensory input from peripheral receptors is analyzed and converted into motor response by central nervous system.

Cybernetically speaking, when the functional appliance is placed, sensory receptors feel as if the upper dental arch (reference input") is in a more anterior position.

The comparison of dental arches (upper and lower) position by servosystem then produces a "deviation signal." This signal then evoke motor response in protractor muscles.

The deviation signal will be reduced by an appropriate forward positioning of the lower dental arch through the muscle propulsion of the mandible. This implies a supplementary contractile activity of the LPM,inducing a supplementary growth of the condylar cartilage and, consequently, a supplementary lengthening of the mandible.

With time, this supplementary lengthening will result in a reduction of the anatomic relative "retroposition" of the mandible and thus in a decrease of the "deviation signal." The supplementary contractile activity of the LPM and the supplementary condylar cartilage growth rate will also tend to diminish as a result.

In 1990, Stutzmann and Petrovic proposed four lines of evidence suggesting that the lateral pterygoid muscle (LPM) plays a role in the physiologic control of the condylar cartilage growth rate:

1. After surgical resection of the LPM in the growing rat, untreated or treated with a functional appliance, a relative decrease in the growth of thecondylar cartilage was observed.

2. Electromyographic record of the LPM in the monkey treated with a functional appliance shows increased electrical activity.

3. In an experimental study, The LPM was directly stimulated by means of intermittent electric shocks (frequency, 5 times per second; duration, 10 ms; potential, 0.55 v). This microelectronic stimulation of the LPM produced an increased rate of condylar cartilage growth.

4. After treatment with the postural hyperpropulsor, there is a significant increase in the proportion of fast non-fatigable fibers in the young rat's LPM These authors suggested that increased activity of the lateral pterygoid muscle will result tension in the posterior part of the condylar capsule **because of it's attachment to the articular disc.**

McNamara and Petrovic noticed one peculiar phenomenon where patient experienced pain when mandible was retracted. They termed it as' **pterygoid response'** . This was due to altered muscular balance resulting in ' **tension zone** ' distal to condyle.

Two possible means of filling the so called tension zones are:

- growth of condylar cartilage or
- Remodeling of glenoid fossa.

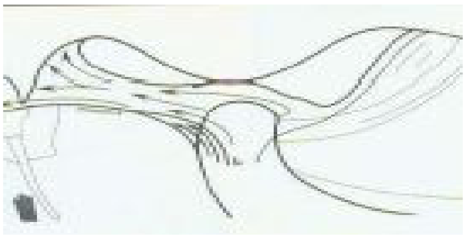
Some researchers claim that the main effect of functional appliance therapy is increased condylar growth. Other researches believe that functional appliance causes remodeling of the glenoid fossa.

Viscoelastic Hypothesis

After extensive study, Johnston (1970s) concluded that the lateral pterygoid muscle hyperactivity hypothesis is incorrect. His statement shattered notions of how functional appliances produce skeletal or condylar modifications which was established 30yrs earlier by Andresen and Haupl.

Support for this theory of 'viscoelastic force' came from of work of Herren, Harvold, and Woodside (1973). These researchers do not accept the theory that myotatic reflex activity with isometric muscle contractions induces skeletal adaptation. It was claimed that the 'viscoelastic' properties of muscle and the stretching of soft tissues are decisive for action of functional appliances. During each application of force, secondary forces arise in the tissues, introducing a **bioelastic process** for induction of bone.

According to proponents of viscoelastic theory, it's not the lateral pterygoid muscle but the retrodiscal tissue which is responsible for bony deposition in glenoid fossa or increase in length of condylar cartilage.



Stretch of retrodiscal tissue induces new bone formation.

Hence, any appliance which keeps the mandible forward (**irrespective of how, actively or passively**) will induce bone formation and subsequent increase in mandibular length. This hypothesis formed the basis for mode of action of most of the existing bite jumping appliances including fixed appliances.

Functional Matrix Hypothesis

Another hypothesis, functional matrix theory postulates that principal control of bone growth is not bone itself, but rather the growth of soft tissues directly associated with it.

Melvin L Moss (1962, 1969, 1997), who proposed this hypothesis, emphasize that length of mandible depends upon the size of oral capsule.Any increase in size of oral capsule will result in secondary bone deposition in TMJ region to keep unchanged relationship between temporal bone and mandible. ('Carry away' phenomenon)[8]

Professor Rolf Frankel, from East Germany used this hypothesis in his functional regulator appliance. Both design of appliance and its use are based on functional matrix hypothesis.

Main components of Frankel appliance are lip pads / buccal shields which try to increase the dimensions of basal bone through periosteal pull. In addition, any deleterious muscular forces are shielded away from dentition.

For correction of mandibular deficiency, muscles are actively involved in keeping the mandible forward.

Unlike any other functional appliance:

- functional regulator is almost tissue born except for crossover wires in maxillary arch
- Functional regulator does not forcefully keep mandible in forward.
- Mandible is guided forward by **proprioception** induced by lingual pad.

This proprioception feature of appliance truly uses the active role of muscles for keeping the mandible forward. Along with these design features, proper use of appliance is must for long term success of treatment.

Frankel's insistence of full time wear and making the appliance an exercise device with oral gymnastic during the day time demonstrate significant **role of function** .

Enlow, Moffet, Graber and others confirm the Frankel's findings that periosteal pull, which is a type of viscoelastic stretch has the potential to stimulate bone growth. In short, functional regulator uses all the logical means for growth modification namely:

- Active muscular involvement (proprioception)
- Viscoelastic hypothesis (periosteal stretch by lip pads/buccal shields)
- Screening deleterious forces (lip pads/buccal shields)

But poor patient cooperation associated with functional regulator favoured development of fixed bite jumping appliance. Prototypes of fixed appliances are Twin Block, Herbst and jasper jumper. Recently, 'Viscoelastic' hypothesis revisited to ensure survival of these fixed bite jumping appliances because their role in growth enhancement can not be explained by muscle activation.

Based on basic 'viscoelastic' hypothesis, Voudouris and Kuftinec (2000) advanced **Growth relativity hypothesis** to explain mode of action of these fixed functional appliance.

A) Growth relativity hypothesis

Growth relativity refers to growth that is relative to the **displaced condyles** from actively **relocating fossae** . According to authors, there is no role of muscles for growth modification. Basis for this **' non muscular' theory** came from following two observations:

- Attachments of the LPM to the condylar head or articular disk may be expected to cause condylar growth, but **anatomic research has not found evidence that significant attachments actually exist**
- More recently, permanently implanted longitudinal muscle monitoring techniques have found that the condylar growth is actually related to**decreased postural and functional LPM activity.**

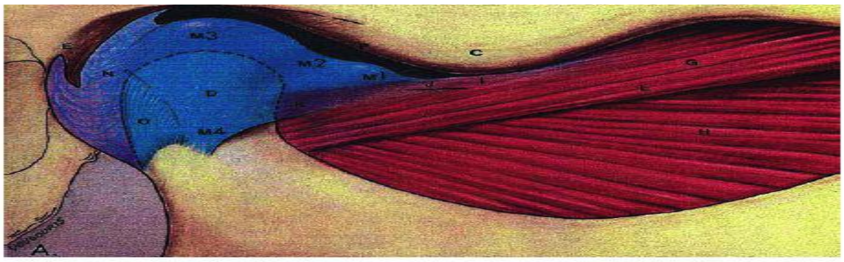


Fig: A) Three- dimensional illustration of unadvanced human TMJ shows minimal attachment of superior head of the lateral pterygoid muscle to articular disk . B) Clean, representative TMJ dissection from human adult cadaver specimen to expose the pterygoid muscles.

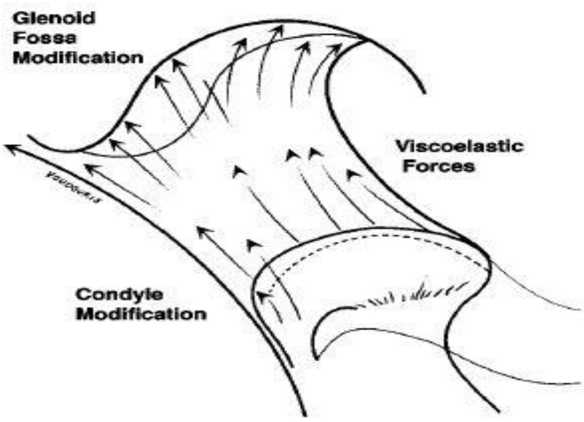
THREE GROWTH STIMULI in growth relativity

Displacement + Viscoelasticity + Referred Force

The concept that viscoelastic tissue forces can affect growth of the condyle suggests that modification first occurs as a result of the action of anterior orthopedic displacement. (**Displacement)**

Second, the condyle is affected by the posterior viscoelastic tissues anchored between the glenoid fossa and the condyle, inserting directly into the condylar fibrocartilage. (**Viscoelasticity)**

Third and the most interesting aspect is the new bone formation some distance from the actual retrodiscal tissue attachments in the fossa by the transduction of forces over the fibrocartilage cap of the condylar head.



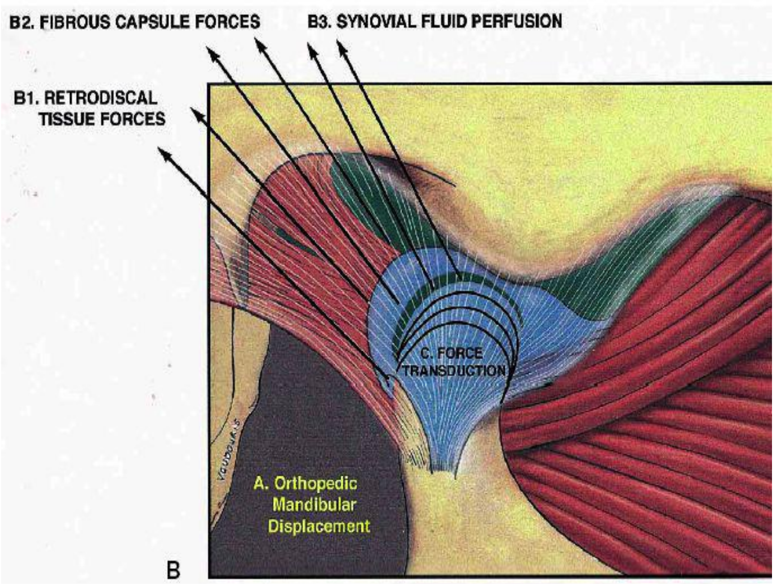


Fig: Growth relativity hypothesis for condylar and glenoid fossa growth with continuous orthopaedic displacement. Three factors influence growth mofification A) Displacement B) Viscoelastic tissue pull and C) Transduction with fibrocartilage.

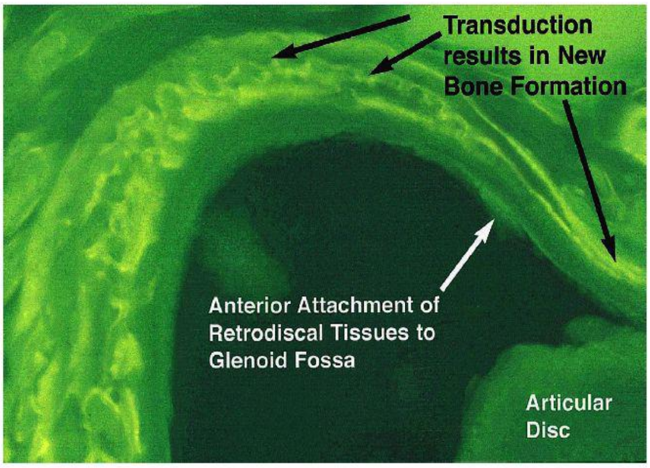


Fig: Transduction; photomicrograph of undecalcified parasaggital section of glenoid fossa

Where the condyle was orthopedically advanced in 12 weeks.

After considering all these hypotheses/theories (**muscula**r , **viscoelastic** , **functional** , **growth relativity**) the obvious question arise – which one is best to explain mandibular growth?

Enlow and Hans (1996, 2001) presented an excellent overall perspective suggesting that mandibular growth is a composite of **regional forces** and **functional agents** of growth control that interact in response to specific **extracondylar activating signals** .

In other words, mandible grow under the influence of all these variables and therefore, it's growth can not be attributed to any on particular variable.

Where the functional appliances stand today, after 125 years. !

Typically, functional appliances obtain the average 6-7 mm of correction needed for the resolution of Class II malocclusion through a combination of **orthopedic (30% to 40%)** and **dentoalveolar (60% to 70%)** effects. **(Creekmore, Radney and Righellis 1983).**

The originators of functional appliance had their own philosophies to explain how their appliances achieved the correction of a Class II malocclusion. However, there are six possible structural mechanisms through which functional appliances obtain a Class II correction.

These include:

1 Retardation or redirection of the mesial and vertical **growth of the maxilla.**

2 Encouragement of **mandibular growth** (including condylar growth) as a secondary response to its anterior dislocation from the articular fossa.

3 Retardation of the mesial and vertical **maxillary dentoalveolar growth.**

4 Mesial and vertical **mandibular dentoalveolar Growth.**

5 Overjet correction through a combined maxillary and mandibular orthopedic effect with **maxillary incisor lingual tipping and mandibular incisor labial tipping.**

6 **Remodeling** changes in the temporomandibular joint.

There is a lack of consensus regarding the relative orthodontic/orthopedic correction obtained by functional appliances during Class II treatment. Different authors give different percentage of contribution.

McNamara, Petrovic, Eirew, Joho think that functional appliance therapy results primarily in orthopedic changes, particularly increasedmandibular length and limited tooth movement.

Gianelly, Bernstein, Gottfried, Schmuth, Graber and Neuman believes that the changes are primarily dentoalveolar.

Baumrind, Harvold, Vargervik. Hiniker Ramfjord believe that the changes are primarily dentoalveolar with some maxillary orthopedic effects.

Functional appliances and mandibular growth

The influence of functional appliances on mandibular growth is a controversial issue. The primary question is whether treatment with a functional appliance can induce a clinically significant increase in mandibular growth that would create a better looking face than traditional orthodontic therapy. Much of the work demonstrating the ability of functional appliances to stimulate mandibular growth is based on animal experimentation. Whether these findings on animal models are applicable to human beings during routine clinical treatment is debatable because :

1 Young primates are known to have high condylar growth rates than human beings.

2 Primates have orthognathic class I occlusion, whereas human beings require correction of mandibular retrognathism.

3 Discrepancies between animal and human studies are expected since animal experimentation frequently involves the use of continuous forces.

These types of forces usually are impractical and often undesirable in most clinical situations; therefore treatment results can be expected to be less dramatic and more variable McNamara and Petrovic (1986) evaluated their own results obtained in laboratories and concluded that on long term basis, a maximum of **5% to 15%** increase in mandibular length can be expected.

In clinical studies:

Radney (1983) found an increase of 1.1 mm increment per year **Baumrind and associates (1984)** found even less increment of growth with functional appliance (0.71 mm).

Whether these increases are clinically significant ?

It is unlikely, however, that such differences could produce a noticeable change in facial appearance.

This further leads to another question :

Are these increases in mandibular growth limited to with use of functional appliances ?

Baumrind and associates (1981) found that patients treated with standard fixed orthodontic appliances and cervical headgear also showed a **0.63** mm increase in mandibular growth as compared with functional appliance **(0.71mm).**

Gianelly and associates (1983) found an identical increase in mandibular growth in patients treated with activator and those treated with fixed mechanics.They found that mandibular length, measured from the condyle to pogonion, increased by :

2. 8 mm in the activator group

2.7 mm in the headgear group

2.1 mm in controls

Recently, **Haralabakis,Halazonetisand Sifakakis (AJO- DO 2003)** also concluded that on long term, the overall effect of the activator and headgear appliances was found to be clinically comparable.

Gianelly, Arena, and Bernstein (1988) compared the effects oftreatment on Class II, Division 1 malocclusions using

- edgewise mechanics and headgear
- Begg mechanics with Class II elastics
- FR-II

They found that there were no significant differences between the appliances with respect to the skeletal and dental changes that occurred to achieve successful results. In addition, they concluded that there were no significant differences in the amount of mandibular growth among the three modalities. Furthermore, they concluded that the Class II correction was achieved through a combination of orthodontic and orthopedic effects, with the predominant change being a dentoalveolar effect. They believed that all of these three treatment modalities would probably influence the average growing face in a similar manner.

1.9 TREATMENT TIMING

1)DENTAL FACTORS

Since the teeth we wish to move are the permanent teeth, it follows that the best time to start in relation to dental development is when permanent teeth have erupted- especially if a fixed appliance phase is to follow.[9]

a. Dental trauma

A definite potential advantage of starting treatment early is the reduced incidence of trauma to prominent upper incisors. Studies are often not clear on the degree of incisal trauma. On balance we feel that in general the other factors outweigh the potential reduction in dental trauma which starting at say the age of 9 years of age would confer. O BRIEN et al found a trend to increased incisor trauma in those patients who had early reduction of overjet compared to the controls.

2)PSYCHOLOGICAL FACTORS

Many papers have addressed this aspect but most have not shed convincing light on the best age for patient motivation and ability to co-operate with orthodontic treatment. The paper by tung and kiyak (1998) is representative. However some evidence is staring to emerge.

The study by O Brien et al showed a significantly lower failure to finish rate in the younger patients when treated by the same operator with the same appliance . The study by Banks et al(2004) found that patients younger than 12.3 years were three times more likely to complete the functional treatment with twin block.

3) GROWTH

a. Pubertal growth spurt :- predictability

An important point is that growth spurt cannot be predicted with clinically useful accuracy. Even with longitudinal monitoring of stature ,Sullivan (1983),has shown that our prediction will still be more than one year incorrect in 33% of cases. The pubertal spurt can be accurately charted once it in full swing,enabling good retrospective studies, if not clinical prediction.

b. Pubertal growth spurt :- amount

The maxilla may grow 2.5 mm more per year at the peak of the spurt than in the year before the spurt,but the size of the spurt is again very unpredictable. The average patients wether male or female –will be in the very late mixed dentition or early permanent dentition when the growth spurt is at its peak.

c. Pubertal growth spurt:-influence on orthopaedic effects of treatment

The limitations of their ability to manipulate the increased rate of growth to their advantage must also be remembered. Headgear and functional appliance can on average retard maxillary growth to a modest but useful extent. Functional appliance may also promote mandibular growth on average to a small extent . It would be anticipated that these effects would be greater when growth is more rapid,but this has not be convincingly demonstrated.

Pancherz and Haqq(1985) found that somatic maturation didi indeed havev a significant effect on the mandibular and skeletal response , but Pancherz and Anehus-Pancherz (1993) found no such effect in the relation to the maxilla. Hansen ,Pancherz and Haqq(1991), found that timing in relation to the growth spurt did not influence the long term changes, but later treatment was associated with substantially greater stability. In a more recent paper comparing patients treated before and after peak pubertal growth rate, Konik ,pancherz and Hansen (1997) found the Herbst appliance to be equally effective at molar relationship and overjet correction in both groups . However, there are approximately 2 degrees more tipping on both upper and lower incisors in the late group.

Omblus et al (1997) found very little difference in the response to the Bass appliance in relation to age and growth periods.

Tulloch in the may 1997 paper also conducted that there was little to be gained from precisely timing early treatment to specific age / maturity markers.

Ghafari et al (1998) concluded that treatment in late childhood was an effective as that in mid childhood. A recent study by Baccetti et al (2000) reported a larger orthopaedic effect in a group treated at or just after the onset of the pubertals growth spurt than in a groups (average 10 years of age) before the pubertal spurt .

However the difference is very small indeed- e.g pogonion advanced 2.5 mm in the early group and 2.6 mm in the pubertal spurt group. It seems far from proven that coinciding treatment with the growth spurt is of significant benefit .

REVIEW OF LITERATURE

CHAPTER :2 REVIEW OF LITERATURE

- **Kingsley (1866)** experimented with appliances for the correction of cleft palate and introduced the term and concept of "jumping the bite" patients with mandibular retrusion with the use of a bite plate. It was the treatment for protrusion of the maxilla, not necessarily with extractions, shaping the dental arches to be in harmony with each other. He used vulcanite in conjunction with ligatures, elastic bands made of rubber, jackscrews, and the chincap.. He designed many tissue borne vulcanite appliances such as vulcanite palatal plate which was inserted consisting of an anterior incline that guided the mandible to a forward position when the patient closed on it. This maneuver corrected the sagittal relationship and opened new vista in orthodontics.
- **Kingsley (1880)** published A *Treatise on Oral Deformities* which replete with numerous designs of all metal fixed orthodontic apparatus nad many tissue borne vulcanite appliances , the forrunners of the modern 'hawley' and other forms of active and passive mechanisms.
- **Hotz** modified the kingsley's plate into a vorbissplate used it for deep bite and retrognathism.
- **E. Herbst(1900)** introduced the Herbst appliance.
- **Pierre robin(1902)** devised an appliances called 'monobloc' made up of single block of vulcanite that was able to induce forward repositioning of the mandible improvement in airway patency, expansion of the arches.
- **Viggo Andresen(1909)** developed a tooth-borne,loosely fitting passive appliance consisting of a block of plastic covering the palate and the teeth of both arches, designed to advance the mandible several millimetres for Class II correction and open the bite 3 to 4 mm. It is known as the 'activator', 'andresen method', 'andresen appliances'.
- **Karl haupl**, an Austrian pathologist saw the possibilities of the appliances made by andresen and brought about a lot of changes in the device and became an enthusiastic advocate of what he and Andresen called the "Norwegian System".
- **Caseley. R. (1947)** had worked on principles and construction of the oral screen as a functional appliance.
- **Endicott .C.L(1947)** did a study on functional jaw orthopaedics.
- **Hooton.A.G.(1948)** worked on Norwegian system of orthodontic treatment.
- **Marsh.L.R.(1948)**did a practical survey of modern trends of thoughts with functional treatment in orthodontics.
- **Peacock .A.S.(1949)** did a study and worked on functional appliances.

- **Wachsman.C.(1949)**did a study on treatment of irregularities of the teeth and the jaws by means of activators(Robin-Andresen Method).
- **Wilhelm Balters (1950s)** developed the Bionator appliance. The idea behind developing this appliance was to increase patient's comfort and facilitate daytime wear to increase functional use of appliance. This appliance was developed at the same time as the Bimler Appliance which was known as the skeletonize version of Activator appliance.
- **Bjork .A.(June, 1951)** discussed on the principle of the Andresen method of orthodontic treatment based on cephalometric x-ray analysis.
- **Madsen .B.C(Sept 1951)**worked on functional malocclusion in orthodontics.
- **Gresham.H.(Jan 1952**) reported the mandibular changes in Andresen treatment of angle class II malocclusion.
- **Angelman.J. (June-July1952)**reloaded the functional therapy in the treatment of orthodontic cases.
- **Lawes.A.G.H. (Nov-Dec 1952)**gave an outline of the Norwegian system of orthodontic treatment.
- **Angelman.J. (1953)** revised the functional therapy in the treatment of the orthodontic cases.
- **Bimpler.H.p (1953)** did a study on the functional orthodontic treatment with elastic appliances.
- **Hoffer.O.(1953)** worked on the new appliances in functional jaw orthopaedics.
- **Muhlemann.E.R (1953)**showed the indications of different functional appliances in the treatment of classII Div 1 cases.
- **Wilson.H.E(1953)** did a broad analysis on myofunctional appliances.
- **Gresham .H. (1953)** did a study on Andresen therapy.
- **Grude.R.(1953)** reviewed the various cases after their treatment by the Norwegian system (myofunctional therapy).
- **Hoffers .O. (1953)** gave the indications and contraindications for the Norwegian system.
- **Softley J.w (1953)** analysed the cephalometric changes in seven "post-normal" cases treated by the Andresen method.
- **Iyer .V.S (1954)** worked on the construction of the activator for treating cases with a distal step in the profile.
- **Andresen H.(1954)** determined the optimum orientation of the jaws for monobloc.

- **Bescombes .A. and Soulet.R. (1956)** introduced 'propulsor' in functional orthodontics .
- **Glass .D.F (1956)** worked on the variations on a scheme by Andresen.
- **Petrik .L. and Rebak .R.(1957)** showed the possibilities and limitations of orthodontic treatment with activators.
- **Weise .W (1957)** introduced the new method for construction of orthodontic activators.
- **Herren.Paul(1959)**introduced the mode of action of activator.
- **Ahlgren .J and Wheatly.A.E(1961)** worked to respond the activator therapy.
- **Hovell J.H.(1962)**added some comments on activator.
- **Robertson.N.R.E and Takahama Y. (1963)**added new information on Andresen appliance in the treatment of classII malocclusion.
- **Rodger A. (1963)**worked on self activating labial arch.
- **Grossman.W. and Moss.J.P.(1964)** explained the role of functional jaw orthopaedics in orthodontics.
- **Reichborn-Kjennerud .A.M (1964)** did a astudy on functional adaptations of the temporomandibular joints and bite raising by means of and Andresen Haulp activator in a case of distocclusion.
- **Stockfish .H.(1964)** experienced in active and functional plate treatment and the utilization of kinetic muscle energy in jaw orthopaedic methods.
- **Westbrook .A (1964)** did a practical and clinical assessment of treatment by elastic activator.
- **Dickson G.C.(1965)** surveyed on 100 cases treated with the Andresen appliance (symposium of functional appliances).
- **Grossman .W. and Moss(1965)** worked on activator and functional appliance therapy.
- **Rix R.E. (1966)** gave the further thoughts on monobloc therapy.
- **Thilander B. And others(1966)** did the study on muscle activity related to activator and intermaxillary vtraction in angle class II Div 1 maocclusions and reported with an electromyographic study of the temporal , masseter and suprahyoid muscles.
- **Gupta .D.S(1966)** focused on the orthodontic treatment with the help of the monobloc, its construction and trimming procedure.
- **Freunthaller.P. (1967)** observed the changes during treatment of the class II div 1 malocclusion using cephalometry.
- **Rinderer L. (1967)** emphasized on the difficulties an failures in the use of bimaxillary functional orthopaedic appliances.
- **Lieb G. (1968)** did the study on the application of activator in rhesus monkey.

- **Posen .A.L. (1968)** revised the study on the monobloc
- **Trayfoot .J.(1968)** analysed the treatment of class II malocclusions by the Andresen method.
- **Eirew G.(1969)** also worked on the application of the activator in rhesus monkey.
- **A. L. Posen(1968)** did the study on Monobloc and described that the certain steps in monobloc fabrication have been eliminated and its fabrication is simplified. One of the most important steps in monobloc fabrication is the registration of the bite.
- **Frankel.R. (1969)** worked on the treatment of class II div1 malocclusion with functional connectors and reviewed the importance on the functional matrix.
- **Hasund A. (1969)**did a study on the use of activators in a system employing fixed appliances.
- **Hausser E. (1969)** did the study on possibilities of functional treatment.
- **Parkhouse R.C(1969)** worked on the cephalometric appraisal of cases of angle's class II div 1 malocclusion treated by the Andresen appliance .
- **Roth (1969)** modified the monobloc appliance for the treatment in scoliosis.
- **Dahan J. (1970)** reported the static and dynamic morphology before and after functional treatment with the activator.
- **Hotz R.P.(1970)** did a study on the application and appliance manipulation of functional forces.
- **Karwetsky R. (1970)** introduced the karwetsky u-clasp activator.
- **Ruhland A.(1971)** introduced the elastic open activator .
- **Boyko R.(1971)** showed how to use the activator in the mixed dentition period.
- **Pfeiffer J.F. (1972)** studied on the simultaneous use of the cervical appliance and activator in an orthodontic approach to fixed appliance therapy.
- **Ahlgren J.(1973)** did a study on a longitudinal clinical and cephalometry of 50 malocclusions cases treated with activator appliances.
- **Demisch A.(1973)** did a study on effects of activator therapy on the craniofacial skeleton in class II div 1 malocclusion.
- **Herren P. et al (1973)** reported the palpation phenomenon of the condyle at the external auditory meatus during treatment of class II div 1 anomalies by means of activators.
- **Schienbein H. (1973)** modified the Andresen- Haupl activator.
- **Valinoti J.R. (1973)** introduced the European activator and its uses.
- **Cunat, John J. (1974)** explained activator as an orthopaedic puzzle.

- **Hans Pancherz(1979)** reintroduced the application of Herbst Appliance in the orthodontic literature.
- **Olibone, Vivian Lys L; Guimaraes, Antonio Sergio and Atta, Joao Yates(1980)** did a study to verify the efficiency of the mandibular propulsor orthopaedic appliance twin block in the mandibular growth.
- **James A. McNamara and Scott A. Huge(1981)**described the steps involved in the construction of a frankel FR-2 appliance and also gave a description of model preparation with proper impression technique.
- **Hans Pancherz(1982)** did a functional analysis of treated class II malocclusion and discussed the effect of continuous bite jumping with the herbst appliance on the masticatory system.
- **Ralph M. Clements and Alex Jacobson (1982)**reported a case treated with the MARS appliance.
- **E.G. Righellis(1983)**did a statistical comparison of effects of frankel, activator and extraoral traction therapy**.**
- **Franciskus Tan (1984)**did the study on frankel appliance with the particular reference in the treatment of class II div 1 malocclusion.
- **Hans Pancherz and Odont Dr. Opens(Jan,1985)**discussed on the biologic effects and clinical use of the herbst appliance.
- **James A. McNamara, Fred L. Bookstein and Timothy G. Shaughnessy (August,1985)** experimented skeletal and dental changes following functional regulator therapy on class II patients and reported a little effect of treatment upon maxillary skeletal structures with the exception of point A, which moved slightly posteriorly. Dentoalveolar adaptations due to the treatment included a decrease in the normal forward movement of the upper molar and an increase in the normal vertical movement. There was a 2 mm posterior movement of the tip of the upper incisor but minimal anterior tipping of the lower incisor.
- **Gary A. Bolmgren and Farhad Moshiri(July,1986)** did the study on the treatment of class II Div 1 patients using Bionator and reported the most notable differences in bionator effect are increased vertical dimensions and mandibular plane angle.
- **Jasper(1987)** developed a new and more flexible fixed functional appliance, the Jasper Jumper (JJ) and concluded the module applies posterior forces to the maxillary dentition and reciprocal anterior forces to the mandibular dentition.
- **Clarke (1988)** published The Twin Block technique in the american literature

- **James A McNamara and Raymond P. Howe (1988)**discussed the clinical management of the acrylic splint herbst appliance.
- **Zorana Stamenkovic and Vanja Raickovic(1988)** analysed the use of frankel functional regulator in early treatment of skeletal distal and mesial bite.
- **Samir E. Bishara and Robert R. Ziaji(March 1989)** reviewed to evaluate the scientific studies that describe the effects of functional appliances on the dentofacial structures in the treatment of class II malocclusions. The review was limted to two appliances the activator and the functional regulator.
- **Dr. Chris Farrell(1989)** studied and discovered that the etiology of malocclusion and TMJ disorder was myofunctional; he founded Myofunctional Research Co.(MRC) to develop myofunctional appliances that would prove to effective in early orthodontic treatment.
- **A.H.Mamandras and L.P.Allen(1990)** showed mandibular response to orthodontic treatment with bionator appliance.
- **Peter Ngan, Stephen Wilson, Michael Florman and Stephen H.Y. Wei(1992)**demonstrated that open bite complicated by a class II vertical growth pattern can be treated during the mixed dentition with favourable results by a combination of a removable functional appliance and high pull headgear.
- **Dr. Brock Rondeau(1993)** experienced that when orthopaedic appliances are utilized , this routinely results in a reduction in the signs and symptoms of TMJ dysfunction. He reported that the Twin Block is an ideal appliances for significantly improving the patients profile as well as the health of the TMJ. The success of the orthopaedic treatment depends directly on the quality of the study models as well as the construction bite.
- **H. Pancherz and M. Anehus Pancherz(1994)** analysed the facial profile changes during and after herbst appliance treatment.
- **Ellf Erbay ,Turkoz Ugur and Mustafa Olgen(1995)** indicated the effects of frankel’s function regulator (FR-4) therapy on the treatment of angle class 1 skeletal anterior open bite malocclusion.
- **Frank J. Weiland and Helmut Droschl(1996)** reported the treatment of a class II div 1 malocclusion with the jasper jumper.
- **Yang KH(1996)**modified the twin block and analysed the fabrication method and use in a child with a class II malocclusion.
- **James A. McNamara, John E. Peterson and Richard G. Alexander(1996)** did the study on the three dimentional diagnosis and management of class II malocclusion in

the mixed dentition with FR-2 appliances and reported although both skeletal and dentoalveolar components of class II div 1 malocclusions were altered in the class 1 direction with either a facebow or FR-2 appliances accomplished the correction in dramatically differing ways. FR-2 appliance had less of an effect on maxillary and dentoalveolar components and a greater effect on mandibular length.

- **Franz –Peter Schwindling(1997)** did a study on Jasper jumper and stated the treatment objectives and the biomechanics in class II correction.
- **Mesou Lai and James A.McNamara(1998)**evaluated the two –phase treatment with the herbst appliance and the preadjusted edgewise therapy.
- **Ingrid Rudzki Janson and Regine Noachtar(1998)** emphasized on the functional appliance therapy with the bionator.
- **Con Laparidis(1999)** did a retrospective cephalometric study of the effect of the Frankel appliance, the Clark twin block and the activator on class II div 1 patients.
- **Sabine Ruf, Dr. Med Dent, Hans Pancherz and Odont Dr (2000)** did a prospective longitudinal study of 62 consecutively treated class II malocclusions to determine whether bite jumping causes the temperomandibular disorders.
- **Tiziano Baccetti, Lorenzo Franchi, Linda Ratner Toth and James A. McNamara(2000)** did the study and reported the findings of the short-term cephalometric study which indicate that optimal timing for Twin-block therapy of Class II disharmony is during or slightly after the onset of the pubertal peak in growth velocity.
- **Dr. Colleen Ann Adams(2000)**investigated by cephalometric analysis of the vertical control with the twin block appliance.He found Regression analysis which identified the most important variables in the overbite correction for the deep group as increased lower face height of 2 Smq downward movement of pogonion and gnathion by 2.0mm,restriction of mandibular hcisor eruption by 1.7m and proclination of the lower incisor by 4.5 degrees.
- **Claudio Manfredi,Roberto Ciino ,Alberto Trani and H ans Pancherz(2001)**investigated the skeletal changes with herbst appliance therapy with more conventional cephalometrics and European norms. They concluded even short term herbst therapy can be efficacious with the most frequent effect being mandibular forward repositioningb followed by mandibular ramus elongation.
- **Brock Rondeau(2001)**studied on herbst appliance, the fixed functional appliances in the treatment of class II skeletal malocclusion.

- **Paula S. Allen-Noble(2002)**did the study on management of crown/banded herbst appliances.
- **Xi Du, Urban Hagg and A. Bakr M. Rabie(2002)** did the study to compare dental and skeletal treatment changes in class II div 1 malocclusions with two modes of maxillary control and two modes of bite jumping.
- **Timothy G. Shaughnessy(June,2002)** introduced and worked on the wire reinforced banded herbst appliance.
- **Hoshang Rumi Sukhia(Dec 2002)**worked on the usage, effects and recent modifications on the jasper jumper appliance.
- **Terrance J. Spahl(2002)** concluded the bionator as sleeping giant.
- **Marclo Rodrigues de Almelda, Jose Fernando Castanha Henriques and Weber Ursl(2002)** had a comparative study on the Frankel(FR-2) and Bionator appliances in the treatment of class II malocclusion and investigated that both the appliances showed statistically significant increased in mandibular growth and mandibular protrusion ,with greater increases in patients treated in the bionator group.
- **GD Singh and BS Thind (2003)**did a geometric morphometric satudy which elaborates the effects of the headgear activator Teuscher appliance in the treatment of class II div 1 malocclusion.
- **Zafer Sari,Yasar Goyenc ,Cenk Dorukand Serdar Usumez(2003)**did the comparative evaluation of a new removable jasper jumper functional appliance and an activator headgear combination.
- **Neville M. Bass and Anton Bass(2003)** introduced a new orthopaedic appliance that is the Dynamax System.
- **Rafi Romano(2003) described** a new type of anterior repositioning splint, which can be used for anterior repositioning of the mandible in cases with temperomandibular joint dysfunction.
- **Kevin O Brien et al (2003)** did a multicebter, randomized ,controlled trial to analyze the skeletal and dental effectiveness of early orthodontic treatment with the twin block appliance.
- **Zafer Sari, Yasar Goyenc, Cenk Doruk and Serdar Usumez(July,2003)** did a study on comparative evaluation of a new removable jasper jumper functional appliances vs an activator –headgear combination.
- **Kurt Faltin, Rolf M. Faltin, Tiziano Baccetti ,Lorenzo Franchi, Bruno Ghiozzi, and James A. McNamara(Nov 2003)**did a study on long term effectiveness and

treatment timing for bionator therapy and reported that the treatment is more effective an stable when it is performed during the pubertal growth spurt.

- **Jeff Rothenberg, Eric S. Campbell and Ravindra Nanda(2004)** worked to correct the class II with the twin force bite corrector and added that the twin force bite corrector is a new fixed intermaxillary appliance with a built in constant force for class II correction.
- **Marcio R. Almeida, Jose F.C. Henriques, Renato R. Almeida, Renato R. Almeida-Pedrin and Weber Ursi(2004)**did a retrospective investigation to evaluate the dentoalveolar and skeletal cephalometric changes of the bionator appliances on individuals with a class II Div 1 malocclusion.
- **Antanas sidlauskas (2005)** analysed the effects of the skeletal and dentoalveolar changes in class II Div 1 malocclusions treatment with the twin block.
- **Hideki Tabea, Hiroshi M. Ueda, Masaaki Katoa, Keiko Nagaokaa,Yoshiko Nakashimac, Eka Matsumotoc, Noriko Shikatab and Kazuo Tanned(2005)** investigated the influence of an activator appliance and a spring active appliance on masticatory muscle activity by means of electromyography (EMG).
- **Jeffrey L. Berger, Valmy Pangrazio Kulbersh, Cameron George and Richard Kaczynski(2005)**compared the long term treatment outcome and stability of class II patients treated with either functional appliances or bilateral sagittal split ramus osteotomy.
- **Marcio Rodrigues de Almeida, Jose Fernando Castanha Henriques, Renato Rodrigues de Almeida ,Weber Ursi and James A. McNamara(2005)** investigated and evaluated the dentoalveolar and skeletal cephalometric changes produced by the herbst appliance during the short term treatment of mixed dentition periods.
- **Didem Nalbantgil, Tulin Arun, Korkmaz Sayinsu and Fulya Isik(2005)**evaluated the skeletal , dental and soft tissue changes in late adolescent patients treated with jasper jumpers applied with sectional arches.
- **Rehab A.AI- Rawi and Fakhri Abid Ali(2005)** did the clinical and cephalometric study and evaluated skeletodental modulation for horizontal activator treatment for skeletal II and dental class II div 1.
- **Antanas Sidlauskas(2005)** analyzed the skeletal and dentoalveolar in class II div 1 malocclusions cases treated eith twin block appliance.
- **Antanas Sidlauskas (2005)** did the study to assess clinical effectivenessof the class II div 1 malocclusions treatment with the twin block appliance.

- **Seniz Karacay, Erol Akin, Huseyin Olmez, A.Umit Gurton and Deniz Sagdic(2006)**compared the effects of Forsus Nitinol Flat Spring and Jasper Jumper in the correction of class II div 1 malocclusion.
- **Carlos Flores Mir and Paul W. Major(2006)** evaluated facial soft tissue changrs by cephalometry after the use of the twin block appliance in class II div 1 malocclusion cases.
- **Luis Antonio de Arruda Aidar , Marcio Abrahao, Helio K. Yamashita and Gladys Cristina Dominguez(2006)** did the prospective study to verify changes in the position of the temperomandibular joint disc by means of magnetic resonance images in adolescent patients treated with the herbst appliance.
- **Moachos A. Papadopoulos (2006)** introduced current principles and techniques for the treatment of the class II non compliant patient.
- **Wahl N (June 2006)** studied once again the history of functional appliances in the midcentury.
- **Gregory Stylianos Antonarakis and Stavros Kiliaridis(2006)**Evaluated the anteroposterior short-term skeletal and dental effects on Class II malocclusion in growing patients following treatment with functional appliances (activators or twin block), extraoral traction, or combination appliances(appliances with both functional and extraoral traction components). Their study showed all appliance groups an improvement in sagittal intermaxillary relationships (decrease in ANB) when compared to untreated subjects.
- **Christoph Casutt, Hans Pancherz, Manfred Gawora and Sabine Ruf(September 2007)** analysed the success rate and efficiency of activator treatment in a retrospective multicentre study.
- **Carlos Flores-Mir, Abenaa Ayeh, Ashim Goswani and Shouresh Charkhandeh(2007)**evaluated skeletal and dental changes in growing individuals through lateral cephalograms obtained after the sole use of the splint type herbst appliances in class II div 1 malocclusions.
- **N Tadic and M Woods(2007)**did a comtemporary study on the class II orthodontic and orthopaedic treatment.
- **Renata Rodrigues de Almeida-Pedrin, Marcio Rodrigues de Almeida, Renato Rodrigues de Almeida, Arnaldo Pinzan and Fernando Pedrin Carvalho Ferreira(2007)** investigated to evaluate the dentoalveolar and skeletal cephalometric changes produced by headgear(HG) biteplane and bionator appliances with classII div 1 malocclusion.

- **C.Boucher, M.Charezinski, A.Balon Perin, F . Janssens, N.Vanmuylder and R. Glineur (2008)** did the study to observe the effects of treatment with a trainer T4K myofunctional appliance of thirteen late mixed dentition patients.
- **Geserick marc(2008)**introduced The Bite Jumping Screw , the new modification of the twin block treatment.
- **Nenad Nedelijkovic, Vesna Zivojinovic and Mirjana Ivanovic(2009)**did the study on the clinical effects of fixed functional herbst appliance in the treatment of class II div 1 malocclusion.
- **Anita G and Suma S(2009)** did the study on the functional appliances to alter mandibular growth which play a major role in growth modification treatment.
- **Akira KANAO, Masanori MASHIKO and Kosho KANAO(2009)** introduced the application of functional orthodontic appliances for the treatment of " mandibular retrusion syndrome"
- **Rafel Pinelli Henriques, Guilherme Janson, Jose Fernando Castanha Henriques,Marcos Roberto de Freitas and Karina Maria Salvatore de Freitas(2009)** investigated to evaluate the skeletal and dentoalveolar effects of the treatment of class II malocclusion with the jasper jumper appliances.
- **Abdolreza Jamilian , Rahman Showkatbakhsh and Shabnam Sheikholeslam Amiri (2010)** showed the treatment effects of the R- appliance and twin block in class II div 1 malocclusion.
- **Milind Darda(2010)**compared the skeletal and dental changes by the cephalometric study in class II malocclusion by jasper jumper and forsus.
- **Ashok Kumar Jena and Ritu Duggal(2010)**evaluated the treatment effects of twin block and mandibular protraction appliance IV in the treatment of class II div 1 malocclusion.
- **Nicole J. Siara, Valmy Pangrazio Kulbersh, Jeff Berger and Burcu Bayirli(2010)**determined the longterm dentoskeletal changes with the bionator, herbst, twin block and MARA functional appliances.
- **Letizia Perillo, Rosangela Cannavale , Fabrizia Ferro, Lorenzo Franchi, Caterina Masucci, Paolo Chiodini and Tiziano Baccetti(2010)**did the study on the metaanalysis of skeletal mandibular changes during the Frankel appliance treatment.
- **Dr.Dinesh M.R, Dr. Dharma R.M, Dr.Prashanath C.S and Dr. Amarmath B.C(Feb2011)** made a study on twin block and evoluted that the appliance itself had been accepted as a more competent class II corrector compared to earlier bulky monobloc appliances.

- **Asli Baysal and Tancan Uysal(feb, 2011)** did the study to evaluate and compare the changes in the soft tissue profile related to treatment with twin block and herbst appliance in classII div 1 mandibular retrognathy.
- **Emmanuelle Medeiros de Araujo, Rildo Medeiros Matoso, Alexandre Magno, Negreiros Diogenes and Kenio Costa Lima(may-june2011)** did a cephalometric evaluation of the effects of the joint use of a mandibular protraction appliance (MPA) and a fixed orthodontic appliance on the skeletal structures of patients with angle class II, div 1 malocclusions.
- **Ameet Revankar(oct,2011)** did the study on the fabrication of a simple Churro jumper .
- **Mote NR and Toshniwal NG(2011)** did a clinical and cephalometric study and described the efficacy of fixed twin block.
- **Saud A. and Ai- Anezi(2011)** reported the treatment of classII malocclusion using combined twin block and fixed orthodontic appliances.
- **Hiten Kalra(july,2011)** worked on twin block and its modifications.
- **Larry Ching Fan Li and Ricky Wing Kit Wong(sept- oct 2011)** had worked on the management of severe class II malocclusion with sequential removable functional appliances such as Twin Block and orthodontic appliances that is hyrax palatal expander and high pull headgear.
- **Ankur Chaukse, Sandhya Jain, M.S. Rami Reddy , Rachna Dubey, Shan Mammen John and Suma S.(2011)** reported the skeletal class II malocclusion treatment using the 'Forsus" appliances.
- **MS Ravi and Jatin Ahuja(2011) reported** the interceptive and growth modification therapy with fixed functional appliance.
- **Francyle Simoes Herrera, Jose Femando Castanha Henriques, Guilherme Janson, Manoela Favaro Francisconi and Karina Maria Salvatore de Freitas(2011)** did the study to evaluate the dentoskeletal and soft tissue effects of class II malocclusion treatment with the jasper jumper followed by classII elastics at the different stages of therapy.
- **Aynur Aras,Emel Ada, Hatice Saracoglu,Naciye S. Gezer and Isil Aras(2011)**compared the dentoskeletal changes and alterations of mandibular condyle disc fossa relationships in subjects at the peak and the end of the pubertal growth period treated with the Forsus fatigue resistant device.
- **Dr Mohammad Khursheed Alam(2012)** revised the functional appliances and ahbit breaking appliances.

- **Aya Ehab Ei Kattan(2012)** modified twin block appliance for class II div 1 treatment during the mixed dentition period.
- **Alkhiary ,Yaser M ;Ezzat, Abdel Salam Kh; Tayel , Seham B(2012)** did the study to compare the change of anatomical relationship of the oropharyngeal airway space in loud snoring patients by using two removable prosthetic appliances for improvement of snoring and respiratory disturbance.
- **Roberto Martina Laccpo Clotti, A Galeotti and Sargio Peduano(jan 2013)**did a randomized controlled trial and showed the efficacy of the Sander bite-jumping appliance in growing patients with mandibular retrusion.
- **Francyle Simoes Herrera- Sanches Jose Fernando Castanha Henriques, Guilherme Janson, Leniana Santos Neves,Karina Jeronimo Rodrigues Santiago de Lima, Rafael Pinelli Henriques and Lucelma Vilela Pien(march –april 2013)**reported the class II malocclusion treatment using jasper jumper appliances to intermaxillary elastics .
- **Dr. Falguni Mehta, Dr. Dolly Patel and Dr. Nishit Mehta(april 2013)**worked on activator and concluded that being simple this functional appliance are effective for the treatment of the skeletal classII correction.
- **Anil S. Malik and Abhijeet S. Karnik(july 2013)** did a study on activator and reloaded the result that using this myofunctional appliances is best and show successful correction of class II molar malocclusionwith excellent form and function which resulted in improvement of the patients frontal and facial profile.
- **KrishnaU.S.Nayak , Varun Goyal and Nikhil Malviya (July 2013)**discussed the two phase treatment of class II malocclusion in young growing patients.
- **Dr Tina Chowdhury and Dr Madhu Maheswari(July-aug 2013)**worked on activator which often chosen for the treatment of class II malocclusions and concluded that the activator had an influence on the skeletal structures of the faces as well as the growth and position of mandibular arch.
- **Fatimah Ibrahim, Nooranida Arifin and Zubaidah H A Rahim(2013)**reported the effects of orofacial myofunctional exercise using an oral activity rehabilitation device on physiological parameters that include labial closure strength, tongue elevation strength and the right and left facial skin elasticity.
- **R.Showkatbakhsh, M.I. Castaldo,A.Jamilian, G. Padricelli, M.Fahimi hanzayi, S.Cappabianca and L.Perillo(2013)** did the study to compare the effects of a differently designed functional appliance with frankel-2.

- **Cesare Luzi, Valeriano Luzi and Birte Melsen(2013)** did a preliminary study on mini implants and efficiency of treatment done with herbst appliance.
- **Katyal and Vandana(nov ,2013)**did the preliminary study on the effects of the treatment with twin block appliance on obstructive sleep apnea in children.
- **Bengisu Akarsu Guven, Aslihan Zeynep and Pinar Sahin Veske(2013)** compared the dental arch changes in class II patients treated with frankel –II, trainer and fixed anterior biteplane appliances.
- **Richard Perkins and Suzanne Stock(2014)** studied on herbst appliance and made adjustments and check the stability of the appliances.
- **Hussein N. AI-Khalifa(July,2014)** compared the effect of face mask and maxillary bite block in skeletal class III patients during the mixed dentition with control group of the same class during their growth.
- **Ahmad S. Burhan and Fehmieh R. Nawaya(Oct,2014)**did the randomized clinical trial on the dentoskeletal effects of the bite- jumping appliance and the twin block appliance in the treatment of skeletal class II malocclusion.
- **Swapnil Ghodke ,Ashok Kumar Utreja, Satinder Pal Singh and Ashok Kumar Jena(2014)** reported the effects of twin block appliance on the anatomy of pharyngeal airway passage (PAP) in class II malocclusion subjects.
- **Ahmad S. Burhan and Fehmieh R. Nawaya(2014)** did a randomized controlled trial and concluded that the dentoskeletal effects of the bite jumping appliance and the twin block appliance in the treatment of skeletal class II malocclusion.
- **Dean A Heinrichs, Imad Shammaa, Chris Martin , Thomas Razmus, Erdogan Gunel and Peter Ngan(2014)** evaluated the treatment effects of forsus atigue resistant device in growing patients with class II non extraction malocclusions.
- **Eyad Almuhtaseb ,Mao Jing, He Hong and Rawan Bader(2014)**discussed the growth modifications in the treatment of class II malocclusion using headgear and functional appliances.
- **Leniana Santos Neves, Guiherme Jnson, Rodrigo Hermont Cancado, Karina Jernimo Rodrigues Santiago de Lima, Thais Maria Freire Fernandes and Jose Fernando Castanha Henriques(2014)** compared the treatment effects between the jasper jumper and the bionator associated with fixed appliance.
- **Kishnani R., Uppal S.,Patel G., Acharya A. and Metha P.(2014)** discussed the functional appliances like the activator and the functional regulator.

- **Ehsani S, Nebbe B, Normando D, Lagravere MO and Flores-Mir C(2014)** did a systematic review and meta-analysis of the short term treatment effects produced by the twin block appliance.
- **Liju Marcely Dauravu, Venkataramana Vannala,Mohamed Arafath, Gowri Sankar Singaraju , Sreekanth A. Cherukuri and Anju Mathew(2014)** did a cephalometric clinical study to distinguish skeletal and dental corrections on skeletal classII div 1 growing subjects with twin block therapy .
- **S. Jay Bowman(2014)** reported the class II combination therapy that is the distal jet and jasper jumpers.
- **Dr. Taruna Puri and Dr. Dolly Patel(2014)** corrected the skeletal discrepancy in class II div 1 malocclusion using fixed twin block.
- **Kishnani R. , Uppal S., Patel G. , Acharya A., and Metha P.(2014)** did a study on growth modifications of the mandible by two appliances : the activator and the functional regulator.
- **Shalki Alawadhi, S. M. Bapat and Preeti Bhardwaj(2015)** studied on different removable functional appliances which harness the natural forces of oro- facial musculature that are transmitted to the teeth and alveolar bone through the medium of aplliances such as oral screen, lip bumper, activator, bionator, twin block, frankel's functional regulator etc.
- **Dr. Ankita A. Sawant and Dr. Shubhangi A. Mani(2015)** compared the facial profile attractiveness treated with the twin block appliances.
- **Aggarwal Ankur, Shivalinga B.M, and Jain Sunny(2015)** reported the skeletal correction of class II with unilateral fixed functional appliances.
- **Ehsani S., Nebbe B., Normando D, Lagravere MO and Flores –Mir C(2015)** did a sysytemic review and meta analysisi of the short term treatment effects produced by the twin block.
- **Prasad V Bonde, Veerendra V Kerudi , Neeraj Patil, Siddhesh G Dolas and Harshal A Patil (2015)** reported the treatment effect of skeletal classII malocclusion with twin block in permanent dentition phase.
- **Dirk Wiechmann, Julius Vu, Rainer Schwestka- Polly , Hans- Joachim Helms and Michael Knosel(2015)** discussed on the clinical complications during treatment with a modified herbst appliance in combination with a lingual appliance.
- **Pavithra U.S, Vagdevi H.K, and Sanju Thomas Varughese(2015)**discussed on the hybrid appliances uch as hybrid hyrax ,hybrid aligner therapy and bioblock therapy.

- **Emine Kaygisiz , Tuba Tortop, Serna Yuksel and Erdal Bozkava(2015)** did the study to evaluate and compare the skeletal and the dentoalveolar effects of jasper jumper and activator headgear combination and an untreated control group.
- **Biswas Palukunnu Padmaprabha, Shaji Aboobacker Ponnambathayil, Hariprasad Aynipully, Midhun Vinod and Deepak Parambath Reghunathan(2015)** reported the precise method of measuring simultaneous intrusion and uprighting of mandibular molar using denta scan.
- **Piyush Bolya, Bhoopendra Singh Rajput, Gunjan Tiwari, Hitender Singh Yadev , Ashish Choubey and Sandeep Kumar Swarnkar(2015)** did a study on the intraoral approach to molar distalization .
- **Nashid Fareen , Mohammad Khursheed Alam and Mohd Fadhli Khamis(2015)** did the study to create a clear conception on the effects of the twin block appliance and also compare its efficacy eith other functional appliances.
- **Emily Deen,and Michael G Woods(2015)**did the study on the effects of the herbst appliance in growing orthodontic patients with different underlying vertical patterns.
- **U S Krishna Nayak, Ashutosh Shetty, Crystal Runa Soans and Vivek Bhaskar (June 2015)**reported the treatment of a class II patients with Twin Block and Headgear followed by fixed therapy.
- **Abdolreza Jamilian(nov,2015)** compared the effects of a differently designed functional appliance with frankel -2.
- **Amjad AI Taki and Arash Ghaffarpasand(2015)** did the study to evaluate the changes in dentoskeletal components following orthopaedic therapy of class II skeletal malocclusions and to assesss the effect of the changes on the depth of the pharyngeal airways, after treatment with removable and fixed functional appliances.
- **Gisuppe Pennetti, Jasmine Primozic, Lorenzo Franchi and Luca Contardo(2015)**did the systematic review and meta – analysis of controlled studies on the treatment effects of removable functional appliances in prepubertal and pubertal class II patients.
- **Bhumi.N. Modi, A.T.Prakash , K. Sadashiva Shetty and E.T.Roy(2015)** presented the effects of skeletal class II div 1 malocclusion correction with frankel appliance and driftodontics.
- **Aswathi Joseph, Amith Adyanthaya and Dhanya Kriahnan(2015)** described the treatment of class II malocclusion using twin block appliance.
- **Dr. Pankaj Pupneja, Dr. Ashok Kumar Utreja , Dr. Satinder Pal Singh , Dr. Ashutosh Aggarwal and Dr. Ashok Kumar Jena (2015)** did the study on the

treatment effects of twin block appliance having pulmonary functions in class II malocclusion subjects with retrognathic mandibles**.**

- **Nashid Fareen, Mohammad Khursheed Alam, and Mohd Fadhli Khamis(2015)** described the efficacy of twin block as a functional appliance.
- **Dr Eshan Awasthi, Dr Pallav Ghoshal, Dr Abhilasha Goyal and Dr Sharad Awasthi(2015)** did a study to correct sagittal discrepancy and also redirecting the growth vector from clockwise rotating to closing the mandible in which vertical activator is used alongwith fixed mechanotherapyfor stabilizing the occlusion.
- **Dr. Padhraig Fleming and Prof Robert Lee(2016)** did the study on the clinical use of twin block appliances.
- **Mavreas D, Pasin E and Vande Vannet B(2016)** reported the treatment of classII div 2 malocclusions using a new herbst type appliance (the biobitecorrector).
- **Snigdha Pattanaik, Noorjahan Mohammad , Sasmita Parida and Subhrajeet Narayan Sahoo(2016)** did the study on the treatment modalities from early to late for skeletal class III malocclusions.
- **Xin Yang, Yafen Zhu, Hu Long, Yang Zhou, Fan Jian ,Niansong Ye, Meiya Gao and Wenli Lai(2016)** investigated the effects of the herbst appliance for patients with class II malocclusion.
- **Turi Bassarelli; Lorenzo Franchi, Efisio Defraia and Birte Melsen(2016)** did a retrospective study to evaluate the dentoskeletal effects produced by a modified jasper jumper with an anterior bite plane for the correction of class II div 1 malocclusion.
- **Sonal(2016)** concluded the management of severe class II malocclusion with sequential modified twin block and fixed orthodontic appliance.
- **Parthasarathy Madurantakam (2016)**did a study on fixed or removable function appliances for class II malocclusions.
- **Harpreet Singh, Rajkumar Maurya ,Pranav Kapoor and Poonam Sharma(2016)** modified the occclusal setting appliance in twin block therapy.
- **Fatemeh Ahmadian Babaki, S. Mehdi Araghbidi Kashani and Saeedeh Mokhtari(2017)**did a study to compare the treatment outcomes of classII malocclusion using Twin Block and Bionator Appliances by cephalometric analysis.
- **Vivek Agarwal and Rohit Kulshrestha(2017)** modified the churro jumper by inserting it on an auxillary wire which is placed on the mandibular arch, instead of directly placing it on the main arch wire to improve its efficiency.

- **Hulya Kilicoglu, Nilufer Yilmaz Ogutlu and Ceylan Alioglu Uludag(2017)** evaluated the skeletal and dental effects of modified jasper jumper appliance and delaire face mask with Pancherz analysis.
- **Tomonori Iwasaki et al(2017)** evaluated the effects of a herbst appliance on ventilation of the pharyngeal airway using computational fluid dynamics.
- **Stjepan Spalj,Kate Mroz Tranesen, Kari Birkeland, Visnja Katic, Andrej Pavlic and Vaska Vandevs Ka- Radunovic (2017)**compared the treatment approaches in class II div 1 malocclusion between activator-headgear and twin block.
- **Meenu Mittal, Harpreet Singh, Ashok Kumar and Poonam Sharma(2017)** did a study on the interceptive management of developing class III malocclusion with reverse twin block.
- **Fatemeh ahmadian babaki , S. Mehdi Araghbidi- Kashani and Saeedeh Mokhtari(2017)** did a cephalometric comparison of twin block and bionator appliances in treatment of class II malocclusion.

ACTIVATOR

CHAPTER 3: ACTIVATOR

3.1 INTRODUCTION

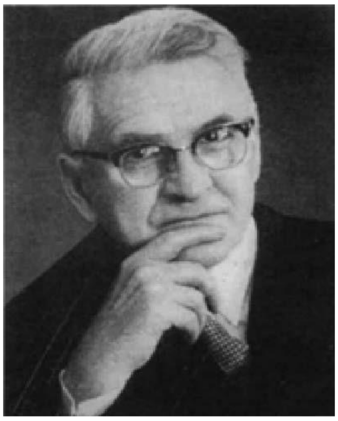
Activator Appliance is an Orthodontics appliance that was developed by Viggo Andersen in 1908. This was one of the first functional appliances that was developed to correct functional jaw in the early 1900s. Activator appliance became the universal appliance that was used widely throughout Europe in the earlier part of the 20th century.

Activators are used to modulate mandibular growth, and the effect of activators on masticatory muscle activity has been reported extensively in previous studies. Ahlgren1 found no increase in muscle activity during sleep, whereas an increased postural activity was detected in the masseter muscle during the day. Miralles et al 2 found a significant increase in muscle activity during saliva swallowing with activator appliances.

3.2 HISTORY AND EVOLUTION

Norman W. Kingsley who first (1879) used forward positioning of the mandible in orthodontic treatment. Kingsley's removable plate with molar clasps might be considered the prototype of functional appliances, having a continuous labial wire and a bite plane extending posteriorly.
Kingsley introduced "jumping of the bite" in 1879 to correct sagittal relationship between upper and lower jaws.
HOTZ modified the kingsley plate into a vorbissplate (used it for deep bite and retrognathism).
The monobloc
The first practitioner to use functional jaw orthopedicsto treat a malocclusion was Pierre Robin (1902).His appliance influenced muscular activity by changingthe spatial relationship of the jaws. Robin's monolocwas actually an adaptation of Ottolengui's removableplate, which, in turn, had been a modification of Kingsley's maxillary plate. It extended all along thelingual surfaces of the mandibular teeth, but it hadsharp lingual imprints of the crown surfaces of both maxillary and mandibular teeth. It incorporated an expansion screw in the palate to expand the dental arches.
Robin designed his monobloc specifically for childrenwith the glossoptosis syndrome (ectomorphicconstitution, adenoid facies, mouth breathing, highpalate, and other problems). It has since been named thePierre Robin syndrome. Treatment would obviously require a total body approach, to include psychologicalsupport, muscular and breathing exercises, and lipclosure, with the monobloc indicated to stimulate theactivity of the facial musculature and to normalize the occlusion.

In 1909, Viggo Andresen (1870-1950) removed his daughter's fixed appliances before she leftfor her summer vacation, as was customary at the time,and placed a Hawley-type maxillary retainer. On the mandibular teeth, he placed a lingual horseshoe flangethat guided the mandible forward about 3 to 4 mm inocclusion. Andresen, a Danish dentist, did not start specializing in orthodontics until 1919. On his daughter's return, he was surprised to see that nighttime wearing of the appliances had eliminated her Class II malocclusion, and it was stable. Applying this technique to other patients resulted in significant sagittal corrections that he could not produce with conventional fixed appliances.



The original Andresen activator was a tooth-borne, loosely fitting passive appliance consisting of a block of plastic covering the palate and the teeth of both arches,designed to advance the mandible several millimetres for Class II correction and open the bite 3 to 4 mm. The original design had facets incorporated into the body of the appliance to direct erupting posterior teeth mesially or distally, so, despite the simple design, dental relationships in all 3 planes of space could be changed.

In designing an inert appliance that fitted loosely in the mouth and, because of its mobility, transferred muscular stimuli to the teeth, jaws, and supporting structures, Andresen had taken a decisive step in orthodontic treatment. Although he had effectively redesigned Robin's monobloc to correct Class II Division 1 malocclusions, he declared that he had noknowledge of Robin's work at the time. Andresen's novel device was not initially well received. ***First***, removable appliances were not much accepted at that time. ***Second***, the profession was under the influence of Martin Schwarz, whose active plate was then a common form of removable— not functional— appliance. Finally, Andresen advocated extractions, although not necessarily in connection with activator treatment. And, in contrast to Angle's concept of ideal occlusion that was then prevalent, Andresen advocated a more realistic "individual and functional gnathological optimum." Thus he was subjected to the same type of ridicule that Tweed endured years later.

In 1925, Andresen, then director of the orthodonticdepartment at the University of Oslo, began developingfor the government a simple method of treating Norwegian children. He modified his retainer into an orthodontic appliance, using a wax bite to register the mandible in an advanced position. At the university, Karl Häupl (1893-1960) an Austrian pathologist and periodontist, saw the possibilities of the appliance and became an enthusiastic advocate of what he and Andresen called the “Norwegian system.” Häupl’s theories were inadvertently strengthened by the findings of Oppenheim, who showed the potential tissue damage caused by the heavy orthodontic forces of fixed appliances. At that time, there was no mention of “growth stimulation.”Viggo Andresen’s activator was archetype of many of today’s functional appliances. Angle’s noncompliance, functional Class II corrector. Activator use became so widespread among European practitioners that there was concern that proper
diagnosis was being neglected. Unfortunately, reminiscent of Angle’s following, “functional jaw orthopedics became a profession of faith, a religion, beside which no other opinion was tolerated.” Furthermore, Reitan, in his 1952 doctoral thesis, questioned Roux’s hypothesis
and demonstrated that no special histologic picture emerged from the use of functional appliances. His findings were supported by later researchers. Andresen and Häupl later collaborated on a textbook (*Funktionskieferorthopädie*) about their system in 1936. The sixth edition included Leopold Petrik as coauthor. Although Häupl’s complete rejection of fixed appliances led the profession astray for a time, had it not been for his promotional efforts, the activator might have languished in obscurity.
The name Activator was first used in their first edition of textbook in the 1920s. Haupl believed that **"Shaking of Bone Hypothesis"** by Wilhelm Roux was the functional concept that described how the appliance would work. Their way of working with this appliance was named as the "Norgwegian System". The original activator was tooth-borne, passive appliance which was indicated to be loose-fitting.

Fig-Andresen Activator

3.3 ADVANTAGES AND DISADVANTAGES ACTIVATOR

The advantages of the activator include:

(1) treatment in the deciduous and early or late mixed dentition is possible and successful,

(2) appointments can be spread out to 2 months or more,

(3) tissues are not easily injured,

(4) the appliance is worn at night only and is acceptable from an esthetic and hygienic standpoint,

(5) it helps eliminate pressure habits, mouth breathing, and tongue thrusting.

Its disadvantages include:

(1) success depends on patient compliance;

(2) activators are of little value in marked crowding, so that patients must be selected;

(3) the appliance does not obtain as good a response in older patients; and

(4) forces on individual teeth cannot be controlled with the same degree of exactness as in fixed appliances.

3.4 INDICATIONS OF ACTIVATOR

- Activator appliance was initially indicated in patient's who are growing. Therefore, young adolescents with growth potential showed the best results of this appliance.
- a patient with retrognathic mandible
- well aligned maxillary and mandibular dentition
- Mandibular incisors should be upright over the basal bone.

USED IN:

1. Class II Div 1
2. Class II Div 2 after aligning the incisors
3. Class III
4. Class I open bite
5. Class I deep bite

For cross bite correction(trimming done in such a way that maxillary molars are moved laterally and mandibular molars lingually)

6. Preliminary before fixed appliance to improve skeletal jaw relationship.
7. For post treatment retention
8. Simultaneously serves as a space maintainer in mixed dentition, the acrylic is extended into the space of missing tooth
9. Treatment of snoring .Found to be more effective than soft palate lifter mouth shield.

3.5 CONTRAINDICATIONS OF ACTIVATOR

- Class I crowding ,due to tooth size jaw discrepancy
- Increased lower facial height
- Extreme vertical mndibular growth
- Severely procumbent lower incisors
- Nasal stenosis
- Non growing individuals

3.6 MODE OF ACTION

1st View - The mode of action for this appliance involved many different views throughout the existence of appliance. The initially theory consisted of Haupl-Andersen's ideas who believed that *Isometric Muscular Contraction* caused by *Myotatic reflex* activity was the primary way functional adaptation of the appliance took place. The functional adaptation led to a new way of mandibular closing pattern. This view was later supported by *Alexandre Petrovic* (1984) and McNamara (1973). Petrovic, in the 1970s, performed studies which found that *Lateral pterygoid muscle* played an important role on *Mandibular condyle* cartilage growth.

2nd View - This view was presented by *Egil Peter Harvold* (1974), *Donald Woodside* (1973) and Selmer-Olsen, Herren (1953). This view completely disregarded the *Myotatic reflex* as the basis to describe the functional adaptation. Proponents of this view believed that Viscoelastic Properties of Muscle and stretching of soft tissues was the primary way of functional adaptation. They believed in creating the construction bite opening which was beyond the postural rest position. They believed that the mandible would be engaged more if the bite is opened more.

Mechanism of action and design The original monoblock designed by Robin in 1902 was a one-piece removable appliance .Andresen and Haupl, who introduced the use of the activator, believed that the repetition of the new mandibular closure pattern induced a musculoskeletal adaptation and resulted in the reeducation of the orofacial musculature. Since it was designed to be loose fitting and required the patient to actively hold the appliance in place, it was often described as an exercise appliance. Although the original activator was made of rubber, the appliance currently is made of acrylic. The muscular forces generated by the forward mandibular positioning were transferred to the maxillary and mandibular teeth through the acrylic body and the labial bow, which contacted the maxillary incisors. In theory these forces were transmitted through the teeth onto the periosteum and bone, where they produced a restraining effect on the forward growth of the maxilla, while stimulating mandibular growth and causing maxillary-mandibular dentoalveolar adaptations. Interocclusal acrylic guide planes were provided to direct the dentoalveolar adaptations in a desirable direction. For a Class II correction, the mandibular posterior segments were directed to erupt vertically and mesially, while the maxillary teeth were directed distally and buccally. Vertical eruption of the maxillary teeth was impeded by the acrylic occlusal stops and the intrusive forces generated by the appliance. Incisal acrylic coverage was intended to inhibit the eruption of the maxillary and mandibular anterior teeth while reducing the flaring of the mandibular anterior teeth. Uncontrolled incisor flaring could result in a rapid correction of the overjet, which would minimize the orthopaedic effects of the appliance on the maxilla and mandible. Most present day activators are a modification of the Andresen-Haupl appliance, which was designed for nighttime use

3.7 COMPONENT

Activator consists of acrylic components and wire components.

Acrylic

Activator appliance initially started out as one block of acrylic which fit in both maxillary and mandibular arch. The lower arch would see the horseshoe shaped lingual plate acrylic extending from distal of the last erupted molar. In the upper arch, initially the anterior portion is covered from canine to canine, but that was later modified, as seen with appliances such as Bionator Appliance which placed its emphasis on the tongue function.

Wire

The wire components of activator included a labial bow which was usually placed 1mm away from the front incisors and extended from canine to canine. The bow would be 0.9 - 0.8mm thick. Additional wire elements were later added to stabilize the appliance.

3.8 CONSTRUCTION BITES

The construction bite of Activator can consist of two types: Horizontal (H) Activator and Vertical (V) Activator.

H Activator

This type of construction bite involves significant changes in the sagittal or Anterio-Posterior dimension. Therefore, the mandible is brought forward by 6-7mm and it is opened 3-4mm. the vertical opening follows an individual's normal postural rest position.

V Activator

This type of construction bite involves significant changes in the vertical dimension. Thus mandible is only brought forward by 2-3mm but vertically the bite is opened by at least 7-8mm.

Since the most variable aspect of appliance design is the vertical dimension of the construction bite, the effects of treatment could be evaluated on this basis. The construction bite determines the sagittal and vertical displacements of the mandible and therefore the degree and direction of appliance activation. Andresen increased the vertical dimension between the molars by 3 to 4 mm. Harvold used a construction bite that increased the vertical dimension a minimum 5 to 6 mm beyond the average 4 to 5 mm rest position. He also increased the horizontal displacement of the mandible beyond the advancement to a Class I molar relationship that was used by Andreasen to an end-to end incisor relationship.

The present study was conducted to investigate the nature of forces induced with activators by measuring strains, electromyogram (EMG) and electroencephalogram (EEG) during a 2-hour sleep period. Fifteen adolescent patients with Class II and Class III malocclusions, (30 subjects) were used. Four types of activators were made for each patient with construction bites taken at incisal edge clearances of 2, 4, 6, and 8 mm vertically. The magnitude of forces generated by passive tension of soft tissues increased significantly ($p < 0.01$) from approximately 80 to 160 gf in the Class II group and from approximately 130 to 200 gf in the Class III group with varying construction bite heights from 2 to 8 mm. Higher construction bites also significantly changed ($p < 0.01$) the direction of forces by passive tension from vertical to posterior and from vertical to anterior in relation to the reference plane in the Class II and Class III groups, respectively. Duration of forces generated by passive tension was most significantly longer than that of active contraction of the jaw closing muscles, irrespective of the construction bite heights. It is concluded that passive tension, derived from viscoelasticity of soft tissues, plays a more important role in inducing changes than phasic stretch reflex during jaw orthopedic therapy with activators.

3.9 A Cephalometric study of the construction bite of the activator

The dimensions of the construction bite of the activator, as well as the positional changes of the mandible and hyoid bone, were studied on cephalometric radiographs with Angle Class II, division 1 malocclusion. The cephalometric radiographs were taken at the start of treatment of each child, one with the mandible in the intercuspal position and one with the activator in the mouth. The activator patients were divided into two groups because of differences in the construction of the wax bite. In group 1 the wax bite separated the upper and lower incisors by 1—3 mm, while in group 2 the incisors were in an edge-to-edge position.

Functional effects of construction bite for activator (Andresen type) especially on lateral pterygoid muscle, as well as the positional changes of the mandible, hyoid bone and surface

EMGs from bilateral anterior temporal (TA) and masseter (MM) muscle, were studied on the electric force scale, MKG, EMG and cephalometric radiographs in 14 subjects with anterior cross bite in mixed dentition. The cephalometric radiographs were taken at the start of each patient's treatment. One was taken with the mandible in the intercuspal position and one was also taken with the activator in the mouth at the overjet improvement.

3.10 Cephalometric analysis

This retrospective study (1) cephalometrically investigates the effectiveness of activator therapy, (2) evaluates the contribution of skeletal growth in the self-correction of the Class II malocclusion, and (3) analyzes separately the dental and skeletal responses to activator treatment and the differences between the incisor and molar areas.Dentoskeletal changes that occurred were compared on lateral cephalograms taken before the treatment/observation period and after 21 months (standard deviation, three months). When the activator patients were compared with the untreated control subjects, therapy promoted a combination of skeletal and dental changes that led to an improvement of the sagittal discrepancy. Other changes observed in the untreated Class II subjects did not bring about a correction of the malocclusion. An analysis of the corrective contributions in activator therapy in the posterior area showed that the orthopedic effects were greater than the dental effects in correcting the posterior occlusal relationship. In the anterior area of the arch, although both the skeletal and dental changes were favorable toward the sagittal correction, the skeletal contribution was greater than the dental contribution. In general, the skeletal contribution (140%) exceeded the dental correction (60%), and the mandibular changes (73%) exceeded the maxillary contribution (27%) both in the anterior and posterior regions.

The purpose of this investigation was to evaluate cephalometrically the mechanism of anteroposterior occlusal changes in activator treatment. The analysis used made it possible to relate alterations in the occlusion to sagittal skeletal and dental changes in the maxilla and mandible. The sample consisted of thirty Class II, Division 1 malocclusion cases treated successfully with activators during an average time period of 32 months. Before- and after-treatment head films in centric occlusion were analyzed. The occlusal line (OL) and occlusal line perpendicular (OL_P) through sella were used for reference. Linear measurements were performed parallel to OL. The following results were found: (1) The improvement in occlusal relationships in the molar and incisor segments was about equally a result of skeletal and dental changes. (2) Overjet correction averaging 5.0 mm was a result of 2.4 mm more mandibular growth than maxillary growth, a 2.5 mm distal movement of the maxillary incisors, and a 0.1

mm mesial movement of the mandibular incisors. (3) Class II molar correction averaging 5.1 mm was a result of 2.4 mm more mandibular growth than maxillary growth, a 0.4 mm distal movement of the maxillary molars, and a 2.3 mm mesial movement of the mandibular molars. (4) When the findings were compared with longitudinal records of persons with normal occlusion (Bolton standards), activator treatment seemed to inhibit maxillary growth, move the maxillary incisors and molars distally, and move the mandibular incisors and molars mesially. Mandibular growth appeared not to be affected by activator treatment.

The study aimed to evaluate the skeletal effect of horizontal activator treatment, examine the dental treatment modulation due to activator therapy, and determine the mode of activator treatment whether it is a skeletodental or a change in the glenoid fossa position.

The main findings were that H-Activator treatment has orthopedic and orthodontic effect and its orthopaedic effect is observed more on the mandible than the maxilla by increasing the length of the mandible with remodeling of the glenoid fossa. Moreover, its dental effect is more on the upper dentition than the lower dentition. This is mostly on the upper incisors by biomechanical forces applied by the appliance which is originally gained from the muscles of mastication, however, dental changes were insignificant.

Myofunctional appliances influence the facialskeleton of growing child and also exert orthodontic effect on dentoalveolar area and the best time for it is use is when the patient is still growing. Many patients complain from Class II malocclusion in which the distobuccal cusp of the upper first permanent molar occlude in the mesiobuccal groove of the lower first permanent molar.1,2 Class II division 1 is probably one of the most disfiguring types of malocclusion causing early apprehension. The early start of treatment, with the proper growth timing, gives a greater chance to the effect of orthopedic force to aid in redirecting the growth pattern into more favorable one correcting the skeletal malrelation and improving the facial esthetic, in addition to the decision of the most effective technique to use in treatment of growing patients with skeletal and / or dental Class II malocclusion. This could be achieved through either extra oral force (maxillary head-gear) in cases diagnosed as maxillary excess or repositioning and encouraging the forward growth of the mandible by orthopedic myofunctional appliances. Basically there are two categories of functional appliances, removableand fixed. Activator and Frankel appliances are examples of removable one and, on the other hand, the Herbst appliance represents an example of fixed functional appliance.The usual intermaxillary relationship for the average class.II problem after orthopedic treatment is end-to-end incisor. However, the overjet is not recommendedto exceed 7-8mm. Anterior positioning of the mandible is contraindicated if: 1. The overjet is too large (18 mm), then the anterior positioning is done in steps, progression accomplished in two or three phases as tissue response and reactivation is better for the condyles with less patient discomfort.

2. Severe labial tipping of maxillary incisor.

3. An incisor (usually the lateral) has erupted markedly to the lingual, so a short prefunctional appliance alignment should be done first.

4. If there is divergent rotation of the bases, the treatment with activator is not possible.

The ideal indication for H-Activator treatment usually Class II division 1 malocclusion with sufficient overjet also class II caused by mandibular over closure that results in functional retrusion, in addition it indicated in class II division 1 malocclusion with posterior position of the mandible caused by growth deficiency but with likelihood of a future horizontal growth pattern (i.e., it most effect appliance in treating dental and skeletal class II malocclusion, particularly caused by mandible retrusion).

Other indication include prevention and correction of oral habit, including thumb / lip sucking, mouth breathing and oral functional aberrations. The treatment was better in patient treated within two-year period around the maximum of pubertal growth, and whatever the type of appliance that is used or the kind of growth effect that is desired, if growth is to be modified the patient has to be growing and growth modification must be done before the adolescent growth spurt end.

3.11 MATERIALS AND METHODS

- Clinically healthy with no history of facial trauma.
- Mild skeletal class II due to mandibular retrognathism with dental class II due to either mandibular dentoalveolar retrusion or mandibular dental retrusion.
- No severe proclination of lower incisors.
- No divergent profile of the bases.
- No skeletal type crossbite.
- No apparent facial asymmetry or hemifacial dysplasia.

Methods:

The patient set in upright position with a relaxed status to be prepared for clinical examination, then, an alginate impression for upper and lower arches were taken. A U-shaped wax (bite rim) is prepared by rolling of the wax sheet about 2-3 mm thickness that have a proper arch form, size and be wide enough. The lower arch guided into the desired anterior position, which required correcting Class II malocclusion and the movement controlled to an edge–to–edge relationship if the case permit and with accurate midline registration.

Wire elements include an upper labial bow (Hawley arch) and Adam clasps. The upper and lower portion were joined by acrylic at the interocclusal area, the dental and gingival portion should be accurately fabricated, especially the lower cast because the gingival (lingual) flange very important which position the mandible more anteriorly and give good retention for the appliance. Cast analysis was carried out on stone study models before and after treatment using a dental vernier and it include:

1- arch length extended from the interincisal point to intermolar width,

2- arch width (inter canine width) between cusp tip of the canines, and

3- arch width between the first permanent molars.

True lateral cephalometric radiographs were taken for each patient before and after treatment, and certain linear and angular measurements have been used .

DISCUSSION

Cast analysis: The evaluation of the post-treatment changes in dental and dentoalveolar parameters in both maxilla and mandible was taken into consideration using study models, which shows insignificant changes between measurements before and after treatment through the treatment period. The activator may induce expansion of maxillary and mandibular arches width 15 and that the treatment may induce change in transverse dimension.

The decrease in the mean value for upper arch length after treatment reflected that the activator effect in anterioposterior relation, by retraction of upper dentition and that confirmed with decrease in the overjet. These findings were non significant statistically, in spite of the activator have an effect on the dentoalveolar structure, therefore it can be concluded that the growth changes during the active treatment period (7 months) was not enough to reach the significant level, indicating the changes of a statistical significance in this study are due to the treatment modulation rather than the growth.

Cephalometric analysis:

Improvement of incisal sagittal and vertical relationship considered one of the most important finding with activator treatment. The angle between upper incisor and palatal plane shows a significant decrease after treatment and this similar to other studies. They explained that functional appliance cause palatal tipping for maxillary incisors by retroclination of these teeth in short treatment period. The insignificant increase of lower incisor to mandibular plane angle (I /man) enhanced probably by increase of mandibular length (Go-Gn) rather than its inclination. The interincisal angle show highly significant improvement after treatment by dental forces in the upper jaw and by orthopedic forces in the lower jaw and both of these forces imposed by activator treatment, and this related with decrease of SNA and increase of

SNB. The effect of the activator appear mainly on a slight modulation of normal maxillary dentoalveolar relocation(slight modulation of anterior growth vector of maxilla) and increase of mandibular length (Go-Gn) and anterior displacement of the mandible that carried out point B forward. Non-significant alteration of Gonial angle considered as important finding and give indication that the orthopedic or dentoalveoar changes occur during treatment period 6-8 months (which considered the effective treatment period) contributed to treatment effect rather than growth. The most important point in our study the significant decrease of Articular angle, due to anterior position of the mandible or mesial and vertical development or migration of lower 1st molars.

The correction of the overjet could be a result of:

1. Orthodontic change: by significant palatal inclination and retrusion of upper incisor and non significant protrusion of the lower incisors and this agreed with Pancherz
2. Orthopedic change by increase in mandibular length by increase of Co-Gn distance or remodeling of glenoid fossa position.

Overbite correction improved significantly by over eruption of lower posterior teet h which also lead to increase of lower facial height (ANS- Me) and this is supported by Janson et al and Ahn and Schneider. The overbite correction confirmed with increase of base plane angle, increase of Y-axis angle and anterior translation of the mandible. Significant change of Ar-Go distance after the treatment related with the changes of the mandibular length by bone deposition at condyles, as it translated downward and forward. One of the most interesting points in this study was a highly significant increase of mandibular length .Functional jaw orthopedics aim to stimulate of mandibular forward growth and it stabilizes the compensatory structural adaptation (condylar region and glenoid fossa remodeling). After 6-8 months of treatment, the present study show highly significant increase in the mandible length so the activator considered the most effective appliance in controlling the translation of the mandible in forward direction and contributing to class II correction by increasing in Co-Go distance and it may include both issues of correction whether mandibular growth can be enhanced above the level of normal growth and condyle length increase or remodeling in the posterior region of glenoid fossa after treatment (bone deposition in the posterior aspect of glenoid fossa).

3.12 SUCCESS RATE AND EFFICIENCY OF ACTIVATOR

The correction of a Class II division 1 malocclusion by means of functional appliances is a frequent treatment approach (O'Connor, 1993). Numerous studies have focused on the mode of action of the different types of removable functional appliances, evaluating their dental and skeletal effects. However, much is still unknown regarding the factors leading to success or failure of functional appliance treatment.

The aim of the present, retrospective, multicentre investigation was, therefore, to evaluate the success rate and efficiency of activator treatment in a large number of Class II division 1 patients treated at two different University clinics. The following factors that may be associated with the treatment outcome were considered: age, gender, dental and skelettofacial morphology, the type of activator used, pre-treatment maxillary expansion, the level of co-operation, treatment length, and the centre where treatment was performed.

Material and methods- From all patients treated with activators presenting with a Class II division 1 malocclusion with an overjet ≥ 5 mm were selected.

If the patient was in the permanent dentition, the molar relationship had to be half or more cusp distal, and in the mixed dentition, with the second lower primary molar still present, the relationship had to be three-fourths or more cusp distal due to the expected spontaneous mesial drift of the molar as a result of the leeway space (Bishara et al., 1988).

Patients presenting with agenesis, extraction of permanent teeth, syndromes, and previous orthodontic treatment, except for transverse maxillary expansion, were excluded from the study.

Using the lateral head films taken at T0, the sagittal jaw base position (SNA and SNB angles), the sagittal jaw base relationship (ANB angle), the vertical jaw base relationship (ML/NL angle), and the mandibular plane angle (ML/NSL) were measured. Furthermore, for the patients from Berne, skeletal maturity, using the cervical vertebrae maturation method (Hassel and Farman, 1995), was assessed.

All measurements were performed twice and the mean of the duplicate registrations was used in the final analysis of the data. The registrations of the patients treated in Giessen and Berne were undertaken by independent investigators. No interexaminer error was assessed. However, for the assignment into the successful, marked improvement and failure groups agreement between the two investigators in Giessen (MG and HP) and Berne (CC and SR) had to be reached.

Three different types of activators were used in the treatment of the patients: the Andresen activator (Andresen et al., 1953), the activator according to Herren (Herren, 1959, 1980), and the van Beek activator (van Beek, 1982). The number of patients treated with each appliance amounted to 92 Andresen activators (Giessen 92, Berne 0), 72 Herren activators (Giessen 0, Berne 72), and 58 van Beek activators (Giessen 26, Berne 32). All treatments at both centres were performed by senior staff and postgraduate students.

The three different types of activators used for the treatment of the Class II division 1 patients: (A) Andresen, (B) Herren, and (C) van Beek.

By examining the patient records, indirect information about compliance: oral hygiene, missed appointments, and fitting accuracy of the appliance were derived. Using these data, the co-operation of the patients was categorized as good or bad. Bad co-operation was assumed if the patient's records showed several missed appointments, repeated notes on bad oral hygiene, reports on bad appliance fitting, or even appliance loss.

The length of activator treatment was defined as the time span from T0 to T1. The mean treatment time was 2.3 years in Giessen (SD 1.34 years) and 1.8 years in Berne (SD 1.03 years).

Treatment success: Activator treatment was considered successful if the following conditions were met bilaterally: treatment started in the permanent dentition: improvement in the sagittal molar relationship of half or more cusp; treatment started in the mixed dentition: improvement in the sagittal molar relationship of a half or more cusp. However, if the second lower primary molar was exfoliated during the treatment period, the improvement in occlusal relationships had to be three-quarters or more of a cusp.

In case of an asymmetric improvement on the right or left side, the smaller amount of cusp width improvement was used in the final evaluation.

For comparison between permanent and mixed dentition treatment, the net activator effect (=total molar relationship change minus quarter cusp for leeway space usage) was used in the final evaluation.

In order to assess the degree of efficiency of activator treatment, the successful group was further divided into two subgroups: (1) an 'ideal' occlusion group and (2) a marked improvement group. The following post-treatment criteria had to be fulfilled to be assigned to the ideal occlusion group: Class I molar relationship + 1 mm, overjet and overbite less than 4 mm, occlusal contact on all teeth, and crowding in the upper and lower anterior segments less than 2 mm.

Any patient from the successful group not fulfilling all of the ideal criteria was assigned to the marked improvement group.

Statistical analysis: For the biometric and cephalometric data, descriptive statistics were performed (mean, median, SD). Group comparisons were undertaken using non-parametric tests (Wilcoxon two-sample and Kruskal–Wallis). For discrete data, the chi-square analysis was used; where the sample size was low, Fisher's exact test was used. Stepwise logistic regression was employed to assess possible interrelationships between treatment success and the independent variables gender, co-operation, activator type, treatment length, transverse expansion, dental, and skeletal maturity. The statistical significance was determined at the 0.1, 1, and 5 per cent levels of confidence. A confidence level greater than 5 per cent was considered not statistically significant.

As no statistically significant group differences (Giessen/Berne) existed for the T0 malocclusion severity (dental cast or cephalometric variables) or for the T1 dental cast characteristics and as the success rate as well as the treatment efficiency were almost identical at both centres, the patient material was pooled for further analysis.Relationship was significantly larger ($P < 0.001$) in the successful (mean 0.7 cusp widths, SD 0.24 cusp widths) than in the unsuccessful group (mean 0.3 cusp widths, SD 0.27 cusp widths). These cast characteristics between the groups .

A negative value implies distal molar relationship.

No significant differences between the success and failure groups were found when testing for nominal data such as gender, activator type used, location where the treatment was performed, dental maturity, skeletal maturity (available data from Berne only), or whether or not transverse maxillary expansion was performed before activator treatment. The only significant factor found to influence the success rate of activator treatment was the level of patient co-operation. While in the success group 75 per cent were classified as co-operating well, this was the case in only 29 per cent in the failure group ($P < 0.001$). Good patient co-operation was also the only predictive factor for treatment success identified by means of logistic regression ($P < 0.001$).

Influence of the activator type (Andresen, Herren, and van Beek) used for treatment in Class II division 1 patients on the improvement in sagittal molar relationship (net activator effect) in cusp widths (CW).

Although no statistically significant differences between the different activator types existed, there was a tendency for a larger cusp width improvement with the van Beek activator (median 0.63 cusp widths) when compared with the Andresen and Herren activators (median = 0.50 cusp widths).

Even if dental maturity had no influence on treatment success, it did significantly influence treatment length. Activator treatment started in the early mixed dentition resulted in a longer treatment period (mean 2.7 years, SD 1.3 years) than activator treatment started in the late mixed dentition.

Influence of dental maturity (early mixed dentition, late mixed dentition) during which treatment was started on treatment length (years) in Class II division 1 patients.

Discussion: The present study is a retrospective case series implying that it ranks relatively low in the hierarchy of evidence because of the inherent risk for selection bias and the lack of a control group. Selection bias in this context would especially mean that the patient material included in this study is not representative of a normal population of patients with Class II division 1 malocclusions.

Treatment success was defined as an improvement in molar relationship of at least a half to three-quarters cusp width depending on whether or not the leeway space was used during treatment. Bishara et al. (1988) reported a spontaneous mesial drift of the lower molars on exfoliation of the second primary molars in approximately 60 per cent of untreated Class II occlusion subjects, depending on the quality of the interdigitation of the teeth. When an activator is worn, the occluding teeth are separated and the acrylic is trimmed to allow the molars to freely move mesially. Therefore, it was assumed that there would be a greater percentage of cases with molar drift than would spontaneously occur.

Such a spontaneous mesial drift of the molars (Bishara et al. 1988) could result in an improvement of the occlusal relationship even without any orthodontic intervention. Therefore, the severity of the malocclusion had to be a quarter cusp width more severe if the lower primary molar was still in place before treatment. Besides this molar drift, no spontaneous improvement in the Class II relationship, sagittal jaw base relationship, and overjet can be expected with age (Bishara, 1998). Therefore, even without an untreated control group, the present results should be transferrable to Class II division 1 patients in general.

The reason for considering a certain amount of sagittal molar relationship improvement as success criteria instead of, for example, the achievement of a Class I occlusion, was the independence of this method from the pre-treatment severity of the Class II occlusion.

The success rate of activator treatment was on average 65 per cent in the present study. A comparison with investigations is difficult as activator treatment success has not analysed in depth and the treatment objectives and analysing methods have differed.

From the present total patient material, 27 per cent attained an ideal occlusion. This is similar to the results of Bondevik (1991) who reported that 18 per cent of his patients treated simultaneously with an Andresen activator and a headgear achieved satisfactory results (neutral occlusion ±1 mm, overjet and overbite less than 4 mm, no observable rotation of upper incisors, occlusal contacts on all teeth, crowding less than or equal to 1 mm). However, except for the inclusion criteria of a Class II division 1 malocclusion and the age of the patients, he did not report any details on pre-treatment malocclusion severity or the amount of treatment change, thus limiting comparability with the present results.

The only factor that significantly influenced treatment success in the present study was the level of co-operation; while in the success group 75 per cent were classified as co-operating well, this was the case in only 29 per cent in the failure group. This is in agreement with several other studies (Ahlgren, 1972; Ahlgren and Laurin, 1976, Bondevik, 1991; Cureton et al., 1993; von Bremen and Pancherz, 2002; Wheeler et al., 2002; Ruf et al., 2007). But it remains open why, despite good co-operation, as judged from the patient's records, some individuals did not respond well and vice versa. The importance of a certain level of co-operation during orthodontic treatment is unquestionable. However, the degree of co-operation required and its relationship to the amount of treatment response is unknown. It might be argued that it would have been better to use more objective measures of co-operation such as timing devices or logs of hours of appliance wear. However, even in prospectively designed randomized clinical trials (Tulloch et al., 1997), these measures of co-operation failed and the investigator had to rely on indirect measurements of co-operation such as those used in the present study.

It should be pointed out that there could be additional decisive factors for the outcome of activator treatment, such as a favourable dental reaction and/or growth pattern (Skieller et al., 1984; Tulloch et al., 1997; Bendeus et al., 2002; Patel et al., 2002; Ruf et al., 2007). However, the pre-treatment sagittal and vertical skeletal morphology (lateral head film analysis), which should be indicative of the growth pattern, did not influence treatment success in the present study. It would, no doubt, have been desirable also to analyse post-treatment lateral head films of the subjects. These were, however, not consistently available.

The successful group was treated on average 0.6 years longer than the failure group. There are two possible explanations for this difference. The first is that in the failure group, treatment was stopped or altered earlier due to lack of co-operation or treatment reaction. The second possibility is a longer retention period in the successful group. The latter seems likely as in case of no further need for orthodontic treatment, the retention period was prolonged until the second molar had erupted. However, if further fixed appliance treatment was necessary, it was started as soon as premolar and canine eruption had finished.

Although dental maturity and treatment length had no influences on treatment success, there was a significant association between dental maturity and active treatment duration; with progressing dental development, the active treatment time decreased. A similar tendency has been described by others (Gianelly, 1995; Tulloch et al., 1997, 1998, Firestone et al., 1999; O'Brien et al., 2003; Tulloch et al., 2004). The relatively longer treatment time, when starting early, can be explained by the fact that activator treatment is generally continued until all permanent teeth (except for third molars) have erupted into occlusion.

The earlier treatment start in Germany compared with Switzerland might be attributed to the difference in health care systems. The majority of orthodontic treatments in Switzerland are private, while in Germany they are covered by the public health care system. Insurance coverage has been shown to lead to larger and earlier demand for medical care (Meer and Rosen, 2004), and thus possibly also for dental care.

The larger percentage of patients treated with transverse maxillary expansion prior to activator treatment in Giessen (71 per cent) compared with Berne (31 per cent) may be due to the fact that in Berne the Herren activator was the most frequently used appliance. A transverse expansion screw is generally incorporated into the Herren activator, thus permitting simultaneous transverse expansion and antero–posterior correction.

After activator treatment, fixed appliances were required in many of the cases (60 per cent success group, 70 per cent failure group) in order to improve tooth alignment and/or to continue with Class II correction. This leads to an important question: does activator therapy as a first phase of treatment result in a shorter and thus more efficient second phase of treatment? It can be supposed that the fixed appliance treatment time may only be reduced for the patients in the successful group. However, Tulloch et al. (1997, 1998, 2004) reported that two-phase Class II division 1 treatment started in the early mixed dentition might not be more effective than one-phase treatment started in the late mixed dentition. Those authors found no reduction in the average duration of fixed appliance treatment during the second stage of treatment and no decrease in the frequency of complex treatments involving extractions or orthognathic surgery. Only 2.4 per cent of their patients were judged not to require comprehensive orthodontic treatment after the first phase with either bionators or headgears. It remains debatable, why the success rate in the study of Tulloch et al. (2004) was so low compared with the 27 per cent of the total present patient material that did not require any fixed appliance treatment after activator therapy. Of course it might be argued that due to the retrospective design of the present study, some bias cannot be ruled out. However, patient selection in the present study was based on clearly defined inclusion and exclusion criteria as well as the availability of records. It seems unlikely that the availability of records should have been better for successful than for unsuccessful patients.

Conclusion: Activator treatment was effective in improving the sagittal molar relationship in about 65 per cent of the Class II division 1 patients Activator treatment was more efficient when started in the late mixed dentition.

3.13 ROLE OF HORIZONTAL ACTIVATOR IN CLASS II DIV I MALOCCLUSION

Alteration of the patient’s facial profile has been a challenge for orthodontists over the years. Many investigations have been carried out to evaluate the possibilities of growth modification with orthopedic appliances. However, the results have generally been a subject of debate since there is little scientific evidence so far that an orthodontist is able to significantly alter the inherited complex craniofacial skeleton of the growing child on a permanent basis as compared to the dentoalveolar changes that have generally been found to be more stable.Orthopedic appliances provide a new muscular and functional environment for the facial bones that encourages growth changes of either the mandible or the maxilla. Headgears, activators, and Herbst appliances have proven to be valuable tools in their clinical results. Sagittal discrepancies between mandible and maxilla can be corrected adequately. However, it remains questionable whether the results of this kind of therapy can be attributed to skeletal effects rather than to dentoalveolar compensation.

The aim of this study was to determine the sagittal and vertical skeletal and dental changes induced by the horizontal activator as an outcome of an Iraqi sample treatment.

MATERIALS AND METHODS The sample consisted of 22 lateral cephalometric radiographs of 11 Iraqi adolescent patients [7 females 10-11 years old, and 4 males 12-13 years old]. Pre and post treatment cephalograms have been taken for every subject. The sample subjects have been selected from patients according to the following criteria: 1- Patient’s age at least 1 year before the maximum growth spurt (which is 12 years for females and 14 years for males. 2- Good general health status. 3- No history of previous orthodontic treatment. 4- Moderate-severe skeletal class II i malocclusion due to mandibular retrognathy (ANB>7 degrees). 5- Horizontal growth pattern (clinically reduced lower facial height). All the steps of horizontal activator fabrication and clinical management were done according to the recommendations of Graber et al. Upper The cephalometric analysis included the following linear and angular measurements: Linear measurements: 1- Go-Me : Extent of mandibular base. 2- Co-Gn :

Mandibular length. 3- Co-Go : Length of ascending ramus. 4- ANS-PNS : Extent of maxillary base. 5- N-Me : Anterior facial height. 6- N-ANS : Upper anterior facial height. 7- ANS-Me : Lower anterior facial height.8- S-Go : Posterior facial height. 9- S-Ar : Lateral extent of cranial base. 10- Ar-Go: Length of ramus representing lower posterior facial height. Angular measurements: 1- SNA: Anteroposterior position of maxilla. 2- SNB: Anteroposterior position of mandible. 3- ANB: Difference between SNA and SNB. 4- N-S-Ar: Saddle angle. 5- S-Ar-Go: Articular angle. 6- Ar-Go-Me: Gonial angle. 7- N-S-Gn SN line and S-Gn line, anteriorly.8- Inclination angle : Angle between the Pn line (perpendicular line on Se-n plane drown from soft tissue nasion) and the maxillary plane. 9- MMP angle : Angle between maxillary and mandibular planes. 10- 1 max : Angle between upper incisor axis and maxillary plane. 11- 1 man : Angle between lower incisor axis and mandibular plane. 12- ii angle : Interincisal angle between upper and lower central incisor axes.

RESULTS: shows the descriptive and inferential statistics for the pre and post treatment linear cephalometric measurements, in addition to the overjet and overbite. Paired t-test has been applied to examine the statistical significance of change between the pre and post treatment readings. All the linear variables that represent mandibular measurements showed an increase in the mean value after treatment (mandibular base, mandibular length, length of the ramus and ascending ramus). The increase in these measurements was statistically highly significant, excepting the mandibular base which showed a statistically non significant increase in mean value. Unlike the mandible, the maxillary base showed a slight decrease in its post treatment mean value which was statistically non significant. The total anterior facial height showed a slight non significant increase, with a non significant decrease in the upper anterior facial height, while a significant increase of the lower anterior facial height mean value after treatment. All the posterior facial height measurements showed statistically significant changes after treatment by a significant increase of the total posterior facial height, significant decrease of the upper posterior facial height, and a highly significant increase of the lower posterior facial height. Both of the overjet and overbite showed a highly significant reduction from severe into normal range values.

DISCUSSION: It is well known that clinical studies that take long treatment time are somewhat difficult to be carried out due to the factor of patient cooperation (especially in case of children and adolescents). 1- Lack of cooperation of many of the patients to continue the treatment and follow the instructions. 2- The hard unstable situations that our country passed through, which played a major role in small sample collection. In a previous Iraqi study, the skeletal and dental changes induced by the horizontal activator have been investigated by treating MILD skeletal class II cases. A major shortcoming in studies that deal with mild skeletal malocclusion treatment is the confusion between treatment changes and natural individual growth changes.(1) For this reason, our study verified the clinical outcomes of horizontal activator therapy by treating Moderate-Severe cases in order to highlight the treatment changes over growth changes. Linear measurements analysis: Among the mandibular measurements, an exclusive behavior was demonstrated by the mandibular base (Go-Me) which showed a non significant increase after treatment. This slight increase may be attributed to the non significant activator influence on mandibular base and/or the horizontally directed growth pattern. On the other hand, the highly significant increase demonstrated by the mandibular length (Co-Gn), Co-Go, and Ar-Go reflects the significant effect imposed by the activator on these variables. The increase in mandibular length, ramus length, and length of ascending ramus results in downward and forward movements of the mandible demonstrating the skeletal influence of the activator. The muscular elastic properties play a positive important role in a favorable neuromuscular response to the forward positioning of the mandible induced by the activator by straining the soft tissues and muscles attached to the condyles stimulating the growth centers there. On the contrary, the restraining effect of the activator on maxillary base growth explains the non significant decrease in its post treatment mean value, a finding which is supported by many authors. Other researchers found a slight increase in maxillary base after treatment and they attributed that to posterior growth of maxillary base, however, this increase was also statistically non significant.A non significant decrease was shown by the upper anterior facial height (N-ANS) which may be due to the non significant effect of activator on midface structure as reported by other researchers.Whereas a significant increase was shown by the lower anterior facial height (ANS-Me) which is attributed to the highly significant increase in the gonial and MMP angles and this will be discussed later on. These changes resulted in an increase of the total anterior facial height (N-Me), however, it was statistically non significant. The upper posterior facial height (S-Ar) was reduced significantly after treatment due to the anterior displacement of the condyle in the glenoid fossa (a marked skeletal effect exhibited by the highly significant reduction of the saddle angle), while the lower posterior facial height (Ar-Go) showed a highly significant increase after treatment. These changes resulted in a significant increase of the total posterior facial height (S-Go). These findings come in agreement with those reported by other researchers.The overjet demonstrated a dramatic improvement from severe class II into normal range value. Overjet reduction can be attributed to: (1) A highly significant retroclination of upper incisors, (2) A highly significant proclination of lower incisors (induced by the acrylic of the activator) with anterior positioning of lower incisors (induced by the downward forward movement of the mandible with the highly significant increase of SNB angle). So, major dentoalveolar and less skeletal changes contributed to the overjet reduction. The overbite has also been changed from deep bite into normal range value. This can be attributed to: (1) Over eruption of lower posterior teeth leading to opening of the bite anteriorly (2) Relative intrusion of incisors by acrylic loading of their incisal edges,(6) and (3) Anterior translation of the mandible. Angular measurements analysis: Highly significant reduction was shown by the SNA angle. It has been reported that point A position is influenced by upper incisors retroclination induced by the activator leading to a decrease in SNA angle.The SNB angle showed a highly significant increase which can be explained by the downward and forward stimulation of mandibular growth, in addition to the proclination and anterior positioning of lower incisors.These changes in the SNA and SNB angles resulted in a highly significant reduction of the ANB angle from severe class II value into normal class I value. However, it must be kept in mind that this ANB reduction was not a pure skeletal improvement due to the significant dentoalveolar contribution. A highly significant decrease was shown by the saddle angle, while the articular angle showed non significant decrease. The reduction in these angles is related to S-Ar decrease which has been explained by the anterior displacement of the condyle with remodeling of the glenoid fossa.The gonial angle showed a highly significant increase, while there was a non significant increase in the Y-axis angle. The increase in these angles reflects the clockwise rotation of the mandible which may be attributed to the forward and downward growth of the mandible, in addition to the extrusion of lower posterior teeth . The clockwise rotation of the mandible played an important role in the highly significant increase of the MMP angle due to the clockwise canting of the mandibular plane. The second important role came from the anticlockwise canting of the maxillary plane, as it has been reported that the restraining effect imposed by the activator on the anterior growth of the maxilla may enhance the posterior growth of the maxillary base leading to anticlockwise canting of the maxillary plane. This phenomenon will clearly explain the highly significant increase of the inclination angle. Before treatment, the ii angle was of low value due to the severe proclination of upper incisors rather than the lower incisors which were nearly in normal relation to the mandibular plane. After treatment, in spite of the highly significant upper incisors retroclination, the ii angle remained of low value which is due to the highly significant proclination of lower incisors in spite of their acrylic capping.

3.14 BITE REGISTRATION

The steps involve making of upper and lower impressions with deep flanges. The bite is recorded by asking the patient to bring the mandible forward and biting on a horseshoe shaped wax roll softened in a wax bath.

The activator bite is recorded within the freeway space . The sagittal forward positioning is 4-5 mm. The bite with upper and lower models is transferred to a hinge articulator. A labial bow of 0.8 mm wire is constructed. A conventional or traditional activator has large lingual flanges extending up to the distal of 1st and 2nd molars. The upper labial bow is constructed from canine to canine. The lower incisors are free and do not have any acrylic cap on them. However, there is a trend to cap lower incisors now,which prevents labial tipping of lower incisors. Appliance wax up is done,which is followed by routine dewax and acrylisation in heat cure acrylic.

3.15 TRIMMING OF THE ACTIVATOR

The most critical aspect of activator finishing is the trimming of the inclined planes of the bite block. The inclined planes are trimmed with extreme caution and care, to induce buccal and distal tooth movement of the maxillary buccal teeth and enhance mesial and occlusal movement of mandibular buccal teeth.

Trimming is done with sharp TC pear shape bur on a slow speed to avoid heating the acrylic. The patient is asked to bite on acrylic inter –occlusal bite block. The distal cusp positions of maxillary buccal teeth and mesial cusp positions of the mandibular buccal teeth are marked with a metal marker. The trimming is done for each tooth and checked in mouth. It is a tedious and time consuming process which can be a test of patience both for the orthodontist and the patient. At the completion of trimming , the interocclusal block of acrylic resembles a honeycomb., which has inclines and space created for the buccal segment of teeth to distalize, while buccal teeth in the mandibular arch are encouraged to erupt vertically and mesially thereby leading to correction of class II molar relation to class I. Palatal acrylic on maxillary anterior teeth is trimmed to induce intrusion and palatal trimming,while mandibular incisors are now a days capped to prevent undue flaring of the mandibular incisors.

PRINCIPLES IN TRIMMING

- ✓ The force is intermittent .This allows dynamic and rhythmicmuscle forces to act in such a manner that the aplliance acts by kinetic energy.
- ✓ The direction of the desired force is determined by selective grinding of the acrylic surfaces that contact the teeth.
- ✓ The magnitude of forces is determined by the amount of acrylic that contact the teeth.
- ✓ The acrylic surface that transmit the force and contact the teethare called guide planes.

VERTICAL CONTROL

- INTRUSION OF THE TEETH
  - INCISORS--- Can be achieved by loading the incisal edges of teeth, the labial bow should be below the area of greatest convexity or on incisal third.
  - MOLARS--- performed by loading only the cusps. Yje pits and fossas are cleared to eliminate any possible incline plane effect .

- EXTRUSION OF TEETH
  - INCISORS—requires loading the acrylic above the area of greatest concavity in the maxilla and below this area in the mandible. Although not effective can be enhanced by placing the labial bow above the area of greatest convexity.
    Indicated in open bite problems.
  - MOLARS--- requires loading the acrylic above the area of greatest convexity in the maxilla and below this area in the mandible.
    Indicated In deep bite cases.
    Simultaneous extrusion of both the upper and lower buccal segments – no adequate control.

- PROTRUSION OF INCISORS
  - Incisors can be protruded by loading their lingual surface and screening lip strain by passive labial bow.
  - Entire lingual surface loaded
  - Incisal third of lingual surface is loaded

- RETRUSION OF THE INCISORS
  - Acrylic is trimmed from the back of incisors
  - Active labial bow is incorporated

MOVEMENTS OF POSTERIORS IN SAGITTAL PLANE

a. Distalization --- the guide planes are loaded in the mesio lingual surfaces. Indicated in class II cases.
b. Mesial movement --- can be achievrd by loading the disto-lingual surfaces. Indicated for the upper arch in class III cases.

MOVEMENTS IN TRANSVERSE PLANE

a. To achieve transverse movement the lingual acrylic surfaces opposite to the posterior teeth must be in contact with teeth.
b. More effective expansion can be achieved using jack screws.

ACTIVATOR TRIMMING IN CLASS II MALOCCLUSIONS

- ✓ If upper incisors are to be retruded and the labial bow is active acrylic capping needed to prevent extrusion.
- ✓ Lower incisor capping needed to prevent lower incisor proclination.
- ✓ Selective trimming of the acrylic that prevents mesial movement of the upper buccal segments and the enhances mesial movement of lower buccal segments- class II correction.

ACTIVATOR TRIMMING IN CLASS III MALOCCLUSIONS

- ✓ The upper incisors are loaded for protrusion and labial bow passive.
- ✓ Lip pads used instead of labial bow to stimulate basal maxillary development.
- ✓ Lower incisors are retruded acrylic ground lingually , labial bow active.
- ✓ Upper posterior teeth guided mesially and lower posterior teeth guided distally- class III correction

3.16 CLINICAL MANAGEMENT AND TREATMENT FOLLOW UP

The patient is motivated on its use, and those who are to wear the appliance, have responded favourably showing improvement in aberrant perioral muscle behaviour by optimising lip seal and tongue thrust. The saggital correction gradually shows up setting the occlusion in class I molar relation. The treatment duration may vary from 18 months to longer.

RETENTION PROTOCOL

The traditional view about retention after activator treatment was that no retention may be required,since the appliance works through modification of muscle function. However, this is not the case,since occlusal changes take longer time to settle. The current thinking is to finish the case with fixed orthodontic appliance , the 2nd phase of the comprehensive orthodontic therapy.

TREATMENT CHANGES WITH ACTIVATOR

The activator treatment seems to inhibit maxillary growth, move the maxillary incisors and molas distally, and move the mandibular incisors and molars mesially. Mandibular growth appeared not to be affected by activator treatment. Most treatment effects are of dentoalveolar in nature. The cooperation is a single most critical determinant of successful treatment and the activator treatment is effective in late mixed than early stages of occlusion development.

3.17 MODIFICATIONS OF THE ACTIVATOR

The activator with spring bows according to Schwarz

Elements:	Labial bow 0.8 mm spring hard, spring bow 1.2 mm spring hard
Function:	Activation through muscle function
Description:	Through the spring bows, which can be activated horizontally or vertically, the muscle activity is stimulated

The base appliance only contains few elements, but can be replenished in any way. A labial bow is bent for each upper and lower jaw and the single plates are finished with plane lateral bite blocks.

The polished and finished plates are set onto the models which were articulated according to the construction bite. Now the unifying spring bows can be bent and be added into the acrylic of the single plates of the activator. These spring bows are supposed to enhance muscle activity.

The spring bows reach distally over the base plate for a proper activation. Different directions for their activation are possible (horizontal, vertical).

A) ***Bow Activator of A.M Schwarz (1956)***

Schwarz modified the original activator appliance by making activator a two part appliance and connecting it with elastic bow. He said that the bow allows periodic adjustment of sagittal relationship of activator over time. This modification allowed transverse mobility, which was not present in previous modifications, and Schwarz believed that this provided additional stimulus for functional development. However, one of the disadvantages of this modification was that the appliance was easily distortable.

The introduction of Andresen's activator was a milestone in the history of orthodontics. Since then the development of removable appliances and modification of activator grew so fast, especially in Europe. In 1964, Rudolf Karwetzky from Wilhelms University Münster, with his article "Ein neues Funktions-kieferorthopädisches Gerät" at the Deutsche Zahnärzteblatzt, introduced a new functional appliance, which he called U bow activator or U Bügel Activator (UBA). U bow activator from Karwetzky consists of maxillary and mandibular active plate, joined by a U bow in the region of the first permanent molars. In addition to acrylic covering the lingual tissue aspects, gingiva and the teeth, the plates also extend over the occlusal aspects of all teeth. Each plate has labial bow and protrusion bow (closed spring), and the upper plate has expansion screw. Labial bow, made from 0.9 mm stainless steel wire, extends from Budihardja: U bow activator 21 canine to canine. Protrusion bow extends from middle of canine to canine at the palatal region, made from 0.7 mm stainless steel wire. The height of these two components depends on front teeth movements that want to be achieved. Expansion screw is placed in the upper plate, at the height of P1 or dm1. U Bow made from 1.2 mm wire, placed at both sides at the height of M1. U bow activation will define the mandible reposition.4 There are three types of U bow activator developed by Karwetzky: a) UBA type 1. In type 1, the U bows are placed downward and this activator is used to correct class II malocclusion; b) UBA type 2. In type 2, the U bows are placed upward and this activator is used to correct class III malocclusion; c) UBA type 3a and 3b. The placements of the U bows are different between the right side and the left side. This type is usually used to correct asymmetry and functional midline shifting. From these three types of UBA, the one that used most is UBA type 1 to correct class II malocclusion. Ehmer, with the dysgnathy classification, said that indication of using UBA type 1 are mandible retrognathy, maxilla prognathy, upper front teeth protrusion and or lower front teeth retrusion, deck bite (Angle class II div 2), and skeletal or functional asymmetry that accompany class II malocclusion.Just as other functional appliance, the optimal time of using UBA are during growth, between 8–11 years old. UBA can also be used earlier (4–7 years), usually in patients with class II div 1 malocclusion accompanied by extreme over jet. This kind of malocclusion can enhance the risk of front teeth trauma, caused negative functional pattern (lower lip is trapped behind upper front teeth and incompetence lip closure) and usually caused psychological stress to the patient (being mocked about appearance). Modes of actions of UBA are splinting of dental elements, sequential anterior reposition of the mandible (stepwise forward positioning of the mandible), selective transversal expansion of the maxilla and incorporation of active elements for desired tooth movement. Acrylic relief on occlusal and palatal (lingual) region will give splinting effect to the teeth. Acrylic is usually grinded when permanent teeth are erupting, or when elongation of posterior teeth is wanted. U bow that join the upper and lower plates can be activated and this activation will caused sequential anterior reposition of the mandible. The construction bite is made 3–4 mm sagittally to anterior. After using the UBA for 3–5 months, activation can be started. The activation is usually 2 mm every 2–3 months.In class II div 1 malocclusions with mandible retrognathy, the upper jaw is usually transversal underdeveloped. By using UBA, it will be possible to do anterior reposition of the mandible together with transversal maxillary expansion. This expansion can be started after 2 months using the UBA (adaptation time) and can be done 1–2 times a week.4–6 Tooth movement, even limited, can also be achieved with labial bow and protrusion bow at upper and lower jaw. Torque control at upper front teeth (not active torque movement) can be achieved if labial bow placed passive more gingivally and the protrusion bow active and more incisal. Inclination and position of lower front teeth can also be corrected by using labial bow and protrusions bow correctly.

B)WUNDERER'S MODIFICATION OF ACTIVATOR FOR CLASS III MALOCCLUSION

- The appliance is split horizontally with the upper and lower portion connected by a screw that is embedded in an acrylic wxtension of the mandibular portion behind the maxillary incisors.

- As the screw is open maxillary portion moves anteriorly with a reciprocal posterior thrust acting on the mandibular dentition.Occlusal surfaces of the posterior teeth are covered with acrylic to enhance retention.
- The construction bite for class III case is takenin most retruded or hinge axis position of the mandible with the incisal edges 2 mm or 3 mm apart.
- In addition to maxillary labial bow used to guide the mandible distally as they occlude.
- Wunderer made a modification of the activator to be used for the patients with Class III malocclusions. The appliance was split horizontally into an upper and lower part and a screw connect the two pieces of appliance. The occlusal surface of incisors in both arches are covered with acrylic. The screw used is named as Weise Screw. Turning the screw lead to the maxillary arch to move anteriorly and a back thrust of the mandible.

C) HARVOLD – WOODSIDE ACTIVATOR

- Harvold (1974) and woodside (1973)
- Woodside opens the mandible with the construction bite as much as to 10-15 mm beyond postural rest vertical dimension.
- The forces generated by this extreme bite registration(10-15mm) represent combination of forces generated by swallowing, biting, activation of the myotactic reflex in the stretched muscles of mastication and the power delivered through the viscoelastic properties of stretched muscles, tendon tissue, skin and musculature.
- This appliance works using potential energy
- Class II div 1 with increased LAFH (environmental factors)
- The Harvold Activator was developed by Egil Peter Harvold, a Norweigan dentist who later moved to America and was largely responsible for the introduction of functional appliance therapy to the country. The activator is constructed to a widely open bite to gain maximum effect from the movement of the muscles. It is designed to treat Class II malocclusions by using occlusal shelves to prevent the eruption of the upper posterior

teeth while encouraging the eruption of the lower posterior teeth, correcting the molar relationship from a Class II to a Class I malocclusion.

- Actual adaptation of the maxilla to the lower dental arch.
- Partially achieved by retroinclination of the maxillary base.
- Differential eruption of teeth
- Good vertical control of both dental arches and only minor forward tipping of the lower incisors.
- Harvold has also emphasized the concept of the “functional occlusal plane “ and the role played by its manipulation in the successful correction of class II malocclusion . this plane represents the functional table of occlusion in the first permanent molar, second molar and first premolar areas.
- The level and inclination of the functional occlusal plane is the result of the neuromuscular growth and developmental forces acting on the dentition.
- The correct manipulation of the functional occlusal plane involves the inhibition of maxillary buccal segment eruption ,which normally follow a downward and forward curvilinear eruption path.
- At the same time mandibular buccal segment are permitted to erupt vertically in harmony with the vertical groeth of the lower face.
- Because of the mandibular molar erupt roughly at right angles to the functional planr , change from class II malocclusion to class I occlusion is facilated.

Fig:Labial view of the Harvold Activator appliance. Also showing labial Bow in 0.8mm S.S wire

Fig:Buccal view of the Harvold Activator appliance. The 'shaded' area is the 'molar covering'.

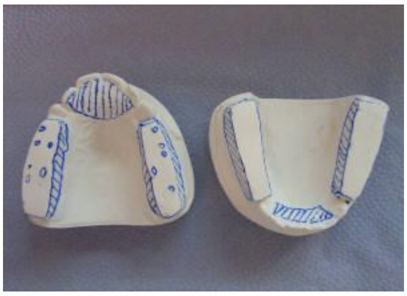


Fig:Occlusal view of the relief areas of the Harvold Activator upper and lower models. Picture shows palatal, lingual relief and molar coverage. N.B. The tips of the cusps of the fully erupted teeth should be just visible and level with the relief material used

Fig: Buccal view of the Harvold Activator appliance

D)HERREN ACTIVATOR

Fig: Herren Activator

- The principle- complete opposition to the kinetic concet of Andersen –Haulp appliance.
- By overcompensating the ventral position of the mandible in the construction wax bite.
- By seating the appliance firmly against the maxillary dental arch by means of arrowhead clasps similar to those used in active plates.

- Herren modified the Activator appliance by including clasps on the appliance. He stated that the clasps allowed the activator to attach to the maxillary dentition, and thus make it more stable. He worried that slight movement of mandible during sleeping will allow the activator to fall out. He also extended the acrylic towards the floor of the mandible to restrict the movement of mandible. He believed in maximal sagittal advancement of the construction bite with 1-2mm vertical opening.

- Mode of action---
  - ➢ Graber coined the term " myotonic appliance"
  - ➢ The mandible is prevented from assuming the natural rest poition – thus if the rest position prescribed by activator does not coincide with natural rest position , the retractive muscle is stretched.
  - ➢ In class II malocclusion, the construction bite of the Herren activator dislocates the mandible ventrally ,parallel to occlusal plane by a total of 8mm or more. The improvement of post normal occlusion was directly related to the amount of ,mandibular displacement, in taking the constrction wax bite.
  - ➢ When the activator is inserted the mandible is purposely carried forward until it is possible to bite completely in to the positioning splint.
- The mandible is kept from being retracted because the activator takes the load of these forces and transmits them in an occipital direction , to the maxillary dental arch.

- Since “action equals reaction” a force of equal magnitude but opposite direction acts against the mandibular dental arch .
- The force acts continuously only as long as the Herren or L.S.U Activator is in place i.e 9-10 hours during night.
- The activator holds the retractive musculature of the mandible passively stretched.
- More over, the activator inserted between the teeth and the tongue act as a shield that keeps the tongue away from the free way space, which enables the eruption of teeth , provided that the acrylic occlusal stops of posterior teeth are ground away from the appliance.
- According to the studies reported by Petrovic et al, the action of Herren type of activator comprises a two stage effect.
- During the time the activator is worn, the protrusive position of the mandible(caused by construction bite_) causes reduced increase in length of the lateral pterygoid muscle and at the same time forms a new sensory “ engram” for positioning of the mandible.
- This causes the mandible to function in a more forward position during the period when the activator is not worn.
- The forward positioning of the mandible by the contraction of the lateral pterygoid muscle, when the activator is not being used an accelerated growth rate of condylar cartilage.

SPECIFIC FEATURES

1. Twin arrowhead clasp
2. Expansion screws
3. Lingual springs to correct moderates incisal irregularities.
4. Extension of the flanges towards the floor of the mandibular anchorage (lower incisor bow if needed)
5. Horizontal slot in maxillary incisors for comfort
6. No pathological changes in TMJ
7. Assymetrical classII div 1 expansion screws with asymmetric cuts in the appliance

   SKELETAL EFFECT

   1. To correct the class II malocclusion in an expedient , reliable and economic way.
   2. To retard forward growth of the maxilla
   3. To reposition the mandible through mandibular growth,either in a horizontal or in a vertical direction.

4. To achieve these performances in the transitional as well as in the early permanent dentition, independent from the pubertal growth peak in body height (by over compensating)
5. To provide a high rate of stability of the treatment results after several years out of retention .
6. Herren activator holds the maxillary dental arch preventing the maxillary forward growth , the mandibular dental arch carried forward together with its basal arch.
7. The treatment results in: a) increase in SNB angle b) decrease in ANB angle
8. Mandible length increased
9. Change in position of he mandible ,either a more forward or a more downward direction.

DENTAL EFFECT

1. Dentoalveolar compensation (distal movement of upper molars,mesial movement of the lower molars) appeared to be inversely related to skeletal adaptation.
2. The correction of molar relationship occurred to 55% by skeletal changes.

CLASS II DIV 2 MALOCCLUSION

Herren advocated expansion screws, lingual springs for correction of retruded incisors and guiding spurs to relieve minor crowding.

RETENTION

Retention period: (due to over compensation) 15 months after normal (neutral) dental arch relationships is achieved and overjet is corrected.

a. This normal dental arch relationship is maintained intaking the construction wax bite for a retention activator. However, the mandible is carried forwarded by about 2mm, beyond neutron occlusion to compensate for the increase in overjet that occurs as a result of rotation of the mandible around the condylar hinge axis when a vertical inter occlusal clearance of 4-6 mm is constructed.

RELAPSE

a. If treatment started too an early age, partial relapse occur after retention. It is recommended to start treatment ,when premolars have erupted.

b. Correction of antero-posterior basal discrepancy, resulting from this therapy, were shown to be stable even 5 years after the end of retention.

E)REDUCED ACTIVATOR OR CYBERNATOR

- Resembles bionator
- Customary labial wire of the activator is used, as well as most of other simple appurtenances of this and other myofunctional appliances including the coffin spring.
- Spurs added to prevent the mesial movement of molars during the shedding of deciduous teeth.
- Can be combined with fixed appliance therpy.
- Headgear tubes can be incorporated for extra oral forces.

F)PROPULSOR ACTIVATOR

- Hybrid appliance
- No wire configuration are used with propulsor, acrylic connecting the upper buccal segment to the lower lingual flanges also serves as occlusal support to stabilize the appliance.
- As treatment progresses this acrylic is removed progressively to allow for unhindered eruption of molars and resultant reduction of the deep overbites, if exists.
- Also if selective eruption is desied to reduce the class II buccal segment relationship by upward and forward eruption of the lower teeth while preventing forward eruption of the upper teeth by removing acrylic in the opposing lower molar area leaving them free.
- The compliances is usually good because of the lightweight and minimum bulk of the appliance.
- This modification had no wire connecting the upper and lower parts. Acrylic connected the upper and lower part with acrylic flanges. This type of activator was designed by Muhlemann and refined by Hotz. This appliance is sometimes known as the hybrid appliance because it has features of vestibular screen and monobloc.

G)CUT OUT OR PALATE FREE ACTIVATOR

- Advantage of the bionator with some of those of the original Andersen – haulp appliance
- Metzelder changes however do have some advantages.
- Appliance is easier to make

- It may carry all the appurtenances described for the activator
- This modification was proposed by Metzelder to combine the advantages of bionator and activator. The palatal area in this modification remains free of acrylic, making the appliance more convenient for patients and them being able to wear it for longer periods of time. The mandibular part of this appliance was same as the original mandibular part of activator, only the maxillary modification was added.
- These include:
  - ✓ The jackscrew for expansion
  - ✓ Petrik finger spring for moving individual teeth(upper and lower canine after extraction_)
  - ✓ Springs for labial tipping of loer incisors
  - ✓ Proclining springs for class II div 2 cases

H) ELASTIC OPEN ACTIVATOR

- The elastic open activator resemble the bionator, with acrylic anteriorly and with more wires.
- The bionator though free movable in the oral cavity, is carefully stabilized on posterior occlusal surfaces or lower incisors as the occasion demands.
- Completely lacks such stabilization and thus its vertical mobility in the mouth is unimpeded.
- Mode of action:
  - ✓ The appliance will react to most of the tongue movements and so it must “come to terms” with the tongue
  - ✓ In this manner, a great number of impulses are transmitted to the teeth,serving as the basis for transformation changes.

I)STANDARD EOA

a. Bilateral acrylic parts, an upper and lower labial wire, a palatal arch and guiding wires for upper and lower incisors.
b. The acrylic parts extend from the canine posteriorly to the point just behind the first or second permanent molar if it is present.
c. The acrylic is quite thin in order to leave the largest possible spaces for the tongue stabilization of acrylic position is accomplished by means of contact with the lingual surfaces of maxillary and mandibular canines.
d. Relieve the crowding

e. To relieve the crowding of maxillary labial wire was omitted, with the other half being used to engage the incisor.on this side, the guiding wire was used only foe the opposite sides.
f. Space maintainers
g. For example ,the second deciduous molar has been lost prematurely. Its space is maintained by an extension of contiguous acrylic;with the flat acrylic surface a double wire is placed mesial to first molar and distal to first deciduous molars.
h. Class II div 1 malocclusion
    a. construction bite
    b. with an overjet as large as 10mm, it is usually possible to get the incisors in to an edge to edge bite.
    c. No TMJ problems, even after such extensive forward positioning of the mandible.

i. Class III malocclusion

    a. Construction bite
    b. Edge to edge bite of the incisors or most retruded mandibular position.
    c. The maxillary labial wire carries lip pads similar to those of frankel appliance

J . Unilateral crossbite

a. Construction bite
b. Bite with slight over correction of the midline is advantageous.
c. The acrylic closely follows the teeth, except in mandibular part that approximates the teeth in cross bite.

J)KINETOR STOCKFISH ACTIVATOR

- Stockfish- elastic activator—semi double plate appliance with latex tubing between the upper and lower components to stimulate function.
- Elastic appliance isotonic muscle contraction -less force magnitude-less effective
- Longer wearing time-efficient

K)Hamilton Expansion Activator

This type of activator was designed by Hamilton who used the expansion of an arch in this approach. The appliance has a screw in the middle for expansion. The activator is bonded to the maxillary arch and the forward guidance of the mandible can happen due to the lingual flanges of the appliance. This type of appliance is used in non-compliant patients.

L)Stockli-Teuscher Approach

In this type of approach, we can see that the inner bows are completely embedded in the labial side of the maxillary splint. The outer arms are bent upwards depending on the angle that is desired for the occlusal plane.

M)Hickam Approach

He placed the hooks on the labial bow to receive the J hook headgear.

BIONATOR

CHAPTER:4 BIONATOR

4.1 INTRODUCTION

Bionator appliance is an Orthodontic functional appliance that was used to correct different malocclusions in orthodontics. The appliance was developed by Wilhelm Balters and it was designed to be a daytime appliance and less bulky compared to the Activator appliance. The appliance was primarily designed to be used in Class 2 Division 1 malocclusions. Bionator appliance was created due to the fact that 50 years of use of Activator appliance made it to too bulky for patient's to be compliant with their orthodontic treatment.

The Bionator I is a removable functional appliance used to treat patients with a Class II malocclusion and a deep bite. While the appliance holds the mandible in a protruded position with acrylic, there is no coverage of the posterior teeth. Instead there are fluted channels angled facially cut into the acrylic that guide the eruption of posterior teeth. This allows for the correction of a deep bite while also expanding the arches dentally. An acrylic cap covers the mandibular incisors and the maxillary incisors contact this cap on a flat plane. This prevents the undesirable eruption of the anterior teeth while also controlling flaring of the mandibular incisors which can occur as a result of the forces exerted on the mandible. There is no acrylic in the palatal vault to allow the proper positioning of the tongue. An omega loop coffin spring joins the two halves across the palate for rigidity and can be activated for lateral expansion of the appliance if an optional expansion screw located on the midline lingual to the lower anteriors is utilized.

.


Since the early 20th century, functional appliance therapy has been a significant part of orthodontic treatment, especially in Europe, where functional appliances have been used to treat many malocclusions, including some skeletal discrepancies. Although the success of functional appliance therapy as reported in numerous short-term studies from 1930 to 1975 led to an euphoric acceptance of this method, the few long-term studies, especially those comparing treated with untreated homogeneous control groups, indicated that the specific skeletal and dentoalveolar effects depended on the individual growth period and pattern of the patient. In this article, a specific functional appliance, the Bionator, is presented. Long-term fol low-up studies provide indications for its use.-- At the present time, functional orthopedic appliance therapy has a more limited but well-defined place in our therapeutic approach. The type and character of the malocclusion determines the indications and contraindictions of the functional appliance. Scientific and clinical experience has shown the importance of a differential diagnosis for each patient, which integrates etiology and morphogenesis in the individual treatment objectives for special skeletal, dentoalveolar, and functional regions. Individualization in the construction of the appliance, taking the above-mentioned factors into consideration, is essential for optimal clinical results.

One type of functional appliance that has been used in our office for years is the **Bionator**. There are other types (the Twin Block, the Frankel, the Herbst, etc.) that also may be used, all with different treatment goals and varying degrees of success. **Bionators** are used primarily for those patients who have a short lower jaw, excessive deep bite, or both. **Bionators** are usually adjusted every 2-3 months and are worn 20 hours per day for 6-18 months. As treatment success progresses, the hours per day are reduced. Speech is influenced initially, however, after a week, speech will greatly improve. The appliance is removable and is removed when playing sports, musical instruments, brushing, eating, etc.

Often, a **Bionator** in combination with a neckgear. Both types of appliances are utilized in skeletally deficient lower jaw cases effectively promoting a more balanced upper and lower jaw relationship. **Bionators** are worn prior to full braces in order to address the skeletal deficiency first. They are most effective during the greatest growth period for children (9-12 years old). Following the improvement of the skeletal discrepancy, comprehensive orthodontics will be initiated.


Functional appliances such as Bionator have been used to treat Class II malocclusion. The purpose of this study was to compare the skeletal, dental and soft tissue effects of Bionator appliances with Multi-P (a newly developed appliance) in the treatment of Class II malocclusion.

Methods and Materials: class II children were chosen and randomly assigned to either the Bionator or Multi-P treatment group. Lateral cephalograms were analyzed at the beginning (To) and at the end of treatment (T1) to evaluate the changes in both groups. The paired t.test and Leven’s test were enrolled for statistical analysis. Results: Reduction of ANB angle was detected in both treatment groups. The Bionator group underwent insignificant greater mandibular advancement as measured by the SNB angle. (P= 0.73) The mandibular plane angle increased insignificantly in both groups. (P> 0.05) The inclination of upper incisors decreased significantly in Multi-P group. (P= 0.04)

Conclusion: Both appliances are effective therapeutic means for class II treatment associated with mandibular deficiency and may lead to normalization of the dentoskeletal parameters at the end of the treatment.

The Bionator is a removable appliance used to help correct an “overbite” by promoting lower jaw growth. In cases where it is appropriate to use this appliance, it will be part of the beginning phase of orthodontic treatment. Since a Bionator is primarily an orthopedic appliance, which influences the growth of bone, the appliance should be used during a period of maximum growth. Generally, the younger the patient's age when it is used, the more change observed over a period of growth. If the patient doesn't grow during use of the Bionator, only changes in tooth position will be seen. When a patient reaches the stage we call skeletal maturity, this appliance is no longer effective at influencing jaw growth.

4.2 PRINCIPLES OF BIONATOR

a. Less bulky than activator
b. The essential part of robin’s concept is function whereas for balter’s it is the tongue .

4.3 History

This appliance was developed by Wilhelm Balters in 1950s. The idea behind developing this appliance was to increase patient’s comfort and facilitate daytime wear to increase functional use of appliance. Thus the appliance could be used both night and day time. This appliance was developed at the same time as the Bimler Appliance which was known as the skeletonize version of Activator appliance

The bionator and other functional appliances of the early 1950s

In 1950, Wilhelm Balters (1893-1973), in an effort totreat Class II malocclusions characterized by deficientmandibles, began to modify Andresen's activator. He gave it the name *bionator*. It is indicated for patients with favorable facial growth patterns and is designed to produce forward positioning of the mandible. As with the function regulator, the bionator is available in 3 designs.

Consisting of 2 halves connected by a Coffin spring, it is less restrictive of speech than Andresen's appliance. However, the treatment also highly depends on patient compliance, especially with regard to exercising.

In 1952, Hans Mühlemann created the propulsor. It was based on the activator, but it lacked the metal elements. The propulsor was later perfected by Hotz. About a year later, Leopold Petrik (1902-65) introduced an activator having greater occlusal thickness to increase the vertical dimension, and Hugo Stockfisch (1914-) came out with his kinetor. This device consisted of 2 movable plates connected by wire buccinators loops, which keep muscle pressure away from the cheeks. An unusual feature of the kinetor was the elastic tubes between the 2 plates that acted not only as shock absorbers but also as a means of broadening and optimizing orofacial muscle pressures.

The Balters' Bionator

is one of the most commonlyused appliances for functional treatment of class-II, division1 malocclusions associated with mandibular retrusion. Thepopularity of this appliance is due in part to a number of favorable characteristics that include the relative ease in theconstruction and clinical handling of the appliance and thehigh level of comfort for the patient, who usually showspositive acceptance and compliance. The generic termBionator, as a matter of fact, describes a ''family'' of tooth-borne appliances that produce a forward positioning of themandible in association with variable effects in the verticalplane, ie, open, close, or maintain the bite.

After its introduction in 1964, the Bionator has been theobject of several investigations aimed to identify both thedentoalveolar and skeletal effects of this appliance. Most studies dealt with short-term outcomes of Bionator therapyby using various types of control groups (untreated class-Ior class-II subjects).

Dentoalveolar changes consist of maxillary incisor re-traction and uprighting, associated with proclination of the lower incisors (when capping of these teeth is not used).An increase in mandibular molar eruption caused by ad- justments in the eruption facets of the appliance has beendocumented as well.

4.4Method of Action

Balters believed that tongue is the center of reflex in the oral cavity. This appliance was also loose fitting which allowed children to speak normally immediately compared to activator appliance which took a long time for patients to get adjusted with their pronunciation. He believed that any abnormal activity of the tongue could lead to deformation of the dental arches and mandibular growth. Thus Balters believed that the equilibrium between the tongue and the circumoral muscles was responsible for any normal and abnormal malocclusions.

This appliance does not take make allowances for facial pattern and growth direction, like activator does. It is believed that high construction bite could impair tongue function and patient can develop tongue thrust habit. Myotatic reflex activity with isotonic muscle contraction is stimulated and this loose appliance works with kinetic energy, just like activator appliance. Bionator focuses on tongue and Frankel appliance focuses on neuromuscular component of the mouth.

4.5 Components

The appliance consists of parts below

- Acrylic - The acrylic in the lower arch is a horseshoe shaped acrylic lingual plate extending from distal of last erupted molar. In the upper part, posterior lingual extensions covered the premolar and molar areas. Anterior portion is open canine to canine to allow proper tongue function.
- Labial Bow - This wire was placed 1mm away from front incisors and it runs from canine to canine anteriorly. Posteriorly, it runs from distal of 1st molar where it becomes vestibular wire with buccinator loops
- Buccinator Loops - The loops were designed to keep away soft tissue of cheeks to prevent the inhibitory influence of the muscle.
- Palatal Bar - The bar emerges from acrylic and forms a loops and inserts on opposite side of arch. The wire is 1mm away from palate, with the loop toward distal of the arch. It is designed to touch dorsal surface of tongue and postures tongue forward.

4.6Trimming

Since the volume of the appliance is already reduced from activator, the anchorage of this appliance was a major concern. Balters introduced the following terms when it comes to trimming

- Articular Plane
- Loading Area
- Tooth Bed
- Nose
- Ledge

  - Articular plane- this plane extends from the tips of the cusps of the upper 1st molars,premolars and canines to the mesial margins of the central incisors,running parallel to the ala-tragal line used to assess the mode of trimming
  - Loading area- palatal or lingual cusps of the deciduous molars (or premolars) are relieved in the acrylic part of the appliance , the grinding enhances the anchorage of the appliance.
  - Tooth bed- some parts of the loading areas are trimmed away to the articular plane.
  - Nose –between tooth bed interdental acrylic fingerlike projections
    They serve as guiding surfaces and provide anchorage in the sagittal and vertical plane.
    Nose mostly on the mesial margin of lower 1st permanent molar.
  - Ledge-depending on the thhth movement requirethe acrylic is trimmed and the nose is reduced.
    This reduced extension placed only on the occlussal third of the interdental area is called a ledge.
    Ledges are between premolars or decicuous molars.

Ascher in 1968, proposed different types of anchorage based on deciduous teeth.

SELECTIVE TRIMMIMG

For extrusion of posterior teeth

1. Acrylic left between level of artivular palne-tooth bed
    - Upper and lower molars trimmed first
    - Then lower premolar's trimmed while molars loaded
    - Then upper premolar's unloadd while lower premolar's and molar loaded.
    - Occlusal surfaces of bionator trimmed for transverse movement
    - For intrusion in case of open bite posterior teeth are fully loaded.

4.7 Types

Standard Bionator

The standard appliance was used for treatment of Class II division I correcting the backward position of the tongue. It was also used for treatment of narrow dental arches of Class I to stimulate tongue function and to increase the volume or mass of the tongue and achieve lip closure.

Consists of

a. Acrylic components— lower horse shoe shaped acrylic lingual plate from distal of the erupted molar of one side to other side

    Upper arch lingual extension that cover molar and premolar region

b. Wire components---

- ✓ Palatal bar

    1. 1-2mm wire
    2. Extents from a line connecting distal surface of first permanent molars to middle of 1st premolars
    3. 1 mm away from palatal mucosa
    4. FUNCTIONS- orients the tongue and mandible anteriorly by stimulating its dorsal surface with palatal bar.

- ✓ Labial bow with buccal extension

    - ➢ Labial bow

        1. 0.9 mm wire

2. Begins above contact point between canine and upper 1st premolar- bruns vertically
3. Labial portion of bow should be at a paper thickness away from the incisors.

Anterior part –labial bow

Lateral part—buccinator bends

Objectives of buccinator bends

- To keep soft tissues away from the cheeks—so that bite is leveled and eruption proceed in buccal segment
- Moves cheeks laterally, which favor expansion or transverse development of dentition.

Class III Bionator

- The appliance was designed to correct the forward positioning of the tongue by bringing the tongue backward. Thus, the palatal bow is curved mesially as opposed distally in traditional. This allows tongue to fall back and encourage the forward growth of the maxillary area. In this type of appliance, the acrylic is trimmed behind lower teeth by 1mm to allow lingual tipping of lower incisors. Encourage development of maxilla .bite opened 2 mm for this purpose

- Contains

  - Acrylic portion

    1. Extends incisally from canine to canine behind the upper incisors.
    2. Acrylic is trimmed away by 1mm behind the lower incisors.

  - Palatal bar

    1. Runs forward with loop as far as deciduous 1st molar or premolar
    2. Function- tongue to contact anterior portion of palate,encouraging forward growth of this area.

3. In front of lower incisors
4. Wire slightly touches the labial surface lightly / it is at a paper thickness away.

Open Bite Bionator

- ❖ This appliance is constructed to correct the abnormal position of the tongue. Thus, the palatal and vestibular wires are same as traditional appliance. The labial bow is placed at the height of correct lip closure to stimulate lip to achieve a competent seal. The construction bite is as low as possible.
- ❖ Purpose of this appliance is to close the anterior space.
- ❖ Contains –

1. acrylic part

the lower lingual part extends into the upper incisor region as a lingual shield,closing the anterior space without touching the upper teeth .

2. labial bow runs between the upper and lower incisors nat the height of lip closure.

4.8 Bio M-S Appliance

This modification was done by Erich and Annette Fleisher. In this appliance the acrylic was reduced in size and a lower bite plane was included which was made out of metal wires to correct the deep bite. The transpalatal bar opens in the distal direction as Class III appliance. It had separate maxillary and mandibular labial bow wire.

4.9 Indications

- Dental Arches are originally well aligned
- Mandible is in posterior rest position
- Skeletal discrepancy is not severe
- Labial tipping of upper incisors is not evident
- Deep bite with accentuated c.o.s
- Class III where reverse bionator can be used
- Open bite

Some of the disadvantages of this appliance is easier distortion when in the mouth. If the appliance is used in a patient with severe skeletal deformity, then the change of tongue function is secondary compared to the skeletal deformity. The indications for this appliance are reduced due to no allowance for vertical component, unlike other appliances such as Twin-Block or Activator.

4.10 CONTRAINDICATIONS

- Class II – if caused by maxillary prognathism
- Vertical growth pattern
- Labial tipping of mandibular incisors

4.11 ADVANTAGES

a. Reduced size
b. It can be worn both day and night
c. Action faster than activator – unfavourable forces are avoided acting on dentition for longer time
d. Constant wear so more rapid adjustment of musculature.

4.12 DISADVANTAGES

a. Difficulty in managing it
b. Difficult to stabilize and selective grinding of the appliance.
c. It is vulnerable to distortion-because less support in the alveolar and incisal region.

4.13 CONSTRUCTION BITE

OBJECTIVE

- To achieve a class I relation
- Edge to edge relation of incisors – to provide maximum functional space for tongue
- If overjet is too large- step by step procedure is followed.
    - Construction bite in Open Bite Bionator

      Constuction bite is as low as possible with a slight opening for interposition of posterior bite blocks to prevent their eruption.
    - Construction bite in reverse bionator

It is taken in more retruded position so as to allow labial mocement of maxillary incisors and also to exert restrictive force on lower arch.

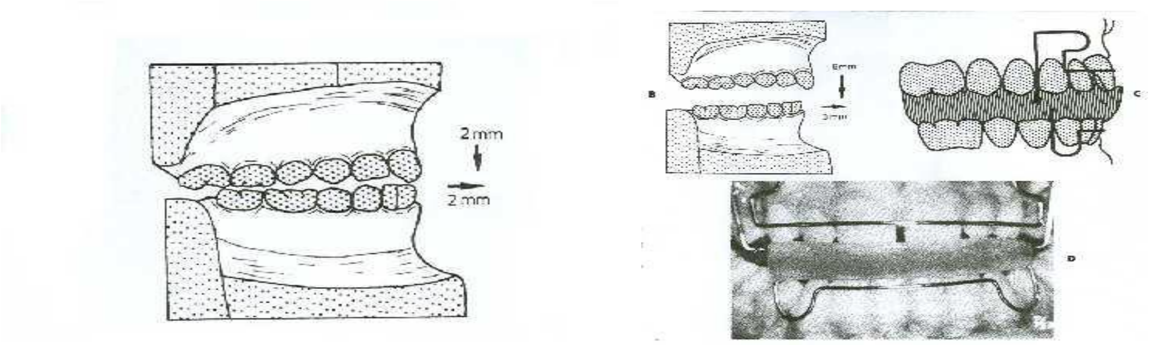


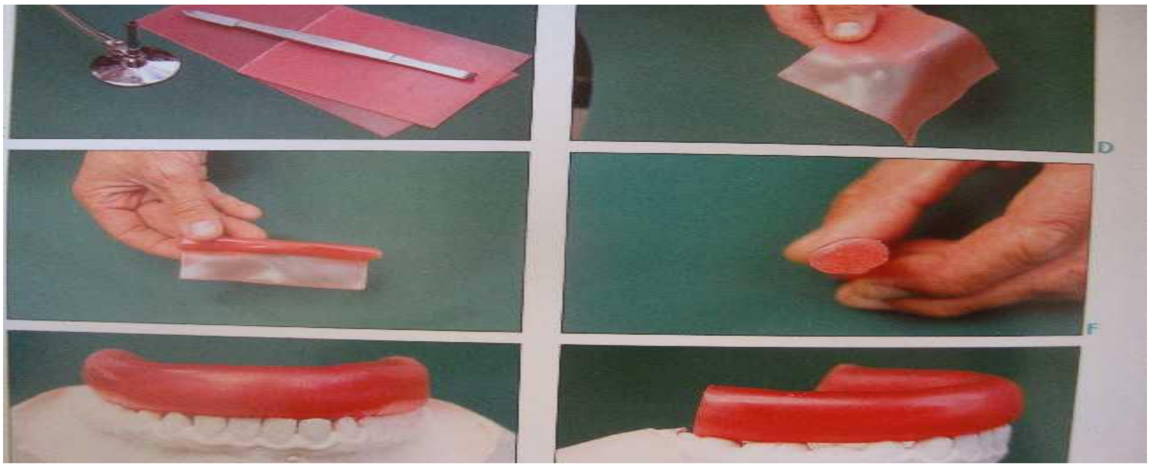
Fig: Edge to Edge

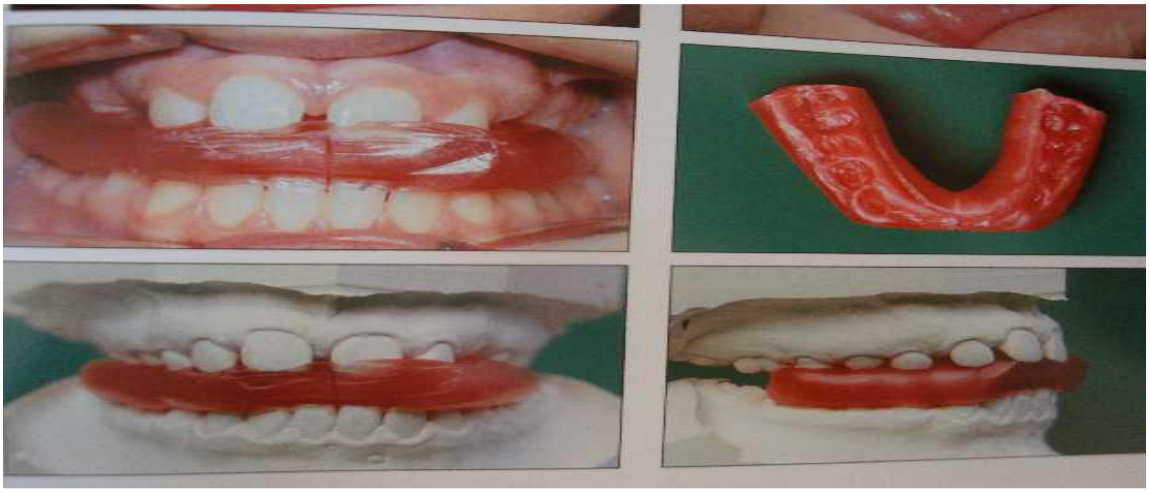
Construction bite

Two thirds of a red wax sheet is warmed by a flame/in hot water.

The soft wax is rolled and fitted on the recently obtained mandibular dental cast.

The patient occludes in the wax roll, positioned at the mandibular teeth – anterior position! (under guidance).





4.14 CEPHALOMETRIC CHANGES DURING TREATMENT OF THE OPEN BITE BIONATOR

Lateral cephalometric radiographs of patients who were treated with an open bite bionator, also known as a “bionator to close the bite,” were obtained from six private orthodontic practices. Comparisons of pretreatment cephalometric values with published standards indicate that clinicians do not generally use this appliance for patients who have marked excessive anterior vertical dimension. Rather, the cases appear to be Class II with mild anterior open bites or with some indication of open bite tendency, such as a steep mandibular plane angle. Changes in cephalometric values during treatment with the appliance were compared with normal growth standards. Patients exhibited a reduction in facial convexity and overjet, reduced eruption of maxillary molars, and less of an increase in facial height than expected. The appliance appears to be effective for Class II correction in patients who require control or improvement of moderately excessive vertical dimension.

Morphometric analysis of treatment effects of the Balters bionator in growing Class II patients. Lateral cephalograms have become one of the major diagnostic tools in the study of facial growth changes and modifications induced by orthodontic/orthopedic treatment. ***Conventional cephalometrics*** enables identification of skeletal, dental, and soft tissue problems in patients with malocclusions in addition to being still widely employed to evaluate angular and linear measures. Although conventional cephalometric analysis (CCA) is individualized, it does not always prove effective in determining accurately the location and mode in which changes in shape and size occur within the craniofacial complex. Thus, CCA has no theoretical foundation, but it is rather governed by conventions involving points and planes, which fail to capture curvilinear forms and changes in theseforms.

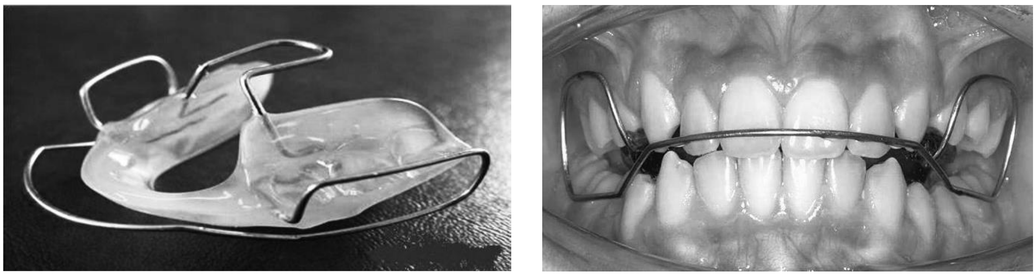


Fig: Standard or Class II Balters bionator

As science evolved, geometric morphometrics emerged5 as an alternative method to address these issues and eventually overcome the difficulties posed by CCA. One such alternative is thin-plate spline (TPS) analysis that assesses spatial changes in the shape of complex skeletal structures, affording reliable graphic and mathematical representations. TPS does not require any reference or superimposition planes. This morphometric analysis quantitatively evaluates changes in shape, expressing the differences between the configurations of two reference points as a continuous deformation. It also allows the construction of transformation grids that capture differences in form, enabling a more effective visual interpretation.Thus, TPS allows precise viewing of the set of changes occurring in facial skeletal structures. These morphometric methods can shed light on the skeletal effects arising from the use of orthopedic appliances in the treatment of malocclusions. Among different therapies available to treat Class II malocclusion, the Balters bionator is a functional appliance designed and introduced by Wilhelm Balters in the 1960s. The bionator moves the mandible anteriorly so that over time a new postural position of the lower arch is achieved, improving the maxillomandibular relationship.While short-term and long-term effects of the bionator appliance on Class II division 1 malocclusion have been previously investigated,16–18 the CCA methods used in those studies do now allow understanding of the changes in mandibular morphology (shape) that occur with bionator therapy. The aim of this study, therefore, was to investigate the effects of the standard (Class II) Balters bionator in the treatment of patients with Class II malocclusion with mandibular retrusion using TPS analysis.

4.15 MATERIALS AND METHODS

The cephalometric records with Class II malocclusion with mandibular retrusion consecutively treated with the Balters bionator (bionator group, BG) were collected from a single orthodontic practice. All subjects were either in mixed dentition or in early permanent dentition. Inclusion criteria for the sample in this group were based on the following factors: individuals with a diagnosis of Class II malocclusion with mandibular retrusion determined by cephalometric analysis of Ricketts et al. and Schwarz, modified by Faltin et al., and orthopedic therapy performed exclusively with the standard (Class II) Balters bionator (without coverage of the lower incisors). Lateral cephalograms were available at the start of treatment (T0, mean age 10.3 years 6 1.2 years) and at the end of treatment with the functional appliance (T1, 13 years 6 2.1 years). Mean treatment time was 2 years and 2 months. Patient compliance and treatment success were not considered as inclusion criteria so that sample selection was conducted irrespective of clinical results.

The following homologous landmarks were digitized on the lateral films using TPS software : point Na (nasion), point Se (sella turcica), point Po (porion), point Co (center of the condyle), point Pt (superior pterygoid point), point Or (orbitale), point ANS (anterior nasal spine), point PNS (posterior nasal spine), point A (A), point A1 (incisal of upper central incisor), point B1 (incisal of lower central incisor) , point R1 (apex of the root of the upper central incisor), point BR1 (apex of the root of the lower central incisor), point Pm (protuberance menti), point Pg (pogonion), point Go (gonion), point A6 (distal upper first molar superior), point B6 (distal lower first molar), and pointMe (menton) . This is a superimposition method where shapes defined by the configuration of anatomic homologous landmarks are compared through various optimization criteria. It involves translation (centralization of anatomic landmark configuration), rotation (rotation of alllandmark configurations to minimize the distance between them), and scaling (standardization of landmark configuration based on the centroid size).

Superimposition parameters are determined so as to minimize the sum of squares of distances between points in each configuration and their corresponding reference points. Any sample specimen or mean sample configuration (consensus) can act as reference.

For each anatomic landmark, the Procrustes residual is the difference between the position of the specimens' anatomic landmarks and the position of the homologous anatomic landmark in the consensus.

The matrix of Procrustes residuals can be used for any statistical procedure.

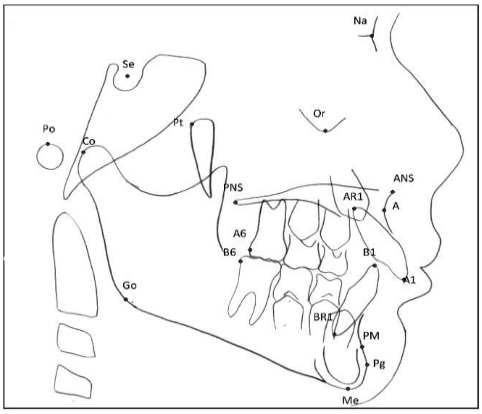
Statistical analysis of shape differences was performed by means of permutation tests with 1000 random permutations on Goodall F statistics . Differences in size (centroid size analysis) at the two developmental phases were tested by means of Mann-Whitney U-test for longitudinal comparisons.

RESULTS: No significant shape differences were found .The resultsfrom centroid size analysis did not reveal any significant difference in size difference between the BG and CG. This difference could be described graphically by a marked extension in the horizontal axis in the region of the mandibular symphysis and in the middle portion of the mandible between the condyle and the symphysis. A slight extension on both the horizontal and vertical axes could be recorded at the gonial angle. A constriction on the horizontal axis in the region of the upper incisors was also evident.

DISCUSSION: Many studies that investigated the dentoskeletal effects produced by the bionator appliance in patients with Class II, division 1 malocclusion,but they all used CCA. CCA cannot analyze adequately the shape detail demonstrated by the cephalogram, and, therefore, it is not capable of fully evaluating craniofacial form (size + shape). The univariate analysis of linear measurements mostly reflect variation of size rather than shape. Angles are size dependent, but they cover large aspects of the craniofacial complex, failing to describe the information within the included angle.Geometric morphometric analysis (eg, elliptic Geometric morphometric methods are being developed to measure changes in biological size and shape caused by growth and orthopedic treatment. It enables easy, comprehensible viewing of changes in shape while clearly highlighting the region where these changes occur. TPS analysis expresses the difference between two average landmark configurations through transformation grids and continuously models the deformation of a given shape into another using a regression function. It also allows performing statistical analysis of the shape change.
The present study compared the shape and size differences in a Class II sample treated with the bionator vs an untreated Class II control group by using TPS and centroid size analyses. The bionator induced significant shape changes in the mandible that could be described as a mandibular forward and downward displacement.This mandibular displacement was more evident at themandibular symphysis as it was associated with a mandibular elongation that was depicted by a horizontal extension of the grid in the middle portion of the mandible between the condyle and the symphysis.
Lux et al. found that the correction of the Class II problem was sustained mainly by a strong dentoalveolar component with retroclination of the upper incisors and proclination of the lower incisors. As in Lux et al., a constriction in the region of the upper incisors indicating a retroclination of these teeth was found. However, it should be emphasized that in the standard Balters bionator used in our study, the buccal shield does not touch the upper incisors and does not have inferior incisal coverage which can play a role in dental compensation rather than orthopedic correction.. Consequently, no significant improvement in the dentoskeletal Class II relationships was evident in the CG. appliance (the only other nontooth supported functional orthopedic appliance) for about 24 months. They compared their results with matched untreated Class II malocclusions using both conventional and geometric cephalometric analyses (tensor analysis). This study found that the advancement of the mandible along the direction of the

facial axis resulted in increases in mandibular length and in vertical facial dimensions with minimal anterior tipping of the lower incisor and significant posterior tipping of the upper incisor. Three-dimensional geometric morphometrics revealed that Fra¨nkel appliance therapy at the beginning of the adolescent growth spurt produced significantly more forward and vertically increased rami in the treated group than in the control group.

CONCLUSIONS: Treatment with the bionator is able to produce significant shape changes that are characterized by aforward and downward displacement of the mandibleassociated with mandibular elongation. These shape changes contributed significantly to the dentoskeletal correction of the Class II dentoskeletal imbalance. These findings confirm the effectiveness of functional jaw orthopedics in the treatment of patients with Class II malocclusion associated with mandibular retrusion.



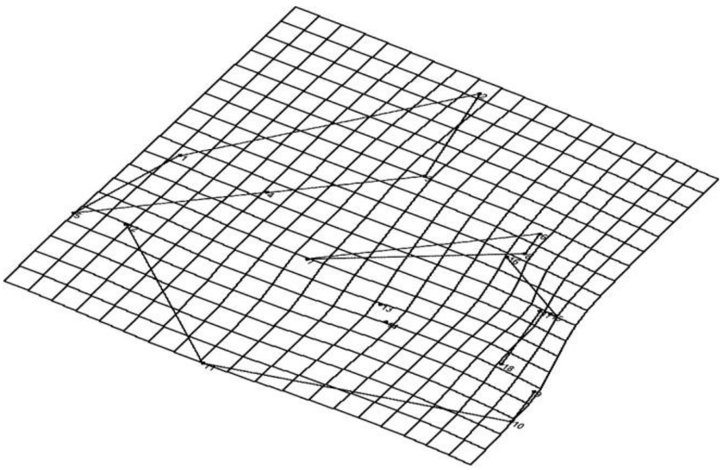
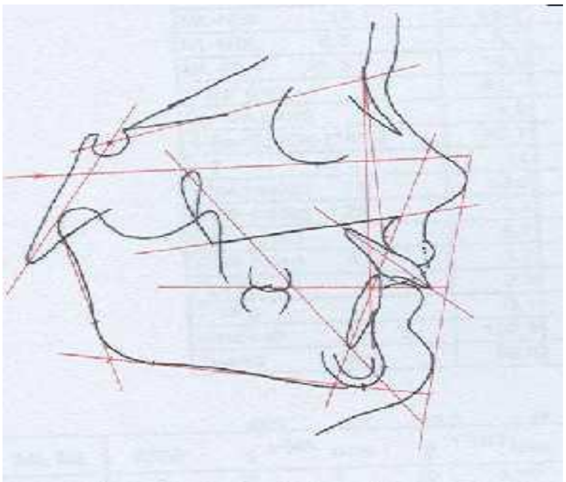


Fig:TPS graphical display of shape differences between T0 and T1 in the bionator group



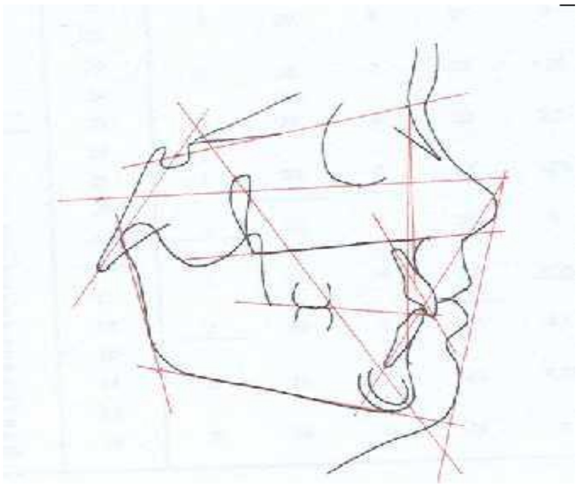


Fig: BEFORE TREATMENT AFTER TREATMENT

4.16 MODIFICATIONS OF BIONATOR

1. MODIFICATION BY WILLIAMSON AND HAMILTON
    a. 3 mm cover for maxillary incisor from L.I TO L.I
    b. This is to secure the position of maxillary incisor
    c. This modification made from construction bite
    d. This also prevents tipping of lower incisors
2. MODIFICATION BY SCHMUTH
    a. Cybernator
    b. Normal labial bow in the maxillary arch- from canine to canine
    c. Mandibular incisors covered with thin 2mm acrylic.
3. BIO-M-S BY ERICH AND ANNETTE FLEISHER MODICATIONS ARE
    a. Acrylic body reduced in size
    b. Instead of long labial bow-maxillary buccolabial arch wire and mandibular labial arch wire
    c. Transpalatal bar opens in distal direction as in class III bionator
    d. Wire spurs used to reinforce anchorage

TWIN BLOCK

CHAPTER:5 TWIN BLOCK

5.1 INTRODUCTION

Twin Block appliances are simple bite blocks that are designed for full-time wear. They achieve rapid functional correction of malocclusion by the transmission of favourable occlusal forces to occlusal inclined planes that cover the posterior teeth. The forces of occlusion are used as the functional mechanism to correct the malocclusion.

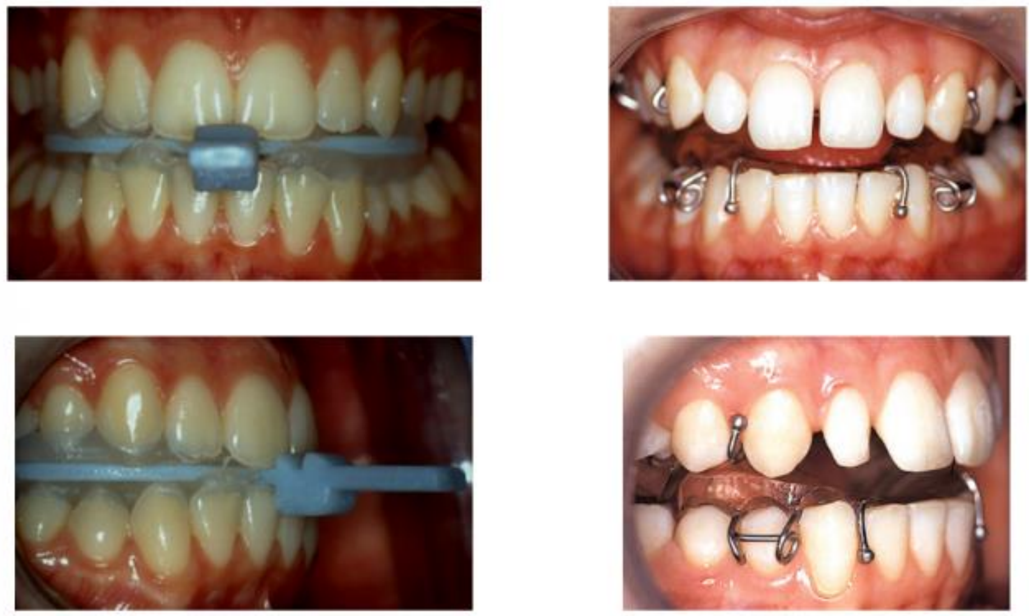


Fig: Twin Block

Class II division 1 malocclusions have been treated for more than a century with different removable functional appliances. A functional appliance is a removable or fixed appliance, which changes the mandible/maxilla interrelationship through forces generated by acrylic or wirework to the dentition and underlying structures. These forces are generated through stretching of muscles, fascia, and/or periosteum. Removable functional appliances can be classified into four groups:

Tooth-borne passive (e.g. Activator, Bass, Bionator)

Tooth-borne active (e.g. Twin Block)

Tissue-borne (e.g. Fränkel)

- Combined (e.g. hybrid appliance)

These distinctive types of removable functional appliances produce changes through different mechanisms, but in essence they create a pattern of function which encourages a new morphological pattern in some of the dental and skeletal facial structures.

The Twin Block is a relatively simple system that uses upper and lower bite blocks. These blocks reposition the mandible and redirect occlusal forces to achieve correction of the malocclusion. They are also relatively comfortable and have good compliance associated with them. There are two phases of treatment with twin block technique, the active phase and the support phase. During the active phase, intra arch form changes are made such as widening and or lengthening. Also included in the active phase are inter arch changes such as class II correction and vertical development. In the support phase, an inclined anterior open bite plane is used to maintain the class II correction and allow for buccal segment development

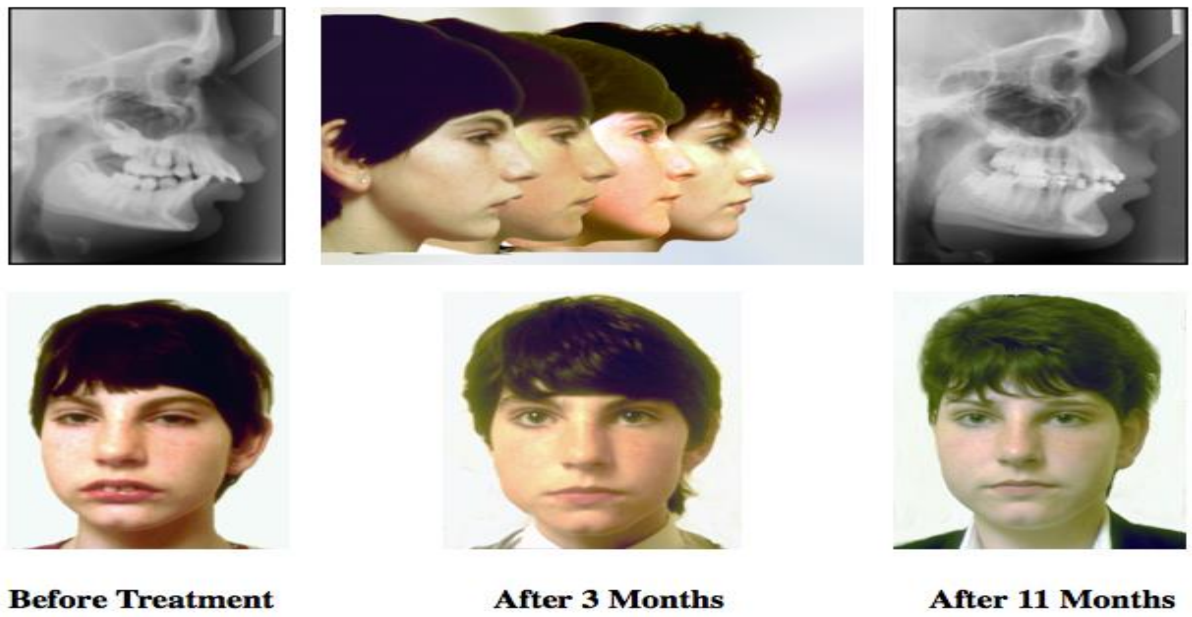


Fig: Treatment changes with time

Before treatment this patient has the typical listless appearance, of many severe Class II division 1 malocclusions, evident in the dull appearance of the eyes and poor skin tone. After only 3 months treatment the patient undergoes a dramatic change in facial appearance. She appears more alert and there is a marked improvement in the eyes and the complexion.

Fig: Twin Block

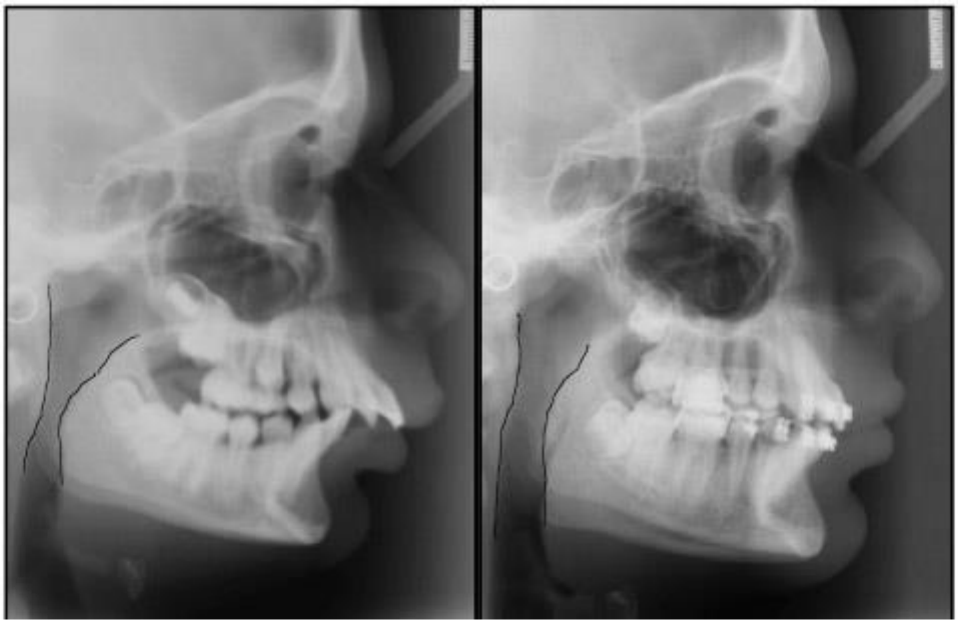
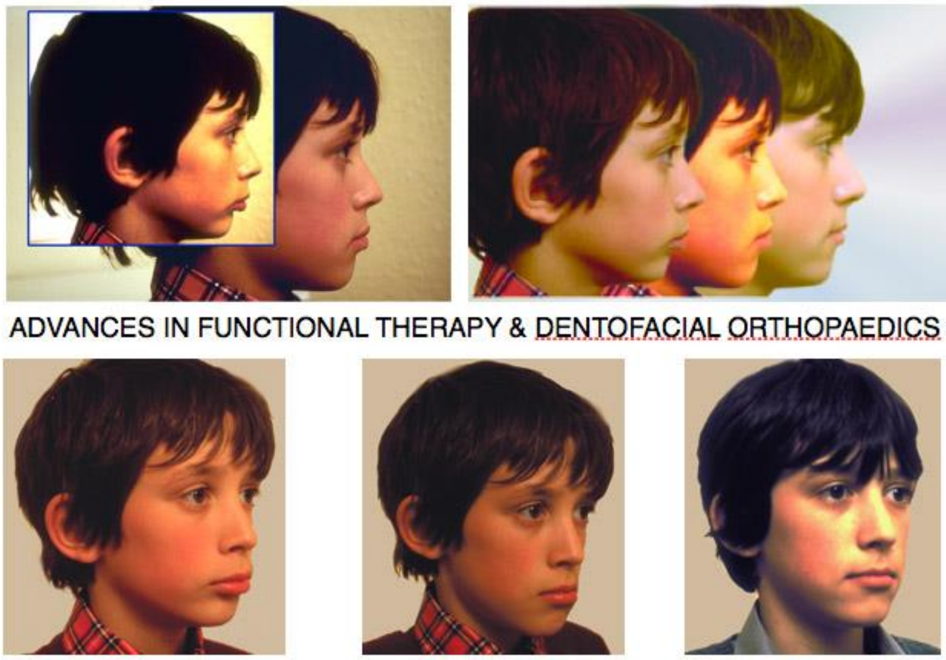


Fig: **Twin Blocks Increase the Airway**

This is a fundamental physiological change, extending beyond the limited objective of correcting a malocclusion.

TYPICAL PROFILE CHANGES AFTER TWIN BLOCK THERAPY

Fig: Dental Views Before & After Treatment



Twin Block Appliance (Functional Appliance)

The Twin Block appliance is a removable, orthodontic functional appliance that is used to help correct jaw alignment, particularly an underdeveloped lower jaw. They work by influencing the growth and development of both the upper and lower jaws. This type of treatment is most effective during a growth spurt. Therefore, it is important to see an orthodontist early to assess the timing of this treatment to avoid missing out on the growth spurt. Every person is an

individual an everybody's growth spurt is different The Twin Block appliance is made up of two plates, one for the upper teeth and one for the lower teeth, which work together to bring the lower jaw forward into a better alignment with the upper jaw and
creating a improved profile.

The appliance holds the lower jaw forward over a period of time (normally 12 months) until the teeth, jaws and joints have "adapted" and the desired jaw position has been obtained. The Twin Block can also be modified for other uses such as the expansion of a narrow arch. This is achieved by incorporating an "expander" in the upper plate, which, over time widens the arch allowing the crowded tooth more room.
Twin Block treatment offers noticeable results and therefore a much better profile. The appliance aligns the jaws but not the teeth, therefore it is considered to be a "first phase" treatment prior to the full orthodontic treatment or braces to align the teeth correctly.

5.2HISTORY

Fig: William Clarck

Dr Clark is the first recipient of an award of distinction from the British Orthodontic Society for an outstanding contribution to the specialty of orthodontics. In 2008 he received the first award from IFUNA for personal outstanding international service to functionalism and orthodontics.

Dr Clark developed the Twin Block Technique in 1977 in his orthodontic practice in Scotland. In 2004 Dr Clark developed invisible TransForce Appliances to correct arch form and align the anterior teeth.

Dr. William Clark, an Orthodontist, developed an uncomplicated technique that incorporates the use of upper and lower bite blocks to reposition the mandible forward for skeletal Class II correction. The Twin Block technique is easy to use and very patient friendly. The design utilizes two separate appliances that fit the maxilla and mandible. The unique design allows for more patient comfort and increased patient cooperation. The Twin Block design also allows for independent development of the upper and lower arches with the addition of transverse and/or sagittal screws.

Fig: Standard Twin Block

Fig: Twin Block to Close

Fig:Sagittal Twin Block

McNamara Twin Block

Dr. James McNamara designed Twin Block includes two upper expansion screws for maxillary arch development. To enhance retention of the lower portion of the appliance a labial bow with acrylic is added to the design. In addition, the lower flanges of acrylic are extended to the molars.

Fig: Functional Appliances: Twin Block Stage II

Once "three-point" contact has been achieved a fixed or removable incline bite plane is used to support Class II correction. The Stage II appliance is used until the bicuspids have erupted into occlusion and the posterior open bite has been closed.



Fig: "Stage II" Fig: Rick-A-Nator Fig: Rick-A-Nator II

The Twin Block Technique® was developed by Qr. William Clark of Scotland during the early 1980's. Dr. Clark lectured and displayed the Technique at the European Orthodontic Meetings throughout this decade. In 1986, Dr. Clark lectured to many of Johns Dental customers and we have been makingthe appliance since.

Twin Block is an uncomplicated system that incorporates the use of upper and lower bite blocks.

These blocks reposition the mandible and redirect occlusal forces to achieve rapid correction of malocclusions. They are also comfortable and the patients wear them full-time—including eating time.

The features of Twin Block mean easier and quicker treatment.

Overview of Treatment

There are two phases of treatment with the Twin Block Technique, the active phase and the support phase. During the active phase, intra arch changes are made such as widening and/or lengthening. Also included in theactive phase are inter-arch changes such as Class II correction and vertical development.

Presents the upper and lower appliances at the first appointment. This buccal view shows the 70 degree interface, the upper pad covering the second bicuspid and the molars, and the lower pad covering the bicuspids.

5 mm of space is required between the upper and lower bicuspids at the interface ramps. This space is needed to maintain the protrusive mandibular position. The occlusal inclined plane changes the function from Class II to Class I during correction.

Presents the upper and lower appliances as they are used for posterior vertical development. This buccal view shows that the upper pad has been gradually relieved to create space - approximately 1/2 to 1 mm per appointment. This is done gradually to keep the tongue from expanding laterally and impeding vertical development of the molars. The lower appliance is the keystone for maintaining the vertical during treatment and should not be relieved. Also, during the acrylic relieving process, the 70 degree interface ramps should not be altered; alteration will interfere with their function.

This illustration does not show the appliance screws. Since vertical takes longer to achieve during treatment than arch width and A-P development, it is important to watch the progress of all three of these factors. Although treatment begins with screw activation and pad relief, arch width and A-P will usually be achieved before vertical development. Consequently, screw activation may stop before all the vertical development has been achieved.

Presents the upper and lower appliances during the final stages of the active treatment phase. This buccal view shows the upper appliance fully relieved; its only function now is to maintain the forward mandibular position. Thelower molars are developing the needed vertical and the pads on the lower appliance are functioning as the keystone for maintaining the vertical.

The active phase ends when there is no further need for the upper and lower appliances. This determination is made with the appliances removed. At that time, observe the anterior segment with the molars in contact.

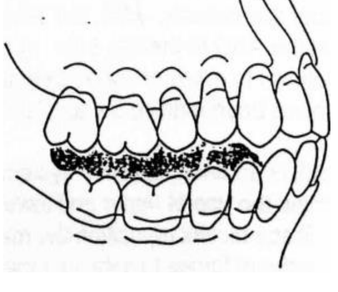
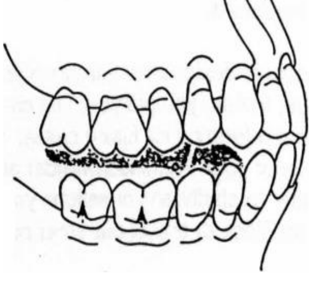
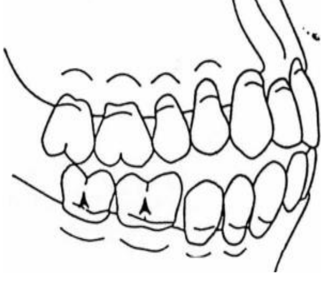
The occlusion presented shows the support phase appliance maintaining the overbite and overjet. This ideal During the support phase, an inclined anterior bite plane appliance is used to maintain the Class II correction.

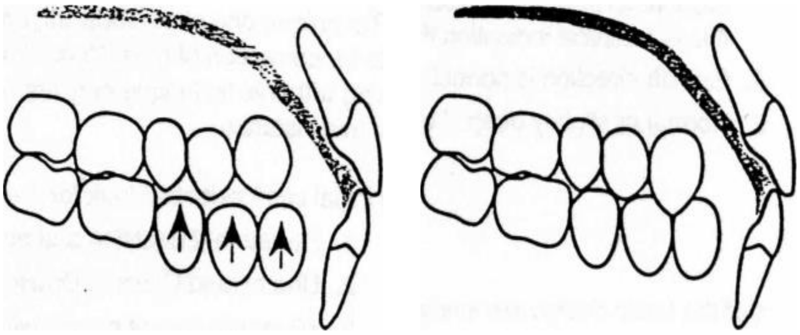
The support phase appliance is designed to allow buccal segment development.

Presents the upper support phase appliance when it is first seated. This buccal view shows the anterior ramp which maintains the mandibular class II correction; the molars now maintain the vertical development.

The lower bicuspids and cuspid are free to erupt into occlusion with the upper arch

Presents the upper support appliance after the patients teeth have settled into full occlusion. The class II correction is complete; the patient has developed into a Class I. The support phase appliance is worn as a retainer for stability.



COMPARISON WITH OTHER FUNCTIONAL APPLIANCES

As seen from the overview, the Twin Block Technique is both simple and effective. Compared to other functional appliances, the Technique stands up as the premier functional treatment modality available.

Esthetics and comfort - patients maintain normal function and appearance because there are no lip, cheek or tongue pads. The patient's appearance is noticeably improved when the appliances are fitted. They look better and feel better about themselves during treatment.

Full time wear - unlike some functional appliances, the Twin Block appliances are not bulky. They are comfortable when sleeping, eating, playing (except swimming) and working. Continuous wear equals continuous application of light physiological forces, the forces that stimulate maximum growth response to correct the skeletal relationship.

All Age Groups - comfort, esthetics, and full-time wear means rapid correction of malocclusions for all age groups. Mixed, transitional and permanent dentition, the Twin Block technique meets the treatment challenges for all ages.

Arch control - with the Twin Block appliances have the advantage of independent control of the upper and lower arch. The benefit is shorter treatment time.

Integrating treatment - integration with conventional fixed braces is simpler than with any other functional appliance.

SELECTING THE FIRST CASE

Like anything new, it takes some time to adjust to Twin Block. It doesn't take long, however, to make the Twin Block.

Technique one of the most important treatment modalities in your practice. The Twin Block technique is suitable for correction of most Class II malocclusions. To avoid complications, however, the practitioner beginning with this technique may first want to consider an ideally suited case. The Basic Twin Block may be used in this instance.

During initial case selection look for the following:

1. Permanent dentition and an active grower

2. Uncrowded Class II, Division I malocclusion with well developed arches

3. 10 mm or less of overjet with normal to deep overbtte - deep overbite is common in these cases

4. During the clinical exam look for improved facial esthetics when the mandible is brought forward to a Class I molar relationship and opened to a normal overbite -this is a clinical indication that the Class II arch relationship is skeletal

5. Growth direction is normal - neither clockwise nor counterclockwise

6. Normal or slightly deep skeletal vertical

5.3 INDICATIONS

The basic indication for the use of twin block is a patient with Class II div I malocclusion. However to avoid complication, the clinician may first want to consider treating ideally suited cases. The following is a good general selection criterion:

1- Permanent dentition and active grower

2- Uncrowded dentition with well developed arches

3- 10mm or less overjet with normal to deep overbite

4- Improved facial esthetics once the mandible is brought forward to class I

5- Normal growth direction

6- Patient is Class II div 2 with limited overjet or Class II div 1 with crowded and irregular incisors, you must align the upper incisors with a fixed or removable appliance before starting a twin bloc. It is recommended to hold the incisors in place for several months before delivering the appliance.

Variations of the basic design are available for a variety of clinical indications.

The Basic Twin Block is indicated for treatment of uncrowded permanent dentition with Class II. Division I malocclusions. It is designed to correct a Class II skeletal relationship, to correct molar relationship and to correct overjet. The function of the appliance brings the lower arch forward. The upper arch is expanded during treatment to accommodate the lower in its new forward position. The Expansion Twin Block is indicated for treatment of deep bite Class II, Division 1 malocclusions where both arches are narrow. Arch widths can be simultaneously expanded with this design. The Sagittal Twin Block is indicated for treatment of Class II, Division II malocclusions. Correction is made by advancing retroclined anteriors and lengthening the arches. Expansion during treatment can also be accomplished with midline screws.

The Mixed Dentition Expansion is indicated for treatment of Class II correction and arch width development vertical development is not normally required at this stage. Case design accommodates changes in dentition.

The Twin Block to Close the Bite is indicated for treatment of Class II correction and anterior open bite. The appliance is designed to allow the anteriors to extrude and to move lingually. Tongue wires are fabricated into this appliance to restrict tongue thrust. The pads are not relieved because posterior vertical development is contraindicated The Twin Block for **Class** III is indicated for treatment of Class III cases. We have designs for both sagittal and expansion of the upper arch. In Class III cases it is important to avoid distalizing the condyle in the fossa. Otherwise,TMJ problems may develop.

5.4 CONTRAINDICATIONS

1. Class II skeletal by maxillary prognathism
2. Vertically directed grower
3. Labial tipping of lower incisors
4. Crowding
5. Very narrow maxilla
6. Skeletal or facial asymmetry

5.5 TIMING OF THE TREATMENT

Cephalometric studies have shown that the therapeutic effectiveness of the most functional appliances is greatest when these appliances are used during the ascending portion of the individual pubertal growth spurt. Typically, patients treated during the peak period demonstrate significant skeletal effects induced by the appliance, whereas patients treated in the pre-peak period have the significant effects confined to the dent alveolar level.

Recent studies have shown that twin-block treatment when a child is in early mixed dentition has no advantages over treatment started at an average of 12 years old (late mixed dentition). However the cost of early treatment of early treatment to the patients in terms of attendance and length of appliance wear is increased.

Major favorable effects induced by functional therapy implemented after the onset of the pubertal peak in growth velocity in comparison with the earlier phases are:

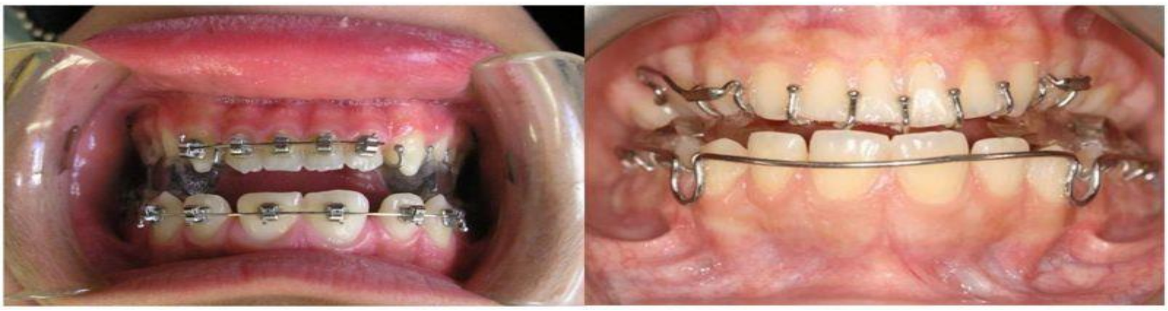
1- Greater skeletal contribution to the correction of the molar relation

2- Larger and clinically significant increments in total mandibular length and in ramus height

3- More posterior direction of condylar growth, a biological mechanism enhancing supplementary mandibular lengthening and reducing the amount of forward condylar displacement in favor of effective mandibular growth and reshaping.

5.6TYPES OF TWIN BLOCKS

Removable Twin Block The removable twin block is a tissue-born functional appliance that is worn fulltime. It helps in the advancement of the mandible. It is a two-piece appliance composed of an upper and lower bite block. Orthopedic traction can be added in cases of severe skeletal discrepancies. This includes the use of a Concord Facebow (or headgear) at nighttime. Opening or closing of the bite can also be controlled with this appliance. Twin blocs have many different designs and can be combined with a fixed brackets.



Fixed Twin Block

The fixed twin block is similar to the removable twin block, but can be used in non-compliant patients. It is similar in design to the Herbst appliance, however the telescopic tubes of the Herbst appliance are replaced with two bite blocks.

Upper The upper part of the twin block is gets its retention from retention clasps such as adams or modified arrow-head clasps. It can incorporate a tube for attachment of a Concord facebow. There is a midline expansion screw which is turned every 10 days to ensure that the upper arch expands at the same rate as the lower arch. Labial and lingual bows can be incorporated to control upper incisor angulation and help with traction, although labial bows risk tipping the upper incisors palatally and are not always recommended.

Lower The lower twin block is retained with 1mm interdental ball clasps in the lower incisor region. The clasping of the lower incisors permits en bloc movement of the dentition, which helps to prevent flaring of the lower incisors. In the mixed dentition, there are clasps also placed on the deciduous molars or first premolars. The lower appliance can split anteriorly, with the two pieces held together with a screw or helical spring. This design helps with expansion and development of the lower arch.

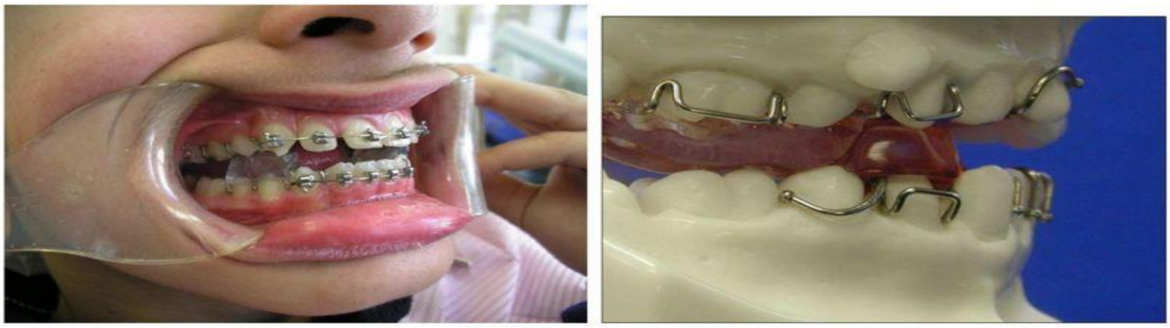


Fig: Twin Block

The bite blocks The bite block on the upper arch covers the lingual cusps of upper posterior teeth, running posteriorly from the mesial marginal ridge of the second premolar. On the mandible, the entire occlusal surface of both premolars is fully covered to compensate for the fact that the mandible is narrower than the maxilla. The upper and lower bite blocks interlock in occlusion and are both inclined 45 degrees.

Facebow A concorde facebow can be worn during the night for 8-10 hours to ensure that the mandible is placed in the right position while sleeping. A curved labial hook is added to a conventional facebow, and an elastic is stretched from this hook to the ball clasps of the lower appliance. This forces the mandible to stay forward and lock in the desired occlusion while sleeping. If additional extra-oral traction is desired, such as in the case of maxillary protrusion or mandibular retrusion, a headstrap can be attached to the facebow (hence making a headgear).

Clinical and Laboratory Steps

- 1. Take an alginate impression of the maxilla and mandible. Ensure that the teeth and lingual area are well captured.
- 2. Take a 'Construction Bite'
  - This is a bite registration with the mandible protruded to its ideal position

  - Multiple layers of wax are melted together. Use the patient's study models to trim the wax to the width of the patient's mouth. When taking the bite registration, avoid soft tissue interference (especially in the retromolar pad region) .
  - Soften the wax in hot water. Direct the patients jaw forward and have them bite into the wax. How much protrusion you will get depends on the ease at which the patient can position his mandible forward. You are trying to move the condyles out of the fossa. If the patient is comfortable, you can advance the jaw up to 10mm .
  - Initial activation can reduce overjet by 5 to 7 mm, and leaves 3 to 5mm of interocclusal clearance in the first premolar region .
    - If your patient has a deep overbite, you can take the construction bite with even more interocclusal clearance so that the appliance will allow the molars to erupt and close the bite
- 3. Send to Laboratory for fabrication of phase I twin bloc.
  - Upper:
    - Retention clasps, midline expansion screw, labial or lingual bow for upper incisor angulation control
    - Bite block covering lingual cusps of maxillary posterior teeth from mesial of 5s
  - Lower:
    - Retention clasps (ball clasps between anteriors, clasps on the primary molars or first permanent molars)
    - Anterior screw/helical spring if in mixed dentition
    - Bite block covering full occlusal surface of both premolars, extending to distal of the second premolar. Leave molars free of coverage in deep bite cases

5.7 LABORATORY REQUIREMENTS

Please provide a prescription outlining your design and treatment goals. The information in this manual describes standard designs and options. Depending on the case requirements, it may be necessary to combine different appliances and components in your designs for either the upper, lower or both arches.

We need upper and lower models free of distortion. Also, please include a construction bite .

In transitional cases or in permanent dentition cases, the first bicuspids should be fully erupted on both arches.

In mixed dentition cases, the D's should have solid roots because they will be used as retention for approximately six months.

5.8 BITE REGISTRATIONS

To insure proper fabrication of the appliance, the laboratory needs a construction bite. The following questions are considered when registering Class I and Class II bites:

1. Can the patient move forward into a comfortable Class I position?

The ideal is Class I or slightly beyond. Patient comfort is important during treatment; it encourages the patient to wear the appliances full time.

2. How much overjet needs to be corrected?

An overjet of 10 mm may be corrected without reactivating the Twin Blocks. Overjets greater than 10 mm normally require increased activation. This is done by the adding cold cure acrylic halfway through treatment.

3. is there enough space to construct adequate interface ramps?

The laboratory needs 5 mm of opening between the upper and lower bicuspids to correctly fabricate the appliances. The success of the 70 degree interface is dependent on this natural freeway space that maintains the interface contact.

4. Where are the midlines?

The skeletal midlines should be aligned.

5. How does the facial profile look?

This may be taken into consideration when reviewing the above factors.

6. In Class 111 construction bites, the mandible should be hinged open to create 5 mm of vertical space between upper and lower bicuspids. Align the skeletal midlines.

5.9 DELIVERING THE APPLIANCES

Phase I: Activation Phase

Appointment 1: Delivery of the twin bloc

1. Place the twin bloc in the mouth and check if the patient is comfortable in the new postural position. At this point, ensure that all posterior teeth are occluding on the bite block.

2. Check if the flanges of the lower appliance lingual to the lower incisors need to be trimmed, so as to avoid irritating the soft tissues.

3. Set the midline screw on the upper appliance to your desired tightness. Instruct the patient to turn the screw once every ten days.

4. If the lower appliance has a screw or helical spring, activate/adjust them.

5. If using a facebow, adjust the Concord Facebow so that it lies just below the level of the upper lip at rest. The outer bow should slant upwards above the level of the inner bow. Show the patient how to attach an elastic from the facebow to the ball clasps in the lower labial area. This should be worn at night time and should help the patient position their jaw forward while sleeping.

6. If using a headgear, adjust the head strap to 200 g of distal force on each side. The patient should wear the strap for 8-10 hours.

7. Since there are no lip, cheek, or tongue pads, appearance of the patient wearing the twin bloc is improved in comparison to other functional appliances. Speaking is also easier than with appliances like the bionator. Inform the patient that there may be some initial discomfort due to the new position of the mandible. For the first three days, the patient can remove the appliance while eating. However, after this point, the appliance should only be removed from the mouth for cleaning after each meal and when brushing the teeth. The patient can remove the appliance when playing sports. A daily fluoride mouthwash can be prescribed .

Recall appointments

Recall appointments should be done every month to check occlusion and to evaluate the correction of the arch relationship.

1. Ensure that the patient is wearing the appliance according to your initial instructions and that the upper screw is being turned once every 10 days.

2. Check incisor inclination and make necessary adjustments with labial/lingual bows

3. You can add resin to the mesial inclines of the upper bite blocks to increase advancement of the jaw as time progresses.

4. Full sagittal arch correction can be expected to be seen in 2-6 months. This should be maintained for another 2-3 months. At this point, correction of a deep bite can be tackled.

a. Overcorrect the sagittal relationship so that incisors are edge to edge. Now, progressively reduce the upper bite block to allow eruption of the lower molars, hence opening the bite

5. At the end of the activation phase, the incisors and molars should be in occlusion. However, the buccal area and premolars will not be in occlusion.

Phase II: Support Phase

The support phase aims to maintain the corrected jaw relationship while the buccal segment and premolars settle in occlusion. The phase II appliance is composed of an upper hawley appliance with an inclined guide plane that is used to ensure forward positioning of the mandible. There is no longer any lower appliance nor any bite blocks.

When wearing this appliance, the buccal segment will be in contact within 4-6 months. The support phase is then continued another 3-6 months to allow the trabecular system to functionally reorient . Headgear is still worn nightly during this phase. The appliance is worn full time, but not when playing sports. It is still removed to be cleaned after meals and when brushing teeth. At the end of the support phase, the patient should be put into retention.

Outcomes of the treatment

Patients with Class II Div I malocclusions can expect to see a rapid change in appearance, for soft-tissue adaptation occurs very quickly (within 2-3 months). The patient will need to adjust to a new lip seal since the mandible will be positioned down and forward.

In the first few days, there is a 'pterygoid response' in which a 'tension zone' is formed distal to the condyle. During this response, the muscle balance is changed and it is painful for the patient to retract the mandible .

Structural alterations take months to come about. Bone remodeling occurs to support the new muscle position. Studies have shown that patients wearing the twin block will have an average of 4.2mm more mandibular growth than control subjects . Since the appliance is tissue born, you're less likely to get dental changes without skeletal changes (such as flaring of the lower incisors). However, some studies still argue that most adaptation is dentoalveolar, and skeletal changes may not be statistically significant .

Changes to be expected include a reduced ANB angle, reduction of overjet, corrected molar relationship, increased lower anterior face height, and reduced facial convexity . Condylar remodeling will occur. The labiomental groove and overjet will be reduced. The lower incisor can be expected to procline in the active phase but upright in the support phase, thus the LI to MPA should have no significant change at the end of treatment

It is important to get treatment started on the right foot. A few minutes used at delivery will prove valuable during the treatment process. Some possible approaches to this educational process include:

1. Fully explain the components and the function of the appliance. Point out the 70 degree inclined planes and " how when inserted the appliance immediately improves the esthetic appearance of the patients face.
2. It should be explained that Twin Blocks achieve correction through the forces of occlusion. It is very important for the patient to wear the appliances full time and to leam how to eat with the appliances in the mouth. Patient hygiene should be explained so that the patient knows how to clean the appliances after each meal.
3. Prior to insertion, tell the patient about the improved facial esthetics they'll notice when the appliances are fitted.
After fitting, tell the patient that to permanently achieve the facial esthetics, they will need to wear the appliances full-time throughout treatment. It is helpful for the patient to see Polaroid photography of the profile prior to and after fitting the appliance.
4. Although the appliances will feel bulky initially to the patient, they will feel comfortable in a few days.
5. Adjust the clasps to secure the appliance without impinging on the gingival tissue. If a labial bow is present it should be out of contact with the upper incisors. The patient should be able to bite comfortably in the preclusive position and the teeth should contact evenly on the pads. The next appointment time is in 1 week.

Adjustment Guidelines

The purpose of adjustments is to maintain the function of the appliances and to insure patient comfort

The first visit

Adjust the clasps to hold the appliances securely in position without impinging on the gingival tissue. If a labial bow is present, it should not be contacting the upper incisors.

The second visit

By now, it's normal for the patient to be wearing the appliances comfortably full time including when eating.

Compliment the patient for becoming accustomed to the appliance so quickly and give reassurance if there are any difficulties. Now is the time to inform the patient and parent about the procedures for turning appliance screws

When the appliance is worn full time, improved facial muscle balance is evident during early stages of treatment.

Help the patient and parent see this as an encouraging sign of early progress.

Possible other adjustments for the second visit are:

In cases with deep overbite, the posterior section of the upper block should be trimmed to leave the lower molars 1/2 to 1 mm clear of the occlusion. This will allow molar eruption for vertical development.

In anterior open bite cases it is very important that no trimming be done on the blocks. All posterior teeth must then remain in contact with the blocks to prevent eruption of posterior teeth.

In skeletal open bite cases molar contact must be maintained. At each visit check to make sure the patient is not opening beyond the freeway space. The bite blocks will ride on occlusal surfaces instead of the 70 degree interface, the mandible will retrude and excess vertical will develop.

In TMJ cases where posterior support is important and vertical development is needed, relieving the second molar contact to achieve vertical development is not advisable. Instead, relieve contact for the first molar and allow it to come into contact and give support at the desired vertical. Some acrylic may need to be added in the first molar area to provide stability as it functions as the vertical posterior stop. Relieve the second molar afterward until it also reaches the desired vertical. This procedure allows you to maintain the needed posterior support during treatment to avoid TMJ complications.

The third visit

Positive progress should now be noted in facial muscle balance and this should be confirmed in a reduction in overjet measured intraorally with the mandible fully retracted.

Minor adjustment is necessary to keep the labial bow out of contact with the upper incisors, and to ensure that the lower molars are not in contact with the upper block in cases with deep overbite. Check that the screws are operating correctly and adjust the clasps if necessary.

Other visits

After the third visit, the following items should be monitored whenever the patient is scheduled in the office.

Common treatment time for Phase I is 4-9 months.

Verify arch width and A-P development. This usually takes 2-6 months. When desired results are achieved the screws need not be activated and acrylic may be added to the screw area to avoid further changes.

The time period for vertical development is usually 2-3 months longer than arch width and A-P development Pads must be added to the second molars as they erupt on mixed dentition cases if vertical development needs to be restrained.

Phase II begins after the desired vertical has been achieved.

When Phase I treatment is completed, a centric bite is used to construct the Phase II appliance. With the bite in place verify that you have the overbite and overjet Upper and lower models are needed to construct the Phase II appliance. To maintain Phase I correction, the Twin Block appliances should remain in the patients mouth until the Phase II appliance is constructed and delivered.

After seating of the Phase II appliance verify that the tissue is not impinged and the anterior guide plane is in contact with all anteriors. The length of the guide plane needs to be sufficient to maintain the Class I bite and not so long as to effect speech. The settling in of occlusion usually takes 4-6 months. The arches need support for 3-6 months following to allow reorientation of the muscular system before the position is naturally retained.

Once the adaptation of the musculature is complete the Phase II appliance can gradually become a night time appliance.

TREATMENT ADJUSTMENTS

Mini-Bite: Twin Block Inclined Plane Modification

If needed, it may be altered the inclined planes during Twin Block treatment to: A. advance the mandible B. correct the midline • C. accommodate TMJ needs

Proceed as follows:

1. Determine what correction is needed
2. Relieve any acrylic interferences from the bite blocks that would impede the correction
3. A credible lower plane is required to construct the upper inclined plane. If adjustments to the lower are not required continue to step 4
4. Warm one-half sheet of wax in a water bath at 139 degrees
5. Fold the half sheet of wax over twice from both sides to achieve four thicknesses
6. Fold the ends of the wax over to fit the arch form and to achieve eight thicknesses
7. With both bite blocks in the mouth, take the 'Mini-Bite' wax registration. Place the folded

warm wax wafer on the lower posterior teeth and away from the anteriors so that they —- may be seen dearly when taking the construction bite. Ask the patient to gently close the mandible forward and upward to the desired position.

8. Remove, chill and trim the "Mini-Bite" so that the wax between the inclined planes is removed. This creates a space for adding acrylic to the upper plane.

9. Now, place the wax bite in the patient's mouth. Check the midline. facial asymmetry, bite*t* opening, and the jaw position. ;

10. Place Vaseline on the lower bite block inclined plane

11. Add acrylic to the upper bite block inclined plane with cold cure or light bond acrylic

12. Place the upper bite block in the patients mouth

13. Place the "Mini-Bite" over the lower bite block. Ask the patient to close into the "Mini-Bite"

14. Cure the acrylic

15. Trim the acrylic

16. Deliver the modified Twin Block

STANDARD DESIGNS

The standard designs in this section have been included to help you understand appliance design and function.

Twin Block, Basic ApplianceClass II, Division I with Deep Bite

Indication: Look for an uncrowded and well developed lower arch.

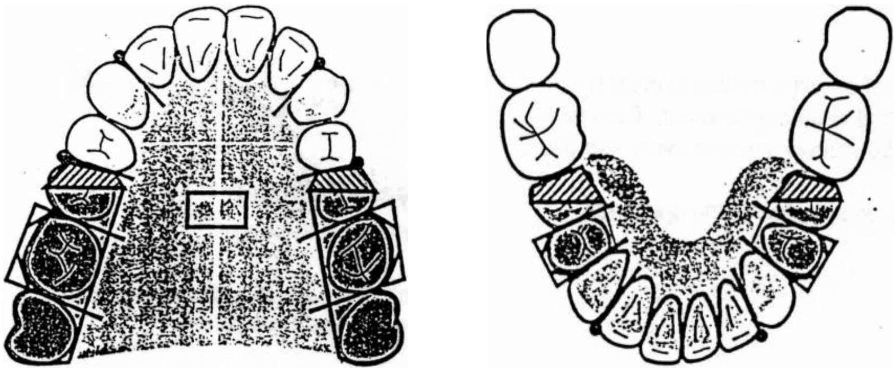
Develop the upper arch about two millimeters to accommodate the lower arch when the occlusion is placed in Class I position.

Features: Twin Block pads for Class II correction and vertical development and an upper midline expansion screw to develop the arch.

Adjustments: Create vertical space for the lower molars to erupt by relieving the molar pads 1/2 mm each appointment. Expand the upper arch by opening the screw one turn each week until the upper is compatible with the lower (One turn equals 90 degrees or 1/4 revolution. Four turns equal 360 degrees or one revolution.)

Options: Consolidate the anteriors by adding a labial arch wire.

Individual tooth movement may be achieved by including springs in thedesign. Bio-finisher wires may be attached to the appliance.



Twin Block, Expansion Class II, Division I with Deep Bite and Narrow Arches

Indication: Look for a case that needs both upper and lower arch width.

Features: Twin Block pads for Class II correction and vertical development. Upper midline expansion screws and lower midline, expansion screw for arch development.

Adjustments: Create vertical space for the molars to erupt by relieving the molar pads 1/2 mm at each appointment. Both upper and lower midline screws may be opened one turn each week -twice each week is possible with younger patients - until the desired arch width is achieved.

Options: Consolidate the anteriors by adding a labial arch wire.

Individual tooth movement may be achieved by including springs in the design. Bio-finisher wires may be attached to the appliance.

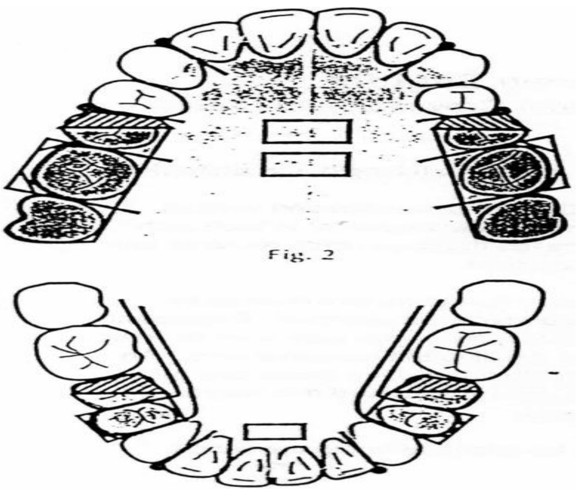
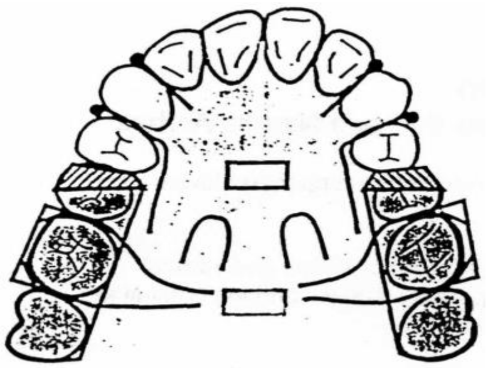


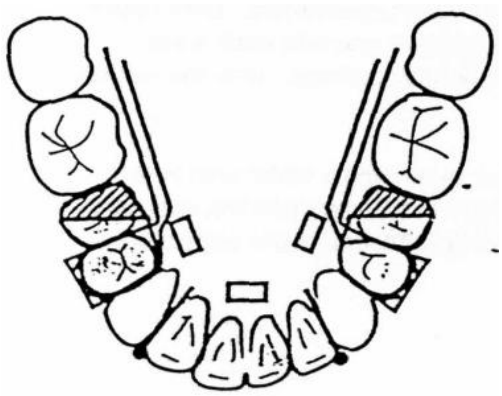
Fig. 2

Twin Block, Two Screw Sagittal Class II, Division II or Anterior Crowding

Indication: Look for a case that needs arch length development. These are usually but not always Class II cases.

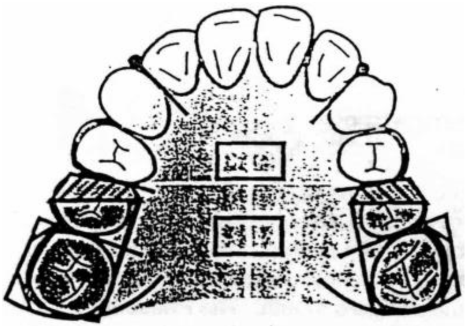
Features: This appliance features Twin Block pads for Class II correction and vertical development. Two sagittal screws for arch length development.
Adjustments: Create vertical space for the molars to erupt by relieving the molar pads 1/2 mm at each appointment. Gain arch length by opening the two sagittal screws one turn every four days.
Options: Bio-finisher wires may be attached to the appliance.





Mixed Dentition, Expansion Class II Correction and Arch Width

Indication: Look for a mixed dentition case that needs Class II correction, arch width development and no vertical development.
Features: Twin Block pads for Class II correction with both upper and lower midline expansion screws. Since retention is desirable on the D's in mixed dentition cases, you may create an undercut for retention in the office by bonding a bead of composite to the buccal of the patient's D's before taking impressions. The bead will then appear on your models when we receive them and C clasps can be constructed for the D's.
Adjustments: Even out the occlusal contact by equilibrating the Twin Block occlusal pads at insertion of the appliance. Since vertical development is not needed, do not relieve pads. Gain arch width by opening the midline screws one turn each week - twice each week if preferred.



Twin Block, To Close the Bite Class II Correction and Anterior Open Bite

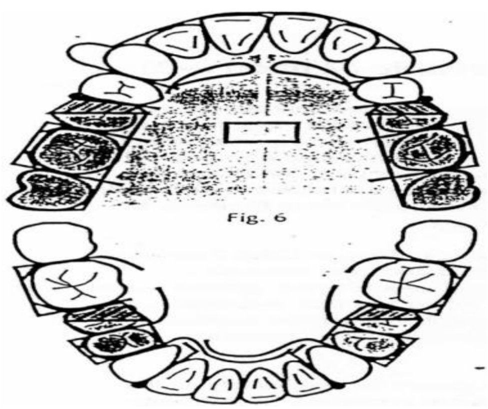
In using the Twin Block for open bite cases, it is important to be certain that the upper and lower bite blocks are interfacing at the 70 degree angle when the patient is wearing the appliance. Otherwise, the lower molars may over erupt and will open the bite further. To avoid this problem, review the options section below. when taking the construction bite, the patient's comfort should be considered while reposition the mandible.

Indication: Look for anterior open bite cases where the upper needs some expansion to match the lower.

Features: Twin Block pads for Class II correction and a labial arch wire to guide anteriors into position. A crib keeps the tongue away from the anteriors and an upper midline expansion screw is included to widen the upper arch to accommodate the lower.

Adjustments: Even out the occlusal contact by equilibrating the Twin Block occlusal pads at insertion of the appliance. Since vertical development is not needed, do not relieve pads. Open the upper midline screw one turn each week until the upper arch accommodates the lower. Maintain the upper labial arch wire at the gingival of the upper incisors. If the second molars erupt during treatment, occlusal pads should be used to establish the desired vertical limit to eruption.

Options: If the bite blocks are not interfacing properly, the lower molars may over erupt. To avoid this problem. Class II elastics may be used full time to guide the patient into proper biting. A chin strap may also be used for night time wear.



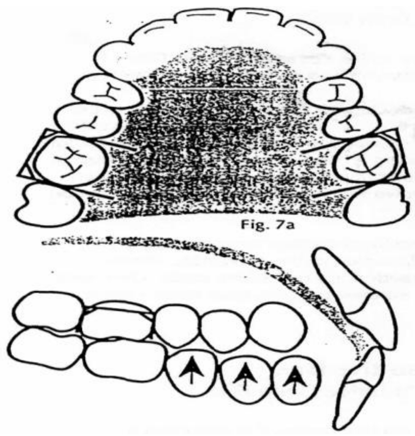
Phase II, Basic Removable

Indication: Phase II appliances are indicated only after you have treated the case to the point where the centrals have the proper overjet/overbite and the molars are in contact. This test should be made with the Twin Block removed from the patient's mouth. The Phase II appliance maintains the upper arch correction, Class II correction and vertical development while allowing the lower bicuspids to move into contact with the upper arch.

Features: An anterior inclined plane to support Class II correction and vertical development. Delta clasps are used for anchorage on first molars.

Adjustments: Be certain that the patient is biting evenly on the inclined plane and that the molars are in contact.

Options: Labial arch wire, individual tooth springs and/or a Biofinisher wire attached to the appliance.

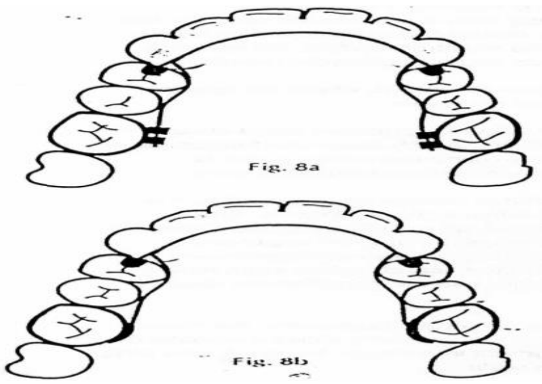


Phase II Fixed and Fixed Removable (Wilson 3-D)

Indication: Phase II appliances are indicated only after you have treated the case to the point where the centrals have the proper overjet/overbite and the molars are in contact. This test should be made with the Twin Block removed from the patient's mouth. The Phase II appliance maintains the upper arch correction. Class II correction and vertical development while allowing the lower bicuspids to move into contact with the upper arch.

Features: An anterior inclined plane to support Class II correction and vertical development. The fixed and fixed removable appliances have features that are of benefit to the clinician working with an uncooperative patient or where less bulk is desirable. These Appliances require more attention to patient hygiene because they are not as easily cleaned as are removable appliances.

Adjustments: Be certain that the patient is biting evenly on the inclined plane and that the molars are in contact. To eliminate appliance breakage caused by the patient's tongue moving the appliance up and down in the mouth, a small spot of composite may be bonded incisal to the bite plane of the appliance or occlusal to the wires along the bicuspids.



Class III

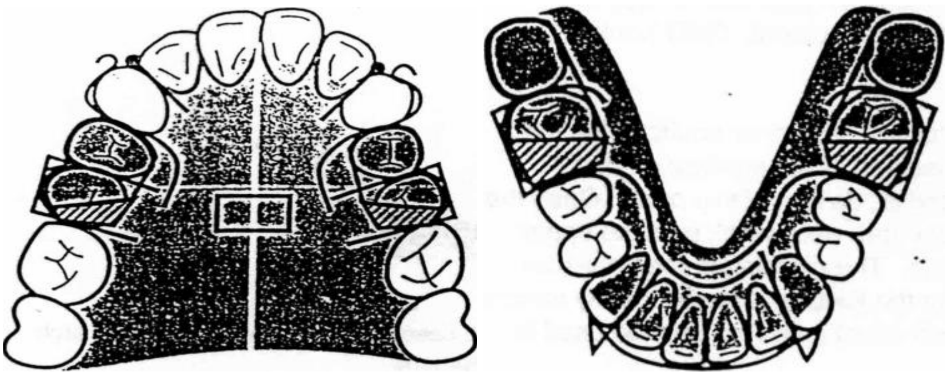
In all Class III cases it is important to avoid distalizing the condyle in the fossa. Otherwise, TMJ problems may develop.

Twin Block, Expansion Class III

Indication: Look for Class III cases where additional upper arch width is needed and/or where vertical correction is desired.

Features: Class III Twin Block occlusal pads for vertical development, upper expansion screw to widen the upper arch, lower labial arch wire and reverse headgear (RHG) hooks.

Adjustments: Create vertical space for the upper molars to erupt by relieving the molar pads 1/2 mm each appointment. Expand the upper arch by opening the screw one turn week until the upper is compatible with the lower. Use RHG if the maxilla needs to come forward. The lower labial arch wire may be used to consolidate the anteriors.



Twin Block, Sagittal Class III

Indication: Look for Class III cases with short arch length, crowded cuspids and/or where vertical correction is desired.

Features: Class III Twin Block occlusal pads for vertical development.

Two sagittal screws are used to lengthen the arch. RHG hooks. Lower labial arch wire.

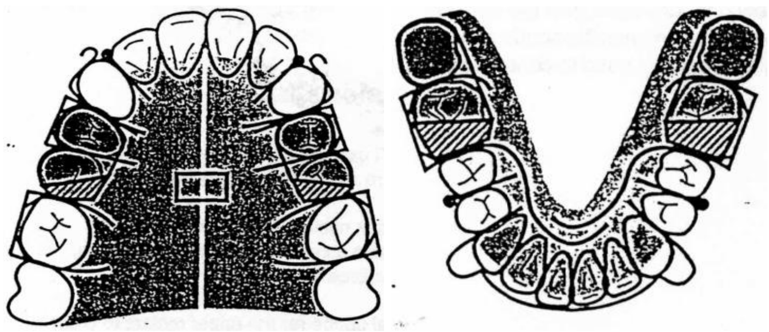
Adjustments: If the maxilla needs to come forward, the RHG may be used. If vertical is needed, relieve the occlusion on the lower pads ½ mm each appointment to allow for vertical development. Arch length development can be achieved by opening the sagittal screws one turn each week. The lower labial arch wire may be used to consolidate the anteriors.
Options: Three or four upper screws may be used in this design.

Twin Block, Expansion and No Vertical Class III

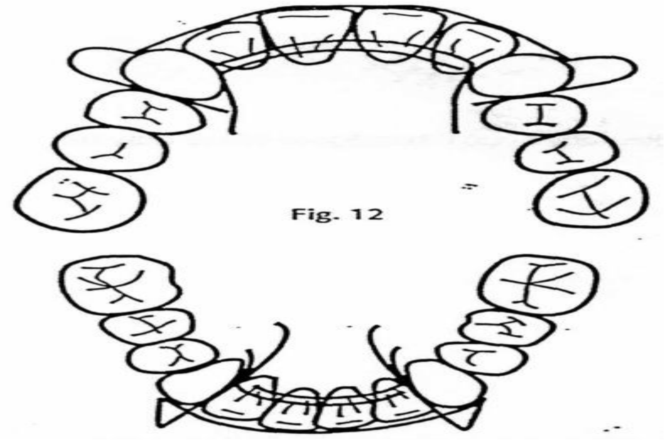
Indication: Look for Class III cases needing additional upper arch width and no vertical development.

Features: Class III Twin Block occlusal pads and an upper expansion screw for upper arch development. RHG hooks. Lower labial arch wire.

Adjustments: Even out the occlusal contact by equilibrating the Twin Block occlusal pads at insertion of the appliance. Since vertical development is not needed, do not relieve pads. Open the upper arch expansion screw one turn each week until the upper arch is compatible with the lower. The clasping in the appliance provides additional retention for the RHG and consequently restricts vertical development.
The lower labial arch wire may be used to consolidate the anteriors.



Options This section includes options to the standard designspreviouslypresented. Labial arch wires can be used to consolidate and/or control anterior teeth if desired. Lapped lingual springs may be used to round out the arches. Individual tooth springs may be used to move or rotate individual teeth.



Class II hooks and elastics may be added to any Phase I design.

These are used for only a few weeks to train the muscles. Theyencourage the patient to bite at the correct interface of the bite blocks when the appliance is being worn. The hooks may be removed from the appliance afterward.

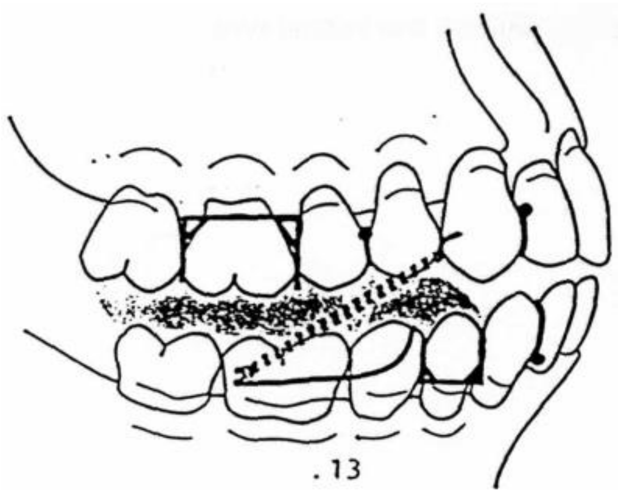


Fig: RHG (Reverse Headgear) is indicated, attachment hooks for elastics may be included in the appliance for the RHG.

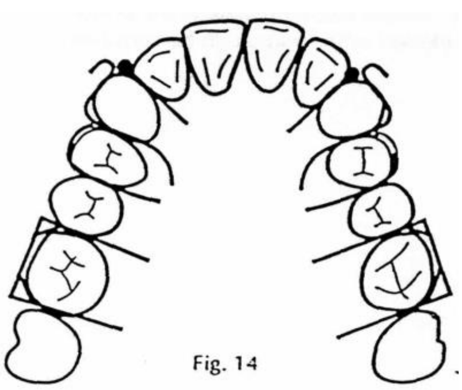
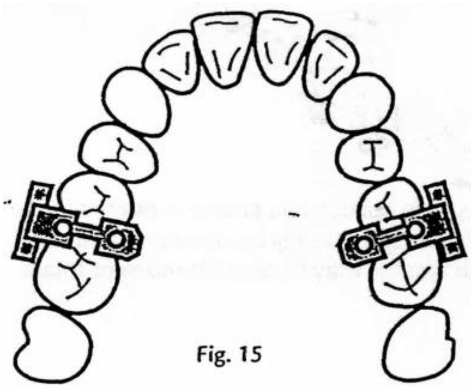
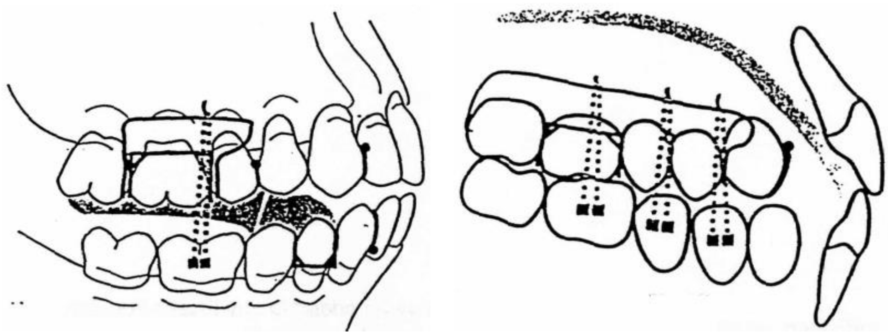
Fig 

Fig: a headgear is indicated, buccal headgear tubes may be included. - .



The Bio-finisher option on the Phase I appliance for faster vertical development of the lower molars. This option is of special value in adult cases. The wire is usually made removable so patients can wear the appliance during the day without the buccal wire.

The Bio-finisher option on the Phase II appliance for faster vertical development of the bicuspids. Tubes can be placed in the acrylic so the wires may be easily removed or the wires can be cured into the plastic.



The purpose of this investigation was to determine the treatment effects of the Twin Blockappliance and in particular to assess the extent to which the Twin Block appliance stimulates mandibular growth. This appliance, developed more than 20 years ago by Dr. William J. Clark1'3 in Scotland, recently has gained popularity in North America. Very little has been reported in the scientific literature, however, with regard to the effectiveness of thiswidely used functional appliance.

The most closely related study available was done byDeVincenzo,5 who used an appliance similar to the Twin Block. This appliance consisted of maxillary and mandibular bite plates designed with a vertical interface between them. Both the DeVincenzo and the Twin Block appliances are based on the same principle as the protrusive functional appliances used on monkeys by McNamara6"8 and others.Previous clinical studies of a variety of functional appliances have indicated varying degrees of success in achieving skeletal correction.11"20 Because of the high percentage of patients presenting with Class IImandibular deficiency problems, orthodontists still are searching for the most effective means of stimulating mandibular growth preferentially. Barring surgical lengthening of the mandible to correct mandibular retrognathia, functional appliances seem to be the most direct approach to treatment of a mandibular deficiency problem.

The purpose of the current study was to evaluate cephalometrically the treatment effects of the Twin Block appliance.

5.10 MATERIAL AND METHODS AND CEPHALOMETRIC ANALYSIS

The criteria for case selection were as follows:

(1) skeletal Class II malocclusion in which the esthetic appearance of the patient improved when the mandible was postured forward;

(2) angle ANB of 5° or greater;

(3) full cusp Class II molar relationship on one side and end to end Class II molar relationship or greater on the other side.

The active treatment time with the Twin Block appliance ranged from 6 to 15 months. Although all patients were asked to wear their Twin Block appliances full-time, a wide range existed in the compliance.

The basic design of the Twin Block appliance used in this study is illustrated . This design differs somewhat from the conventional Twin Block appliance advocated by Clark1"3 in that an acrylic labial bow has been added to the lower incisor area to improve retention In addition, elastic hooks have been soldered onto the delta clasps of the upper and lower members of the appliance*).* These hooks allow vertical elastics to be worn at night to encourage thepatient to keep the mandible closed forward into the appliance while sleeping.

Similar to the original design by Clark, the maxillaryappliances*)* in this study had a midlinc expansionscrew that was used to correct the transverse relationships as the mandible came forward with growth. The patients were instructed to turn the maxillary expansion screw one turn per week to achieve coordination of the upper and lower arches in the transverse dimension. No expansion screws were used in the lower Twin Block appliances. Labial bows were not used on the maxillary appliances of any of the patients in this investigation. This is in keeping with the recommendations of Clark1"3 to minimize lingual movement of the upper incisors during treatment.

The initial wax construction bite was taken with the mandible protracted approximately 6 mm and opened vertically by about 5 mm. In the patients with slight asymmetries of the mandible, the construction bite was taken with the upper and lower midlines coincident in an effort to correct the asymmetry by encouraging differential growth of the mandible.

As treatment progressed, 1.5 to 2.0 mm of acrylic was added onto the distal inclines of the lower appliance bite shelves to maintain sufficient activation of the jaw muscles, particularly the lateral ptcrygoids. These increments of acrylic were added to the appliance as soon as 3 to 4 mm of overjet reduction had been achieved.

In addition, acrylic was added onto the posterior bite shelves of the upper and lower appliances to increase the vertical opening of the bite in the patients who had deep or impinging overbites before treatment. In these deep bite cases, acrylic was ground from the posterior areas of the maxillary appliance to clear the occlusal aspect of the lower permanent molars, thereby encouraging vertical eruption of these teeth .

In open bite cases, the acrylic bite shelves were constructed to contact the occlusal aspect of the upper and lower molars and thus prevent eruption of the molars as much as possible.

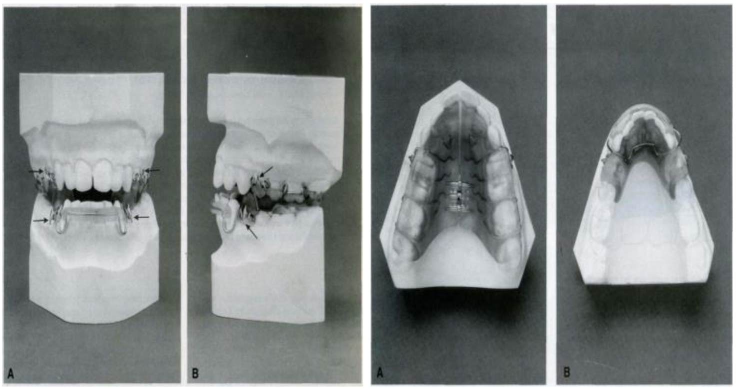
Cephalometric head films were taken approximately 10 days before the start of the Twin Block treatment and again approximately 1 year into the treatment. The cephalograms were all taken using a single machine with an anode-to-midsubject distance of 5 feet (152.4 cm). No adjustments were made for the 11% enlargement factor.

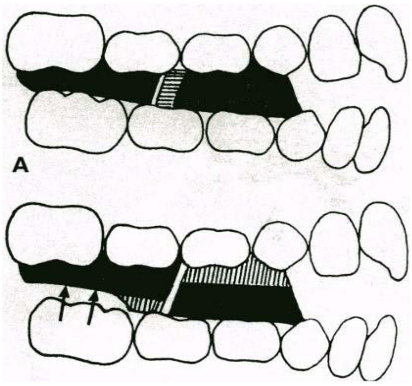
The mean time interval between the initial (Tl) and post treatment (T2) cephalograms was 14 months, with a range of 8 months to 17 months. In the control group, the mean time interval between the first (Tl) and second (T2) cephalometric films was 13 months, with a range of 10 months to 15 months.

The lateral cephalometric headfilms for both the treatment and the control groups were traced by one of the authors using matte acetate paper. Sixty-five points were first located on the acetate tracing and then digitized for each headfilm. From the digitized coordinates, Dento-Facial Planner software was used to perform a standard Jarabak 21 analysis as well as a custom cephalometric analysis to assess 50 cephalometric variables on each headfilm. The custom analysis (KJM/CMM analysis) used sella-nasion as a reference plane for super-imposition.

A vertical reference plane was constructed through sella perpendicular to the palatal plane.

In addition, vertical measurements were made from the various dental landmarks perpendicularly to either palatal plane or mandibular plane. For ease of visualization of individual growth and treatment effects, computer-generated superimposition tracings were obtained for all of the treatment group as well as the control subjects. An overall superimposition





Addition of acrylic *(shaded area)* to the distal inclines of the lower bite shelves to reactivate the Twin Block, making the mandible posture more forward. Addition of acrylic *(shaded area)* to increase height of the upper and lower bite shelves to allow for more vertical eruption of the lower molars in the patients with deep overbites.

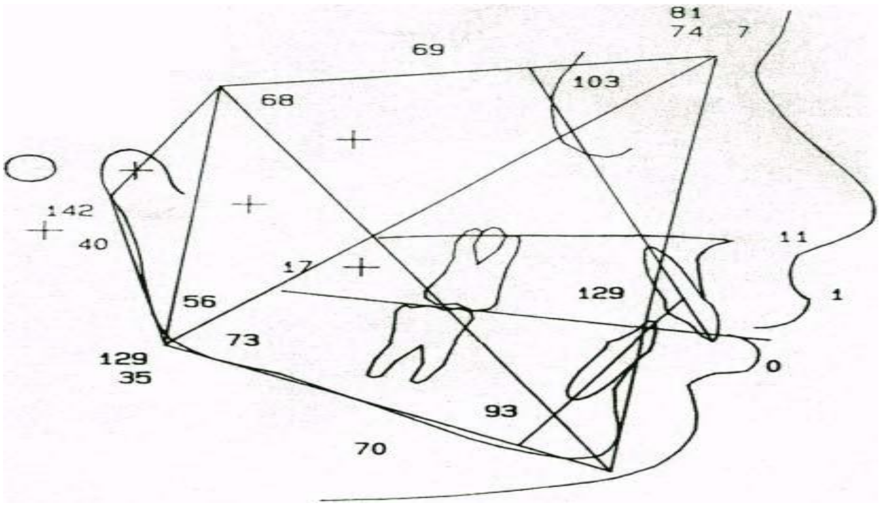
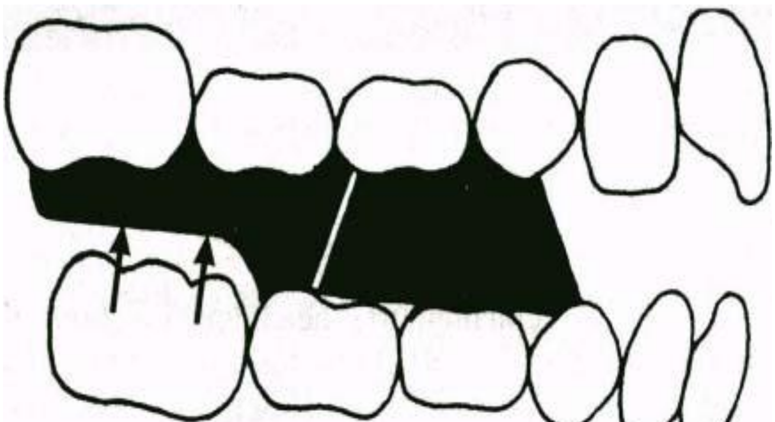
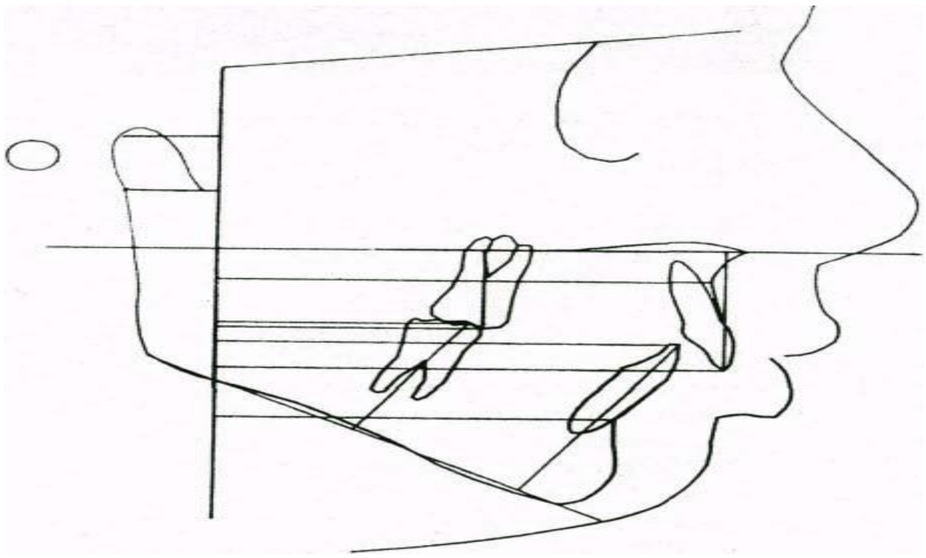


Fig:Standard Jarabak cephalometric analysis as used in this study



Grinding of acrylic on maxillary bite shelves to clearthe way for the lower permanent molars to erupt



KJM/CMM custom analysis used to measurehorizontal distances from skeletal and dental landmarks to a vertical reference plane constructed through sella and perpendicular to the palatal plane.It was done by superimposing on SN and registering on sella.

RESULTS

Statistically significant differences are variables examined in this study . The Twin Block group experienced on average a slight inhibition of forward maxillary growth, as evidenced by the reduction seen in angle SNA as compared with the small increase seen in angle SNA in the control subjects (-0.9° compared with +0.1°, p <0.001). The maxillary unit length increased only . Comparison of the starting forms. Mean tracings of the control group and treatment group at the start of the study are superimposed. Both groups had similar midface structure, but the treatment group had generally more retrognathic positioning of the mandible. It slightly less in the treatment group than in the control group and this difference was not statistically significant.

The mandibular unit length (measured from condylion to gnathion) increased by 6.5 mm in the Twin Block group in contrast to only a 2.3 mm increase in the control group. Approximately two thirds of this increase in overall mandibular length in the treatment group was the result of an increase in ramus height (4.1 mm on average as measured from condylion to gonion). In contrast, the control subjects experienced on average only 1.2 mm of increase in ramus height. The remaining one third of the mandibular length increase in the Twin Block group occurred in the mandibular body with Go-Gn increasing by 3.0 mm. This increase was almost twice as much as that experienced by the control subjects.

The mandibular growth may account for the 1.9° increase in angle SNB in the treatment group as compared with almost no change in the control group.

Both anterior facial height and posterior facial height increased significantly in the Twin Block group during treatment (5.6 mm and 4.3 mm, respectively, $p < 0.001$ for both variables). In spite of the change in vertical facial height, there was no net increase in the angle of SN to mandibular plane in the treatment group.

Some small but significant differences existed between the treatment group and control group when the cranial base angles and measurements were compared. In particular, the Twin Block group experienced a 0.9° decrease in the saddle angle, a 1.3° increase in the gonial angle, and a 1.6 mm increase in anterior cranial base length. The level of significance for these changes wasp < 0.001.

Dentoalveolar changes were evident in the treatment group. An average uprighting effect of 2.5° on the upper incisors was observed during Twin Block treatment, but almost no change occurred in the control subjects. The lower incisors were proclined on average 5.2° in the Twin Block group during treatment as compared with only 1.4° of labial tipping in the untreated control subjects. The overjet was decreased in total 5.6 mm in the treatment group. Nearly two thirds of this decrease could be accounted for by the forward growth of the mandible The upper first molars were distalized 1.0 mm on average in the Twin Block group, whereas the upper first molars came forward 1.5 mm in the control group relative to the vertical reference plane. When the effects of forward maxillary growth were taken into consideration, most of the forward movement of the upper molars in the control group resulted from forward growth of the maxilla (1.2 mm), and only about 0.3 mm was attributable to tooth movement.

In contrast, the Twin Block group experienced a distalization effect on the upper molars of 1.6 mm . In addition, some significant with holding effect was noted with respect to the eruption of the maxillary molars in the Twin Block group.

The lower molars erupted on average almostfour times as much (2.3 mm compared with 0.6 mm) in the Twin Block group as in the control group. They also tended to move more mesially in the treatment group then in the control subjects. When the distance from the lower molars to the vertical reference plane was measured, a total increase of 5.2 mm was noted for the Twin Block group compared with only 1.9 mm for the control group. In both groups, however, much of this forward change in molar position is explained by the forward growth of the mandible. The net dentoalveolar change for the lower molars is a mesial movement of 1.4 mm in the treatment group as compared with only 0.2 mm for the control group .

In the Twin Block treatment group, the combination of distalization of the upper molars (1.6 mm), forward growth of the maxilla (0.6 mm as measured at A point), forward growth of the mandiblemm as measured at B point), and forward migrationof the lower molars (1.4 mm) gave a net reduction in the molar overjet of 6.2 mm as compared with a reduction of only 0.4

mm in the control group. Thus in the treatment group, approximately 50% of the molar correction was accomplished by skeletal improvement in the lower jaw and 50% by dentoalveolar change in the upper and lower molars .

TREATMENT

Manifested in a vertical direction rather than a horizontal direction. If a functional appliance results in a longer mandible, this may be of no value to the patient if the growth is expressed in a vertical direction. In fact the increase could be detrimental to the soft tissue profile. This has been a criticism of the Frankel appliance. The Twin Block appliance, as used in this study, provided mandibular growth increments greater in magnitude than do other removable functional appliances. In addition, the direction of the mandibular growth was favorableand thus contributed substantially to the anteroposterior skeletal correction.

Patient compliance is always a concern whentreating patients with functional appliances. The Herbst appliance has gained widespread acceptance because it can be used as a fixed functional appliance.

Whereas the fixed functional appliance has the advantage of reducing patient cooperation as a factor in treatment success, the removable functional appliance has the advantage of being more tissue-born and therefore less likely to produce dental adaptive changes.

In the current Twin Block study, despite variable cooperation in the subjects, all were corrected from a full cusp Class II molar relationship to a Class I molar occlusion in a reasonable time frame (8 to 14 months). The favorable success rate with the Twin Block appliance may be attributed to the generally high level of patient acceptance of this type of appliance. Because it is smaller than other functional appliances, patients are able to adapt to it more easily and speech disturbance is minimized.

The patient may be more likely to stay closed into the appliance during sleeping hours, thus increasing the effective wearing time in a 24-hour period. The Twin Block appliance is an esthetic appliance with no bulk of acrylic in the anterior region and no maxillary labial bow. This esthetic advantage may help to increase patient acceptance.

With regard to the long-term stability effects of functional appliance treatment, both DeVincenzo and Pancherz and co-workers report very disappointing findings with their respective appliances.

The current study on the Twin Block appliance does not address this issue because insufficient long-term follow-up data were available at this time. It is hoped, however, to provide this information at some point in the future. In addition, a study comparing the treatment effects of the Twin Block appliance in Class II open bite patients and Class II deep bite patients also is needed. With some minor but significant changes in design, the Twin Block appliance can be constructed to either close or open the bite, depending on the requirements of the patient.

CONCLUSIONS

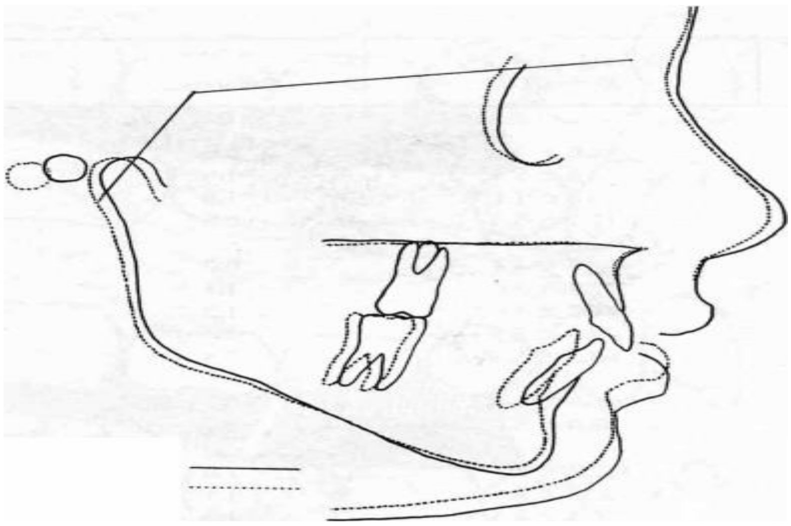
A consecutively treated sample of patients with skeletal Class II malocclusions was compared cephalometrically to a control group of untreated individuals with Class II malocclusions who were matched closely according to sex, age, and facial type. Treatment involved solely the use of the Twin Block appliance and was undertaken primarily in the mixed dentition stage. The mean age of both the treatment and the control groups at the start of this investigation was 9 years 1 month. The mean observation period was 14 months for the treatment group and 13 months for the control group.

The mandibular unit length (measured from condylion to gnathion) increased by 6.5 mm in the Twin Block group as compared with only a 2.3 mm increase in the control subjects. Approximately two thirds of the overall mandibular length increase could be attributed to an increase in ramus height (measured from condylion to gonion). The remaining one third was the result of an increase in the mandibular body length (measured from gonion to gnathion).

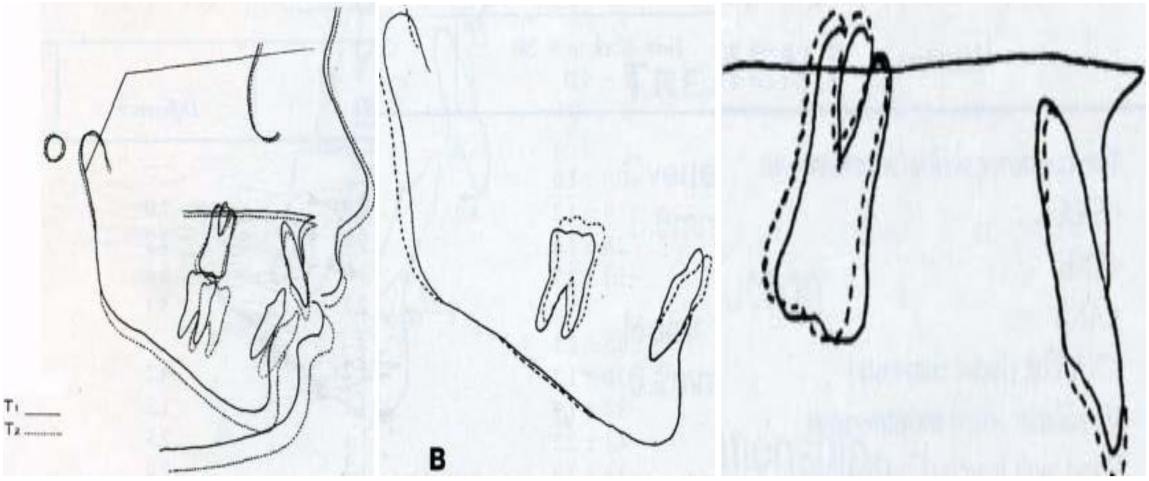
This mandibular growth probably was responsible for the 1.9° increase in angle SNB in the Twin Block group.

By comparison, an increase of only 0.3° in angle SNB was noted in the control group.

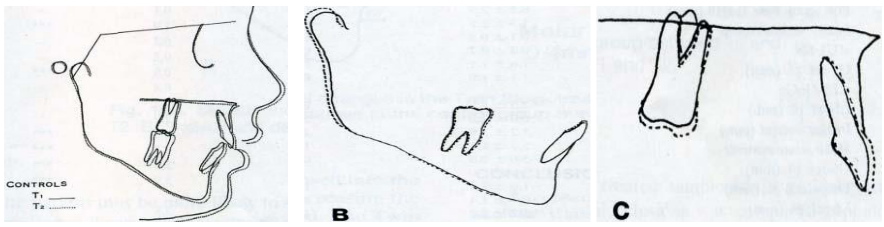
In addition, some "headgear effect" was observed,with the Twin Block group experiencing a slight inhibition.



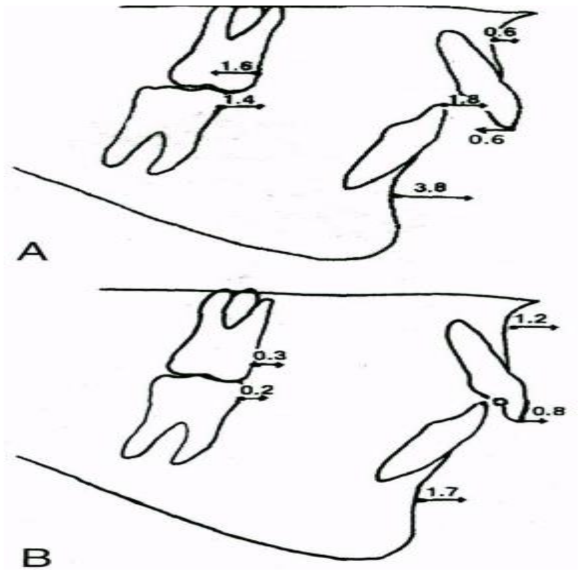
Comparison of the starting forms. Mean tracings of the control group and treatment group at the start of the study are superimposed. Both groups had similar midface structure, but the treatment group had generallymore retrognathic positioning of the mandible.



Comparison of pretreatment and posttreatment average tracings for the Twin Block treatment group. Substantial increments of mandibular growth have occurred, resulting in favorable facial and occlusal changes. The time interval between the start of treatment *(T1)* and the first observation film *(T2)* was on average 14 months.



Growth changes in the untreated control group. The untreated Class II control group



Skeletal and dental changes in the Twin Block treatment group between T1 and T2. B. Skeletal and dental changes in the control group between T1 and T2.

TREATMENT

Overjet 5.6mm reduction

Molar Relationship 6.2mm correction

CONTROLS

Overjet 0.3mm increaseMolar Relationship 0.4mm correction of forward maxillary growth as evidenced by a 0.9° decrease in angle SNA during the treatment phase. The"headgear effect" also was observed dentally as a 1.0 mmdistalization effect on the upper molars in the TwinBlockgroup. In contrast, a 0.3 mm forward migration of the upper molars was measured for the control group. A slight uprighting effect (2.5°) was observed for the upper incisors as a result of the Twin Block treatment. This was despitethe fact that no labial bow was attached to any of the Twin Block appliances used in this study.

The lower incisors tipped labially 5.2° on average in the Twin Block group as compared with only a 4° labial tipping in the control subjects. The lower molars moved mesially 1.4 mm in the treatment group as compared with only a 0.2 mm mesial movement in the control group.

Molar correction or overcorrection was achieved in all 28 patients in the treatment group. Incisor overjet decreased 5.6 mm on average in the treatment group. Nearly two thirds of this reduction in overjet could be accounted for by the forward growth of the mandible.

FUNCTIONAL REGULATOR

CHAPTER 6: FUNCTIONAL REGULATOR

6.1 INTRODUCTION

The function regulator was developed by Rolf Frankel, a German orthodontist, in the 1980s. The appliance is a complex device which uses the oral cavity the basis for treatment of malocclusions with little or no contact with the dentition. Versions of the appliance were available to treat Class I, Class II and Class III malocclusions. The appliance became very popular both in Europe and America. **Frankel appliance** or Frankel Functional Regulator is an orthodontic functional appliance which was developed by Rolf Frankel in 1950s. This appliance primarily focused on the modfulation of neuromuscular activity in order to produce changes in jaw and teeth. The appliance was opposite to the Bionator appliance and Activator appliance.

Other names for Frankle's appliance

1.FUNCTION REGULATOR

2.VESTIBULAR APPLIANCE

3.ORAL GYMNASICS APPLIANCE

Fig : Frankel Regulator

6.2History

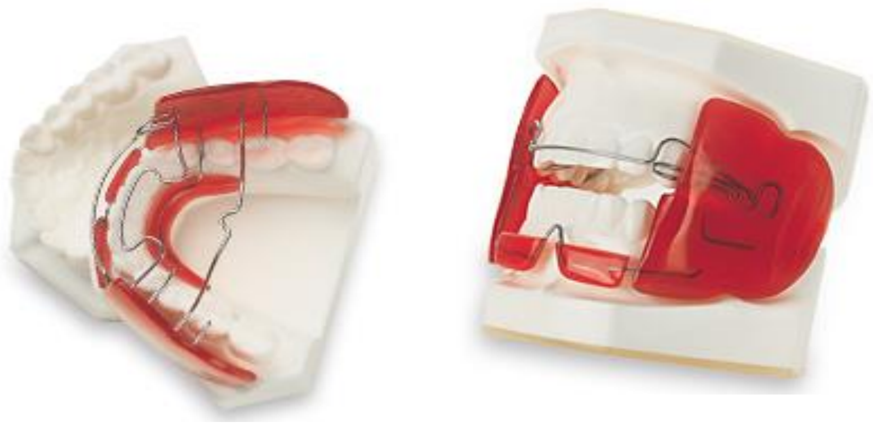
It was developed by Rolf Fränkel in Germany in 1950s. In his practice, Fränkel had used the activator functional appliance and experienced mixed results with this appliance. He believed that a treatment outcome is more stable if the functional deviations of muscles are also corrected along with dentition. Therefore, through his work he developed an approach which allowed the maxillary and mandibular muscles to play an important part in an orthodontic treatment. He achieved that through development of functional regulator appliances. These appliances allowed him to train and reprogram the musculature around the mouth. He published around 70 articles which stressed the importance of his appliance in expanding the dental arches.

He first introduced his functional orthopedic approach in 1966 at a meeting for European Orthodontic Society.

6.3Frankel's Philosophy

Frankel's philosophy mirrored that **Melvin Moss**. Their philosophy was that the functional performance of the muscular portions of the oral capsule influence the developing functional spaces. Frankel also thought that the functional spaces are influenced by the atmospheric pressure. He believed that the perioral muscles had restraining effect on the dental arches and that the insertion of appliance expands the capsule and allows new functional adaptation of the muscle[

Functional Appliances: Frankel Appliances



The Frankel appliances are removable designs invented by Professor Rolf Frankel. The Frankel philosophy uses the vestibules to enhance favorable growth in developing dentition and restrictundesireable muscle forces. Thus, the Frankel appliance is reported to provide an "ideal" environment for maximum arch development and proper skeletal jaw relationship. The three most commonly used designs are the Frankel II, Frankel III and Frankel IV.

6.4Types

Frankel Appliance I (FR 1)

This appliance had Type A, B and C. The difference between A and B was the lower lingual loops in one and lower lingual shield in another. This was mainly used for Class 1 and Class 2 Division 1 malocclusion.

- **Acrylic Components**
  - Buccal Shield - They were about 2.5mm thick and their goal was to expand the soft tissue capsule in the back.
  - Lip Pads - They are tear drop shaped acrylic pads which were placed in the vestibule of the lower arch.
  - Lingual Shield - This allows mandibular muscles to overcome their poor posture.
- **Wire components**
  - Palatal bow - This rests on maxillary molar and has a stabilizing action for the appliance.
  - Cross over wire - They run between 1st and 2nd premolars and are responsible for movement of the buccal segments.
  - Lower lingual wires - They prevent the lingual movement of lower incisors.
  - Labial bow -
  - Canine loop - Used for guided eruption of canine and also for intermaxillary anchorage.

Frankel Appliance II (FR II)

This was used primarily in Class 2 Division 1 and 2.

Frankel Appliance III (FR III)

Used in patients with Class 3 malocclusion. In this appliance the lip pads are used in the maxillary arch to allow the maxilla to grow. The mandibular arch does not have pads in the anterior to allow the soft tissue forces to act on the mandible. The Frankel III (FR-3) Appliance is composed of a system of oral screens which lie in the vestibule of the mouth -- free of direct contact with the dentoalveolar systems. As described by Dr. Frankel, the action of the appliance is to "influence arch development by changing the pressure created by surrounding soft tissue." It has proven effective as a primary treatment appliance in Class III patients with mild, moderate, or severe dentoalveolar, skeletal and/or neuromuscular imbalances -- affecting the skeletal, the dentoalveolar, and the soft tissue components simultaneously. Patient compliance with the Frankel III is typically quite high. It improves the soft tissue profile of the patient with maxillary skeletal retrusion. The purpose of the vestibular shields and upper labial pads are to counteract the forces of the surrounding musculature that tend to restrict forward maxillary skeletal development and cause a retrusion of the maxillary anteriors. The vestibular shields need to be positioned away from the alveolar process of the maxilla, but *must* fit closely to the tissue of the mandible. This results in stimulation of maxillary alveolar development and restriction of mandibular alveolar development. Because of the importance of growth to the success of the Frankel technique, best results are obtained *before* the permanent bicuspids and cuspids come into position. Young patients seem to tolerate the appliance very well, allowing treatment to be started at a very early age.

Frankel Appliance IV (FR IV)

Used in patients with open bite and bimaxillary protrusion cases.

Frankel Appliance V (FR V)

This appliance can be used with headgear in patients with high mandibular plane angle and vertical maxillary excess.

6.5BITE CONSTRUCTION

In order to maximise skeletal changes and minimise the dental effects. Frankel proposed taking the initial construction bite with only 2-3 mm of mandibular advancement. This is not more than what the protractor muscles are able to keep the mandible in a forward position. When a construction bite was taken with the mandible advanced 6-7 month post treatment results showed dentoalveolar changes with frankel appliance, such as maxillary incisor retraction and lower incisor proclination,which are undesirable.

6.6Modifications

- Otton (1992) - Capped Frankel Appliance
- Owen (1985) - Modified functional regulator for Vertical Maxillary Excess
- Chate (1986) - Angulation of Cross Wires was changed
- Kingston - He modified the buccal shields
- Haynes (1986) - He modified appliance to have continuous buccolabial shield palatal acrylic support.

A Functional Appliance is most often comprised of highly polished acrylic shields and stainless steel wires. It is a single piece and is often described as "two connected retainers". This appliance is most often prescribed for patients with more pronounced Class II jaw discrepancies (upper-jaw forward and lower-jaw backward) or Open Bite problems (front jaws/teeth are apart and do not meet). Each appliance is fabricated as a custom fit with buccal shields (side acrylic pieces) and other components to modify growth in all planes of space. These types of appliances work comfortably with a patient's inherent growth to affect the desired changes in skeletal/dental development.

Usage: The FR appliance is to be worn at all times with exception of cleaning and eating. Most patients find it helpful to wear the appliance at home for the first few weeks and then to wear it at all times when speech normalizes

6.7 CEPHALOMETRIC ANALYSIS

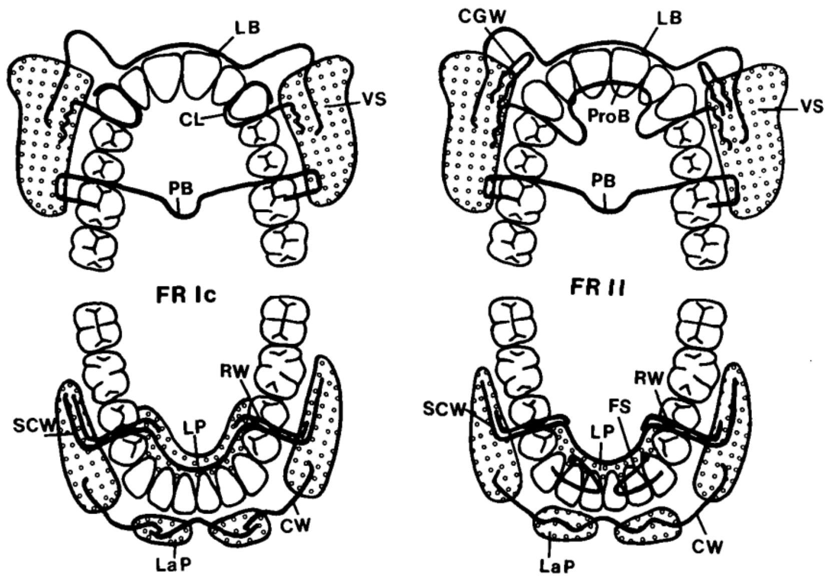
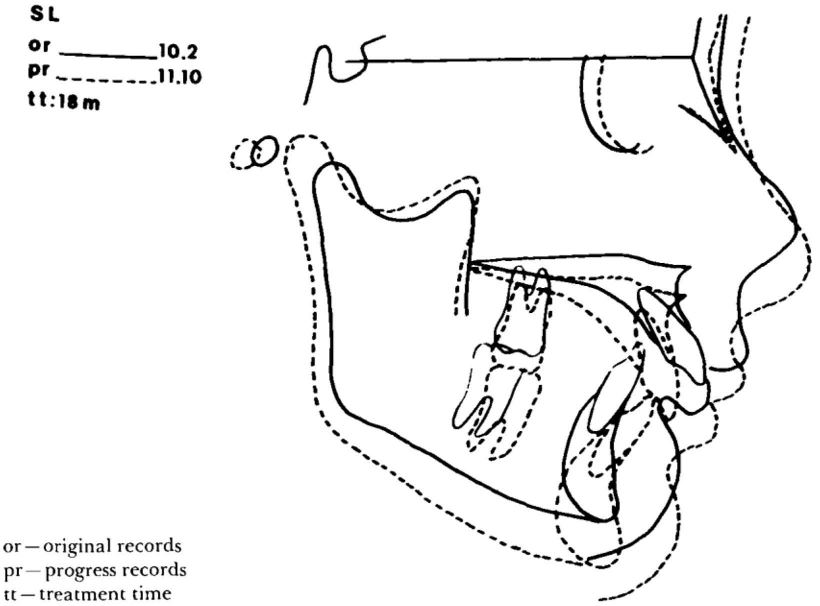


Fig A B

A: FR 1C : Designed to treat class II division 1 malocclution. B: FR II designed to treat class II division 2 malocclution



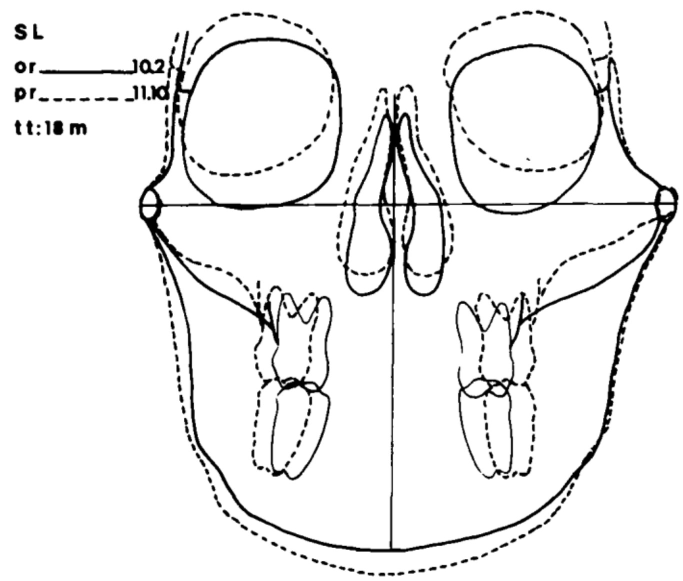


Fig : Progress comparison

Lateral view superimposed on S-N at Sella. P.A view Superimposed on midsagital plane and Zygomartic arch plane.

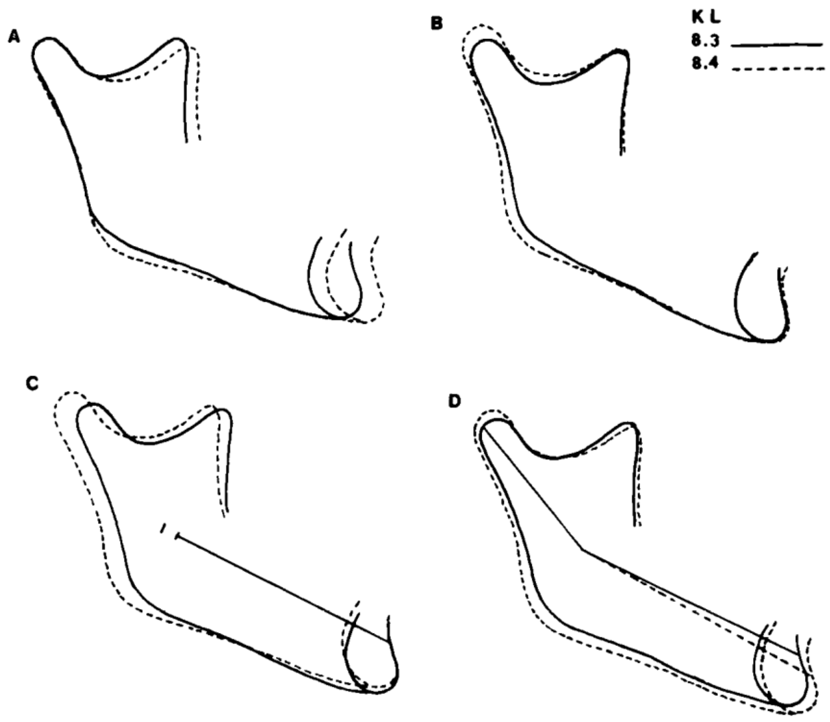


FIG : Comparison of progress tracing mandible to growth forecast mandible.

solid line- growth forecast.   Broken line - progress tracing

A- Superimposition along posterior border and condyle. B- Superimposition along inferior border and planum alveolar. C -Superimposition along corpus axis at pm. D- superimposition along condyle axis at Xi point.

6.8MODE OF ACTION

1. Increase in transverse and sagittal intraoral space:- Contrast outward pull on the connective tissue and muscle which is transmitted to the underlying bone ,resulting in apical bone formation

2.Increase in vertical space :- An increase in vertical intra-oral space is possible as frankel appliance is kept free from the posterior teeth.

3.Mandibular protraction:- Whenever mandibular is brought back the free exerted by the lingual pads course the protractor muscle to position the mandible mesially .

4.Muscle function adaptation :- Eliminate abnormal perioral muscle function. -Periosteal pull leading to apical bone formation. -Improves tonocity of the muscle .

6.9 INDICATIONS

Fränkel I - treats Class I and Class II Division 1 malocclusions.

Fränkel II - treats Class II Division 2 malocclusions.

Fränkel III - treatment of Class III malocclusions.

Fränkel IV - used for open bites and bimaxillary protrusions

6.10 FUCTIONAL REGULATOR THERAPY IN CLEFT PALATE PATIENTS

Cleft lip and palate children exhibitng collapse of maxillary segments and cross-bite were treated orthodontically with the functional regulator (FR) for periods ranging from 6 to 18 months. The purpose of this investigation was to evaluate quantitatively treatment of cleft palate patients with the functional regulator and to evaluate the effect of the appliance on their speech. Cleft palate patients typically have speech, nose, and lip defects which make patient cooperation and appliance acceptance more difficult. However, patient cooperation was considered good with an average mean of 12.7 hours per day of appliance wear and a range of 5.6 to 18.2 hours. Change in interimplant dimension was measured on frontal radiographs, and dental changes were measured of serial dental casts. The resulting data indicated no significant change in maxillary width or cross-bite relationship. The functional regulator was not clinically useful in this sample when the treatment objective was primary expansion of collapsed maxillary segments in the cleft palate patient. Good speech-production skills prior to treatment will minimize the adverse effect that the FR has on speech intelligibility. A significant amount of accommodation to the appliance occurs within 1 week after insertion, but maximum improvement in speech intelligibility occurs with full-time wear of the appliance for as many hours per day as possible.

Rolf Fränkel (1908-2001) must be recognized as theinventor of an appliance that corrects malocclusions with little or no contact with the dentition. He studied in Leipzig and Marburg, Germany, receiving his Dr Med Dent in 1931 but was treating patients in his office at Zwickau with Angle's E-arch as early as 1928. In World War II, he was a military surgeon involved with jaw and facial injuries. After the war, he returned to Zwickau, only to find himself sealed off by the East German regime from mainstream orthodontics.

Recognizing that stability of treatment can occur only if the structural and functional deviations of the muscular system are corrected, Fränkel designed the function regulator (FR, 1957), making the oral vestibule the operational basis for his treatment. The appliance was designated as FR-1, FR-2, and FR-3, for treating Class I, Class II, and Class III malocclusions.

The appliance achieved rapid acceptance in dental orthopedics.

Even so, its fabrication is complex, and few laboratories understand the critical details of its construction.

The FR was welcomed by American dentists, and especially pedodontists, as a solution to their "unbusyness" brought about by the fluoridation of water.

Exercise device:

stimulates normal function, eliminating the lip trap, hyperactive mentalis, aberrant orbicularis oris and buccinator

- Negative pressure of the muscles during deglutition is prevented
- Bodily buccal movement of posterior teeth
- Oral gymnastics: lip seal exercises

Dental effects:

- Appliance anchored to maxillary arch; allows more downward and outward movement of upper teeth

- Lower posterior teeth are allowed to erupt upward and forward; sagittal and vertical correction

Fig:FF **Frankel Appliance**

The Frankel Appliance is a functional orthopedic appliance that is used to help create additional space for permanent teeth to erupt by expanding the arches. It stimulates growth of the lower jaw which will better align the upper and lower teeth. The Frankel can also be used to help with protrusion or overjet by retracting the upper teeth and creating a better bite.

Frankel Appliances are typically worn full-time for 18 – 24 months and possibly longer if the permanent teeth have not fully erupted.Frankel II Orthopedic Appliance

Most patients that present with a small lower jaw and a narrow upper jaw can attribute this to adverse muscle activity during the growth process. The form of the jaw bones follow closely with the function of the surrounding muscles. If the jaw muscles are too strong (i.e., from thumb or lip sucking, etc.), then the muscles resist the growth as it is occurring. Patients can inhibit 50% or more of what would have been their normal growth. Treatment to correct this problem is started roughly around age eight to nine years. Growth cannot be created. It is only enhanced/modified by altering the force muscles applied to portions of the jaw and dental arches during growth. After age 11, there is usually insufficient growth to make a correction with growth modification.

This is a Frankel II Orthopedic Appliance. Notice the acrylic pads around the arch that extend down to the attachment level of the cheeks and lips. Here, the lower "lip pads" are 2mm away from the teeth and bone; the upper pads rest directly against the upper teeth and bone. The lower jaw has also been postured forward to create tension in the joint spaces which, when the muscle forces are removed, enhances lower jaw growth.

Notice the correction of the lower jaw and the facial profile. This patient wore the Frankel II Orthopedic Appliance for about 24 months. There has not been any surgical correction. All visible changes are simply from growth modification and re-training muscles with a single removable retainer-like appliance. This is a lifetime correction. Once the growth has been modified and stabilized and the upper and lower jaws are in their correct relative relationship (usually by age 11 to 12), the Frankel II Orthopedic Appliance is reduced to night wear and a custom removable appliance (known as a positioner/pre-finisher) is used to guide the permanent teeth into full contact.

The appliance to the right is a pre-finisher guidance appliance. It is made of a hard rubber that, when bitten into, forces the erupting and erupted teeth into an ideal occlusion as set up in the appliance. This appliance is worn four to eight hours daily. It can also be worn at night as a retainer after treatment.

FIXED FUNCTION ALAPPLIANCE

CHAPTER 7:FIXED FUNCTIONAL APPLIANCES

7.1 DEFINITON

Fixed functional appliances: They are functional appliances that are fitted on the teeth by the operator and cannot be removed by the patient at will.

7.2 CLASSIFICATION OF FIXED FUNCTIONAL APPLIANCES

They are tooth borne appliances

I) Appliance producing pushing force.

A) RIGID

1)Herbst appliance

2)MARS appliance [Mandibular Anterior Repositioning Splint]

3)MPA [Mandibular Protraction Appliance]

4)Eureka spring

5)Universal – bite jumper

B) FLEXIBLE

1)Jasper jumper

2)Adjustable bite corrector

3)Churro jumper

4)Klapper super spring II5

II) *Appliance producing pulling force.SAIF spring [Several adjustable intermaxillary force spring]*.

7.3MODE OF ACTION

1)Mandibular growth induction.

2)Maxillary growth restriction

3)Dentoalveolar changes

4)Glenoid fossa relocation

5)Changes in neuromuscular anatomy and function.

1) Mandibular growth induction:

Two schools of thought regarding therapeutic induction of condylar growth.One group believes that we can not increase mandibular length to aclinical useful degree.Others believe that the condyles respond to such treatment.Studies by **Pancherz, Woodside, Bishara, and McNamara** onHerbst appliance have been reported where increase in mandibular lengthhave been achieved.According to **Petrovic** appliances displaces condyles downwardand forward from glenoid fossa and then condyles grow upward and backward and is always tries to maintain contact with TMJ.

2) Maxillary growth restriction

Reactive forces in backward direction on maxilla, when themandible is postured forward by the functional appliances.Maxilla experiences an upward and backward force which isexactly opposite in direction to the normal growth descent of the maxilla.This is the head gear effect shown by**Bishara, Pancharz, Cope, Jasperand McNamara** Rate of maxillary growth at peak pubertal growth spurt is about1.5mm/year. This growth increment is blocked if the appliance is timedduring the growth spurt.

3) Dentoalveolar changesBishara

And **Cope** shown that 30-40% skeletal change.60-70% dentoalveolar adaptation which includes a)Distal movement of maxillary molars b)Mesial and vertical movement of mandibular molars.c)Mesial movements of mandibular incisors.d)Distal movements of maxillary incisors.

4) Adaptive changes in glenoid fossa locationWoodside, Altuna (1987), Hinton and McNamara have demonstrated that fixed functional appliances therapy may exercise astrong influence on glenoid fossa remodeling.

5) Changes in neuromuscular anatomy and functions

EMG studies by **Pancherz (1980)** have shown that temporal andmasseter muscle activity is similar in children with normal occlusion.However in Class II patients, masseter muscle activity is reduced incomparison to temporal muscle activity. The studies done in twelvemonths post treatment period have shown that the contraction pattern of these muscles normalized.Adaptation such as elongation of muscle fibers and tendons,migration of muscle attachment are sometime occurs.Most important among them is decrease in growth of lateral pterygoid muscle. Shortening of muscle may cause anterior positioning of jaw.

Thus, regardless of appliances used, the modus operandi of theappliance can be seen in following casual chain given by **Graber,Rakosi, Petrovic**

Functional appliance
↓
Increased contractile activity of LTM
↓
Intensification of retrodiscal pad repetitive activity
↓
Increase in growth stimulating factors
↓
Additional growth of condylar cartilage and subperiosteal ossification of posterior border of ramus.
↓
Supplementary lengthening of mandible.

JASPER JUMPER

CHAPTER :8 JASPER JUMPER

8.1 INTRODUCTION

As an adjunct to fixed appliance therapy, the Jasper Jumper and the Gentle Jumper present an opportunity to minimize extractions and to reduce or eliminate headgear. When activated 4 mm, the Jasper Jumper will exert 360 grams of force. By comparison, at the same amount of deflection, the Gentle Jumper exerts 75 grams of force, which is better suited to mixed dentition cases. Now the clinician can choose between two force levels for an even greater range of clinical applications. Both the Jasper Jumper and the Gentle Jumper provide provide the following:

- They are fixed so patient cooperation is assured
- They work along the growth or Y axis, thus they properly advance the mandible rather than retracting the maxilla
- Because of the ball joint, the Jumpers swivel allowing normal functions such as eating and tooth brushing
- They are safe. No extra-oral traction is involved
- They are cosmetic
- They can be used for Class II or Class III corrections and can apply different forces on each side of the jaw for cross bites
- Forces are adjustable and measurable

Fig: Jasper Jumper

Measuring for correct size:

To get the right length, have patients bite in their retruded or centric bite and measure from the mesial of the headgear tube to the distal of the lower ball stop, then add 12 mm (4 mm for the tube, 4 mm of free play, and 4 mm of built-in activation). Some patients may require different length Jumpers on the left or right side.

Sectional wire for main arch wire attachment

A sectional wire has been specially designed for Jasper Jumper and Gentle Jumper use. The uniqueness of this wire lies in the anterior loop design and its attachment to the main arch wire. This loop design allows for attachment to the main arch from lingual to buccal as opposed to the conventional wrap around from the buccal to lingual. The advantages are lower profile and minimal patient irritation in addition to trouble free action and the virtual impossibility of displacement from the main arch.

8.2HISTORY

The Jasper Jumper is an orthodontic appliance that corrects an overbite or underbite. This first flexible functional appliance was introduced in 1987 by James Jasper.

Fig: James J. Jasper, DDS

This appliance can produce rapid changes in the upper and lower jaws. There are end attachments that allow movement when the patient is chewing, talking or cleaning their teeth; but when the patient is relaxed the appliance straightens and applies gentle, continuous force.

Jasper Jumpers are also a greatly used alternative to elastics. When a patient is not consistent with wearing elastics, no progress is made. Alternatively, when Jasper Jumpers are placed it gives the 24/7 consistency that allows steady progress in minimal time.

8.3CEPHALOMETRIC ANALYSIS

This study was approved by the Ethics in Research Committee of the University of São Paulo, and all subjects signed an informed consent. All patients met the following inclusion criteria: (1) class II division 1 malocclusion with bilateral class II molar relationship (with a minimum severity of one-half class II molar relationship), (2) no craniofacial syndromes or systemic diseases, (3) no tooth agenesis or missing permanent teeth, and (4) mandibular arch showing minimal or no crowding.The Jasper Jumper group (group 1) included 25 subjects (13 males; 12 females) treated with fixed appliances and the force modules of the Jasper Jumper appliance. All patients were in the early permanent dentition with all permanent first molars, and first and second premolars erupted. Their initial mean age was 12.72 years (SD = 1.21, range 10.32 to 14.84 years), and their final mean age was 14.88 (SD = 1.20, range 12.74 to 16.90 years), treated for a mean period of 2.15 years (SD = 0.30). These subjects had an initial ANB angle of 5.38° (SD = 2.87°) and a mean overjet of 6.24 mm (SD = 2.21 mm). This group was collected and treated by one operator (L.S.N.).

The mean treatment time with the Jasper Jumper was 7 months (range 3 to 12 months). After removal of the jumpers, the corrected anteroposterior relationship was retained with 5/16-inch class II elastics for a mean period of 4 months (range 1 to 8 months), with a daily recommended use of 14 h. After removal of the fixed orthodontic appliances, a Hawley plate was used in the maxillary arch and a canine to canine bonded retainer was used in the mandibular arch.

The Jasper Jumper is a relatively new auxiliary capable of producing rapid change in occlusal relationships. It is a flexible fixed appliance that delivers light, continuous force. It can be used to move single teeth, units of teeth or an entire arch. It can deliver functional, bite jumping forces, headgear-like forces, elastic-like forces, or a combination of these.

The element of control is the most important advantage of the Jasper Jumper. The appliance cer-tainly offers more directional control than elastics or fixed coil springs, with their extrusive and constric-tive forces on the lower molars and extrusive forces on the upper anterior teeth.

The Jumper can be easily placed, activated, and removed. It does not interfere with space consolidation, extraction treatment, or non-extraction treat- ment, and it enhances mandibular leveling. It can be used with bite planes, J-hook headgear, and various elastic combinations.

Patient acceptance is excellent because the patient's only responsibility is to keep the appliance clean and avoid breakage. The Jumper's flexibility makes oral hygiene easy, and because the appliance curves away from the occlusal table on closing, it does not interfere with chewing.

8.4 BIO-MECHANICS OF THE JASPER JUMPER

When the Jumper is first installed, it bows toward the cheek. Over time, the mandible moves forward to a neutral position. Mastication then helps deliver intrusive and distalizing forces on the upper molars, much as a high-pull facebow would, along with intrusive forces that work to level the lower anterior teeth.

Furthermore, the forward and downward positioning of the mandible is along the y-axis, allowing the jaws freedom for normal growth.

The usual results of using the Jasper Jumper area:

1 Intrusion and distalizaiton of the upper molars, with occasional opening of the posterior bite similar to that seen with a Herbst appliance.

2 Some indicaiton of condylar growth.

3 Anterior migration of the mandibular teeth through alveolar bone.

4 Intrusion of the lower incisors.

5 Expansion of the upper molars if heavy, con-stricted maxillary archwires and/or transpaltal bars are not used.

Good results have been obtained in mixed denti-tion, adolescent dentition, and adult cases. Treatment time is usually shortened because of 24-hour-per-day, uninterrupted force application. Dr. James Jasper, originator of the appliance, allows six months for leveling and anchorage preparation, six to nine months for Jasper Jumper use, and 12 months for finishing. Leaving the Jumper passively in place for three to four months enhances the stability of the results.

The following modifications to Dr Jasper's origi-nal technique' have been developed to make the appliance easier to incorporate into a busy practice schedule. They allow almost complete delegation of insertion, where permitted by state law, and give the clinician more control over several potentially ad-verse side effects.

8.5RECENT APPLIANCE MODIFICATIONS

Use a transpalatal bar or a full-slot, heavily con-stricted maxillary archwire unless a slow palatal expansion is desired. The palatal bar allows space closure, leveling, and rotation correction to proceed while the Jumper is in place.

Even in fully bonded cases, add a looped lower lingual arch to enhance anchorage. The only exception would be an extraction case in which mandibular molar advancement is needed for space closure.

Always use the largest possible rectangular wire (fill the slot) in the lower arch.

If possible, use -5° lower anterior brackets, or add anterior lingual crown torque to the lower archwire to enhance anchorage.

If anterior vertical elastics are required, back them up with high-pull J-hook headgear to prevent extrusion of the upper anterior teeth.

INTRA-ORAL FITTING OF THE APPLIANCE

Have the patient bite in centric relation, and measure from the mesial of the first-molar headgear tube to the distal of the Teflon friction ball. Add 12mm to the measurement to obtain the correct Jasper Jumper size. If there is no appliance of that size, select

the next larger size and allow the ball pin to protrude more distally from the upper molar tube

Each Jumper is marked "UR" (upper right) or "UL" (upper left) with one of seven sizes. Do not attach a Jumper upside down or on the wrong side; this will cause binding and subsequent archwire, bracket, or appliance breakage.

Attach the Jumper to the upper headgear tube using the supplied ball-pin attachment. Feed the pin through the upper hole in the Jumper, then through the distal end of the headgear tube. Leave 2-3mm protruding distally to prevent binding. Free movement is essential.

For patient comfort and acceptance, it is advantageous in initial placement to let the ball slide out far enough that the appliance is passive. At the next visit, the maxillary attachment can be advanced to activate the Jumper.

There will be a bow in the appliance at first, but the patient will soon position forward as with other functional appliances .

8.6CONNECTION AND ACTIVATION AND METHODS WITH ADVANTAGES AND DISADVANTAGES

There are several ways to connect the Jumper to the lower arch. Each method has advantages and disadvantages.

Method One: As the appliance was originally de-signed by Dr. Jasper, offsets are placed in the lower .018"x.025" or .021"x.028" archwire, distal to the cuspid bracket, and the first bicuspid bracket is re-moved. The Teflon friction bar is slid onto the archwire, followed by the lower end of the Jumper. The arch is then ligated in place, and the upper portion is attached to the headgear tube. The archwire must be bent down distal to the terminal molar to prevent slippage.

Advantage: No additional parts required.

Disadvantages

1 Unattached bicuspids tend to erupt above the occlusal plane as the anterior teeth are intruded.

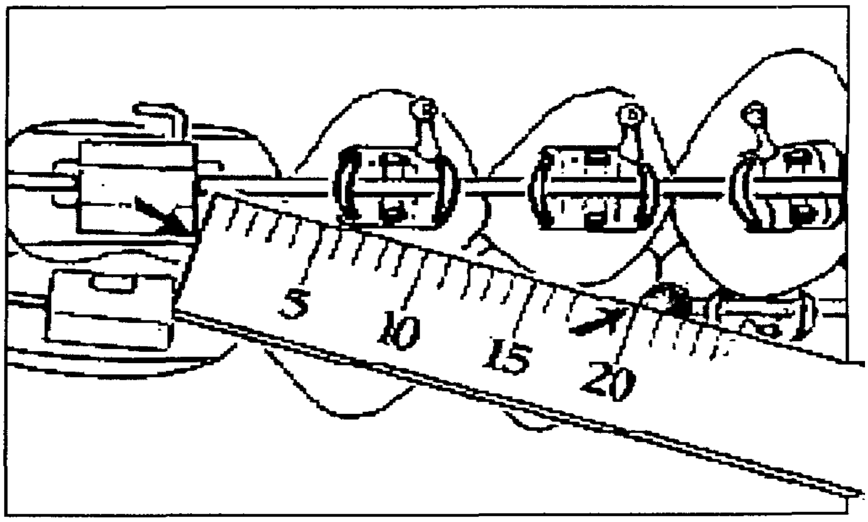
2 Jaw opening is limited because the lower portion of the Jumper tends to bind at the second bicuspid. Limited opening is a major disadvantage of some similar flexible fixed appliances.

3 Replacement of a broken Jumper requires removal of the entire archwire.

4 If an arch breaks or comes untied at the distal tieback, all the force is transferred to the anterior teeth, which tends to tip them for-ward, depress them, and open space.

5 Removing the Jumper for an occlusal check is time-consuming.

6 In an extraction case, it is difficult to close spaces because the Jumper must be attached to the arch before closing loops are bent.



Method Two: Make an attachment out of an .017"x.025" stainless steel wire, soldered to a Rocky Mountain Lock, then bent so as to pass distal to the lower first molar. The lock is attached between the bicuspid and cuspid.

An alternative is to place the lock distal to the molar bracket with the wire bent distal to the cuspid. This approach uses a free-sliding quick connect. The wire runs parallel to the main archwire, allowing the Jumper to clear the bicuspid brackets.

Advantages

1 The attachment can be made in the office laboratory, and placement can be delegated to an assistant— simply screw on the attach-ment, measure, and place the Jumper.

2 The jaws can open fully.

3 Force is directed distal to the molar; if the archwire breaks, there is no effect on the anterior teeth.

4 The Jumper does not interfere with space closure or leveling procedures.

5 A broken Jumper is easy to replace.

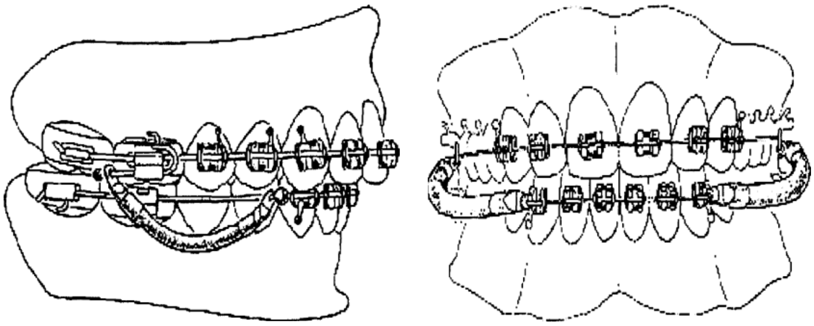
6 No auxiliary tubes are needed on the man-dibular molars.

Disadvantages

1 Laboratory time is required to solder and bend the attachment.

2 The Rocky Mountain Lock assembly is an additional expense.

Method Three: The most time-effective setup uses an auxiliary tube on the lower first molar and pre-formed .017"x.025" sectional arches. The sectional arch is looped over the main archwire, with enough separation for the Jumper to clear the bicuspid brackets and avoid occlusal interference.



Advantages

1 The sectional arches can be bent by assistants during free moments. After measurement by the clinician, the Jumper can be attached by an assistant.

2 If breakage occurs, there is no adverse effect on the dentition.

3 The material is inexpensive.

4 It is easy to change or remove Jumpers.

5 The appliance delivers force distal to the man-dibular molar tube, rather than to the archwire.

6 Full jaw opening is possible.

7 A longer Jumper can be used, allowing more freedom ofmovement and reducing the chances of breakage. A longer Jumper is less likely to take a set and lose efficiency, and therefore delivers a more constant, controllable force.

8 The mandibular first bicuspid brackets do not need to be removed to prevent overeruption.

9 A fatigued Jumper can be reactivated by placing a Rocky Mountain Lock mesial to the Teflon friction ball, positioning the ball more distally.

Disadvantages: None.

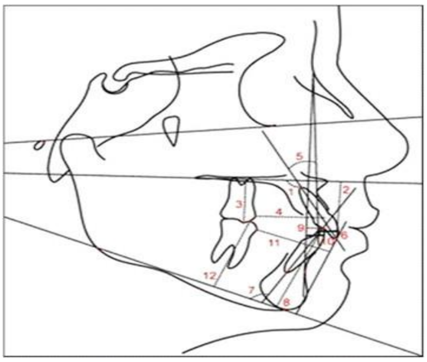
DISCUSSION

The Jasper Jumper is an excellent appliance for class two cases requiring dento-alveolar sagittal cor-rection.The 24 hour constant force generates a round-the-clock forward mandibular pressure, which corrects class two deficiencies earlier as compared to inter-maxillary elastics. However, The force magnitude of the jumper is regulated by the extent of distortion of the open coil. The longer the spring in relation to a certain distance, the more it will bend and the higher its resulting initial force magnitude will be. The set expansion force does not remain constant but falls in course of time.

The initial spring force of about 4N (400 grams) will be reduced by half after a week. The embedding polymer, which is first of all rigid and then de-naturates due to the patients oral functions and or the patients thermal and chemical influences of the oral cavity., plays an essential part in this initial force decline. The remaining force magnitude is attained essentially by distortion of the open coil. This amount of force also falls in time due to metal fatigue and plastic deformation due to chewing biting sucking between the teeth etc. tow or three months later the force magnitude will have declined to about 1 N .

The Jumper has a flexible bite jumping effect that pushes against the maxillary and mandibular denti-tions. This module is a modification of the bite jump-ing mechanism of Herbst that was developed nearly 100 years ago 11. The Jasper Jumper and the related Herbst appliance produces a relatively rapid correc-tion of a Class II malocclusion by both sagittal and intrusive forces. Both skeletal and dentoalveolar ad-aptations have been observed with the jumper mechanism.

The appliance system has been improved over the last 10 years, so that now the modules are more resistant to fracture during appliance wear. Patients should be instructed not to chew on the appliance and also not to perform wide open movements. Strict dietary controls are mandatory. In addition, the pa-tient should be cautioned repeatedly not to "pop" the modules after yawning or excessive wide opening. It is critical that the clinician must prepare anchorage before the force module is placed against the lower arch. If the arch wire is full sized (or nearly so) and is properly anchored posteri-orly, forward movement of the lower dentition is minimized. The placement of lingual crown torque anteriorly and tip-back bends posteriorly will further enhance anchorage. If the clinician is concerned about the mesial movement of the lower dentition, use of lighter forces with the module is advocated.



Dentoalveolar cephalometric variables: 1, 1.PP; 2, 1-PP; 3, 6-PP; 4, 6-ANSperp; 5, 1.NA; 6, 1-NA; 7, IMPA; 8, 1-GoMe; 9, 1.NB; 10, 1-NB; 11, 6-Pogperp; 12, 6-GoMe

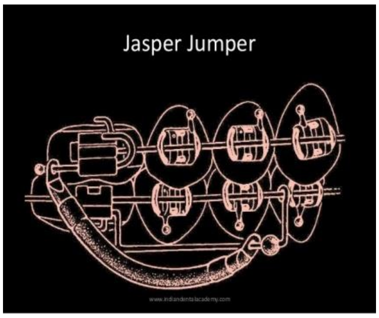
8.7Cantilever Bite Jumper

The **Cantilever Bite Jumper** (CBJ) is an evolution of the **Herbst** appliance. It is composed of stainless steel crowns (SS crowns) cemented onto molars. In the maxilla, the SS crowns can be incorporated to an Hyrax expansion device as seen on this picture.

In the mandibular arch, the SS crowns are joined by a rigid lingual arch with occlusal rest on the first premolars and a long cantilever armspring soldered to the buccal side of the lower SS crown and extending up to the first premolar. The end of this cantilever armspring is augmented by a rectangular tube in which a segmented orthodontic archwire can be inserted to consolidate the anterior lower teeth from canine to canine.

Rigid devices with adjustable length depending on the correction required for each case maintain the lower jaw in an advanced position.

This mechanism is spring free and it is harder to adapt to.


Jasper Jumper

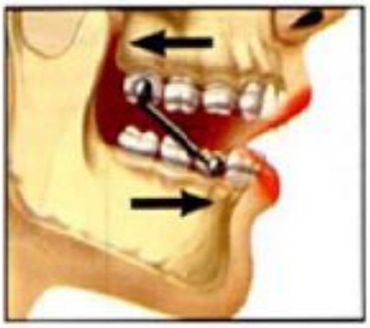
HERBST APPLIANCE

CHAPTER 9: HERBST APPLIANCE

9.1 INTRODUCTION AND HISTORY

The Herbst appliance (Dentaurum, Newtown, Pa) is suitable for slightly older children whose cooperation might not be dependable, because it is a fixed appliance worn 24 hours a day. The Herbst was introduced in 1905 by Emil Herbst (1842-1917), but his findings were not published until 1935. Little more was published on the appliance until the late 1970s, when Hans Pancherz, recognizing its possibilities for mandibular growth stimulation, revived interest. The typical Herbst consists of a telescoping mechanism connected to the maxillary first molars at one end and a cantilevered arm attached to the mandibular fist molars at the other end; it forces the mandible forward.

The Herbst appliance is the fore runner of all the fixed functionalappliances. It was introduced by a German professor **Emil Herbst** at theinternational dental congress in Berlin in 1905. In 1934, Herbst presented a series of article in the **Zahnarztliche Rundschau**on hisexperience with the appliance. After **1934**, however very little was published on the subject, and the treatment method move or less for gotten.The credit of reintroduction of Herbst appliance goes to **HansPancherz**. Through his article published in American Journal of orthodontics in 1979, be showed the treatment of Class II malocclusion by jumping the bite with the Herbst appliance. After this the appliancegained popularity and thereafter many modifications were alsointroduced. Basically, the appliance is a flexible bite jumping – device,with telescope mechanism attached to the upper and lower dentition.



One of the most common problems orthodontists treat is the discrepancy that occurs when the upper teeth protrude beyond the lower. Ordinarily, when we see a patient with the upper teeth protruding, it tend to think that the upper jaw and teeth are too far forward; but, more often than not, this condition is due to a small lower jaw that is further back than it should be. With these patients, it would like to encourage the lower jaw to catch up in growth, and appliances like the Herbst appliance help this happen.

Even though the Herbst appliance prevents the lower jaw from moving backward, opening and closing movement still occur easily, and patients do not have any problems learning to chew their food with their lower jaw in this new position.

Aside from the obvious benefits of orthodontic treatment, like increased confidence and ease of hygiene, another benefit is not so obvious: improved jaw function. If the child has an overbite, simple treatment with braces will not correct the problem. The Herbst appliance, usually in conjunction with braces, is used to help the lower jaw develop in a forward direction. This eventually leads to an ideal bite. Left untreated, an improper bite may threaten the long-term health of your child's teeth, gums, and jaw.

A Herbst appliance is fixed to the child's molars. It includes a metal tube that connects the upper and lower jaw. By adjusting the tube, orthodontist is able to control the jaw's position in relation to the upper teeth. Typical treatment time with a Herbst appliance is 12 months, though this may vary depending on your child's unique needs.

Compliance

The main difference between a Herbst appliance and headgear is that the Herbst appliance is securely fastened to the child's teeth, while headgear is removable. To be truly effective, headgear must be worn between 12 and 16 hours per day, which often poses a problem with patients who don't like to keep it on that long.

Aesthetic

Another difference is aesthetics. Headgear is bulky, made of metal hooks or a facebow, and straps or a head cap to anchor the headgear to the back of the head or neck. A Herbst appliance is a much more discreet option: it may be visible when the child laughs or speaks, but it is far less obtrusive than headgear.

Adjusting to a Herbst Appliance

Muscle Tenderness – When the child first gets his or her Herbst appliance, there may be some overall muscle tenderness and soreness of the teeth. As the child's mouth adapts to the appliance, the soreness should fade.

Tissue Irritation – Because the Herbst appliance is metal, it may cause some slight tissue irritation, especially on the lower gums. It will take time for the child's mouth to adapt. Until it does, dental wax can help to ease the irritation.

Diet – Eating softer food will help with any muscle soreness, especially after the first week or two after getting the appliance. It is also important to eliminate sticky foods, like candy and gum, or hard, crunchy food, which can damage the appliance and lengthen treatment time

9.2 INDICATION

1)The Herbst appliance is indicated in correction of Class II malocclusions due to retrognathic mandible.

2)They can be used as an anterior repositioning splint in patientshaving temporomandibular joint disorders

The following are specific indications of the Herbst appliance:

1) Post adolescent patientsPossible to use residual growth left in these patients as treatmentcompleted in 6-8 months.

2) Mouth breathers

3) Uncooperative patients

4) Correction of functional midline shift by using the applianceunilaterally.

Other indications

•Distalization of molar

•To enhance anchorage

•As a mandibular anterior reposition of splint in patients havingTMJ disorders.

9.3CONTRAINDICATIONS

1)Contraindicated in non-growing patients.

2)Hyperdivergent facial pattern

3)A patient with negative VTO use of functional appliances results in less than satisfactory resultsand is therefore not recommended.

9.4ADVANTAGES

1)Used in uncooperative patient. i.e. patients compliance not required.

2)Action is continuous for 24 hours of the day.

3)Achieve the results in around 6-8 months.

4)Advantageous in mouth breathers.

5)Does not interfere with speech or mastication

6)Used successfully in post adolescent patients in whom very littlegrowth is remaining to work with.

7)Procedures such as rapid maxillary expansion, fixed appliance or head gear can be given with appliance in place.

9.5 DISADVANTAGES

1)Though treatment can achieved within 6-8 months, retention of theresult has to maintain using removable functional appliance

2)Risk of development of dual bite.

3)Masticatory efficiency is reduced.

4)High incidence of breakage and loosening of the appliance.

5)May restrict lateral mandibular movements

6)It is expensive.

7)Plaque accumulation and enamel decalcification occur, especiallyin the splint type of appliance.

9.6CLASSIFICATION OF HERBST APPLIANCE

1)Banded Herbst

2)Bonded Herbst

Larry White classified Herbst appliance in1994 As

1)Herbst appliance I – basis design

2)Herbst appliance II – with addition of fixed appliance.

BASIC HERBST APPLIANCE

The Herbst appliance is an artificial joint between maxilla andmandible. Telescope mechanism on either side of the jaw, attached to orthodontic bands, keep the mandible continuously in an anterior jumped position during all mandibular function.The telescopic tube was attached to the maxillary permanent firstmolar band and the telescope plunger to the mandibular first premolar band.

9.7 Appliance construction

1) In non-extraction cases, upper and lower first molars and first premolars and banded. In extraction cases, first molars and caninesare banded.

2)Take a wax bite with mandible in a forward position, so that thereis about one millimeter of overjet and overbite.An end to end incisal relation ship can be used, but the risk of fracture of incisal edges might be increased.

3)Take upper and lower impressions with band seated. Remove bands, place separators and dismiss patient, put the bands intoimpressions and pour impressions.

4)Mount upper and lower casts on hinge articulator with bite in place.

5)Take the tube with the screw and pivot assembled and hold the pivot alongside off the upper molar band, with the opposite end of the tube about 2 mm from buccal surface of first premolar band.This is working position in which the pivot must be soldered to the molar band.Care should be taken that upper pivots should be placed distally on the molar bands.The tubes comes in right and left with the pivot ends angledto allow for the mesiodistal angulation of the upper first molar buccal surface.

6)Disassemble screw, pivot and tube.

7)Solder the pivot to the upper molar band in correct working position.

8)Solder pivot to lower premolar band

9)Place the tube on upper molar pivot and rod on lower premolar pivot, so that they lie along side each other. Make a mark on tube even with the shank of the rod and mark on rod at the distal aspectof first upper permanent molar. Cut rod and tube at the marks,allowing a little extra length for fine adjustment.

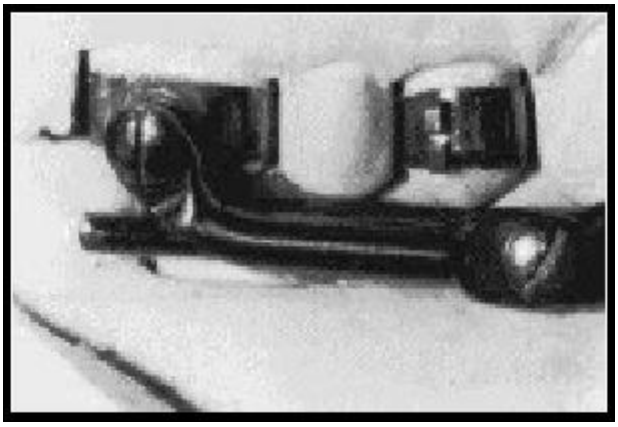
10)For line adjustment of the tube and rod, place rod into tube so thatthe shank of the rod is touching the end of the tube. The assembly shouldslide easily onto both upper and lower pivots, with the anterior teethtouching.

11)Solder a full lingual arch connecting the molar and premolar bandsand solder a buccal stabilizing wire connecting the molar and premolar bands.

12)Solder either a full lingual arch or sectional lingual bars connectingthe molar and premolar bands on each side.The appliance is now ready for polishing and cementing in the patients mouth.

Important consideration in appliance construction

1)Anchorage



In the maxillary arch, the I premolar and permanent I molar are banded and are interconnected on each side with the half round(1.5mm X 0.75mm) lingual sectional arch wire.In the mandibular arch, the first premolars are banded andconnected with a half round lingual sectional archwire touching thelingual surfaces of the front teeth. This from of anchorage is calledas partial anchorage.In several instances this type of anchorage is insufficient andis therefore increased by the incorporation of additional dentalunits. When the lingual sectional arch wire is extended to the permanent I molar band, it is called total anchorage.According the lower anchorage used the patients are dividedinto several groups.I

I Premolar anchoragei.e. Partial anchorageII.Premolar-molar anchoragei.e. Total anchorageIII.Labial-lingual anchorageA premolar to premolar to premolar

labialrectangular arch wire is added to the lingual premolar molar anchorage system. The archwire is attached to the brackets on the front teeth and tubes on the I molar bands.IV.Class III elasticsClass III elastics (about 150gm) are added to thelingual premolar molar anchorage system. In themandible the Class III elastics are attached to a labialcanine to canine rectangular arch wire and in the maxillato the screws on the I molar bands.

Herbst often used crowns instead of bands onanchor teeth. But Langford (1982) was firstcontemporary orthodontist to suggest using preformedstainless steel crowns.

Dischinger (1989) expanded onthe idea of using stainless steel crowns on the upper Imolars and lower I bicuspids. By adding tubes to theupper molar crowns and mandibular molar bands he wasable to simultaneously placed bonded brackets on theanteriors and use utility arches to correct crowding,derotation and intrude the incisors

.2) All bands should be formed individually of orthodontic bandmaterialat least 0.15mm in thickness.

3)The upper and lower pivots should be placed parallel to each other.This will provide a correct and smooth function of telescopemechanism.

4)The upper pivot should be placed distally on the molar bands andlower pivots mesially on the premolar bands. A large inter pivot distance on each jaw side will prevent the plunger from slippingout of the tube when the mouth is wide open e.g. during yawning.

5)The pivot opening on the tube and plunger should be widened. Thiswill provide an increased lateral movement capacity of themandible.

6)The screw on the maxillary parts tends to loosen during treatment,frustrating both the screw slot, can be soldered to the molar crownof the appliance.

Instructions given to the patients

1)Warn the patient to expect muscle pain and general discomfort,which will be transitory.

2)Remind the patient that a soft diet will be necessary for aboutweek, because the molar will not occlude. The patient experiences chewing difficulties during the first 7-10 days of treatment.

3)Chances of loosening of screws should be reminded.

44)Sometimes, the tubes have to be short that the rods pull completelyout of the tube when patient opens wide. It is a simple matter for the patient to place the rod back into the tube and they soon learnhow wide they can open without this happening.

5)Breakage and loose bands should be reported to the clinicimmediately.

6)Maintenance of good oral hygiene.

Reactivation of the appliance

If the initial amount of mandibular advancement built into theHerbst appliance at the time of construction is inadequate in establishingincisor and molar relation ship the appliance can be reactivated after 2-3months. This is done by removing the upper left and right sleeves or tubesand replacing them with longer sleeves thus positioning the mandiblefurther forward.

Retention after treatment

The improvement in sagittal molar and incisor relationships seenafter 6-8months of Herbst – appliance treatment is mainly as a result of increase in mandibular growth, distal tooth movements, in the maxillaand mesial tooth movements in the mandible.A possible relapse in dental arch relationships alter treatment mayresult from dental changes in the maxilla and mandible and or from an unfavorable growth development. A stable cuspal interdigitation willcounteract an occlusal relapse.According to Pancharz , the Andresen activator is most suitable retention device after Herbst treatment. The appliance holds the teeth inthe desired position. Selective grinding of the acrylic makes interocclusal adjustments possible by guiding tooth eruption.A musculature would most likely need a longer for permanentadaptation. So activator helps in adaptation of musculature.A treatment usually is performed in the mixed dentition, retentionwill thus be necessary with the permanent teeth have erupted and theocclusion is stabilized.

9.8TREATMENT EFFECTS ON THE DENTOALVEOLAR COMPLEX

Six months after treatment Class I molar relationship achievedfrom Class II overjet and overbite reduction occurred.

Sagittal cephalometric changes Correction of Class II molar relationship and overjet correctionwere about equally a result of skeletal and dental alterations.

Vertical cephalometric changes Overbite was reduced an average of 55% during 6 months of treatment with Herbst appliance due to changes in

•The mandibular incisors and maxilla molars were intruded duringtreatment while eruption of maxillary and mandibular second premolars and mandibular molars were extruded.

• Also reduction of deep bite is due to proclination of lower incisors.

• With reduction of overbite, lower facial height was increased.

9.9CLINICAL PROBLEMS ASSOCIATED WITH THE HERBSTAPPLIANCE

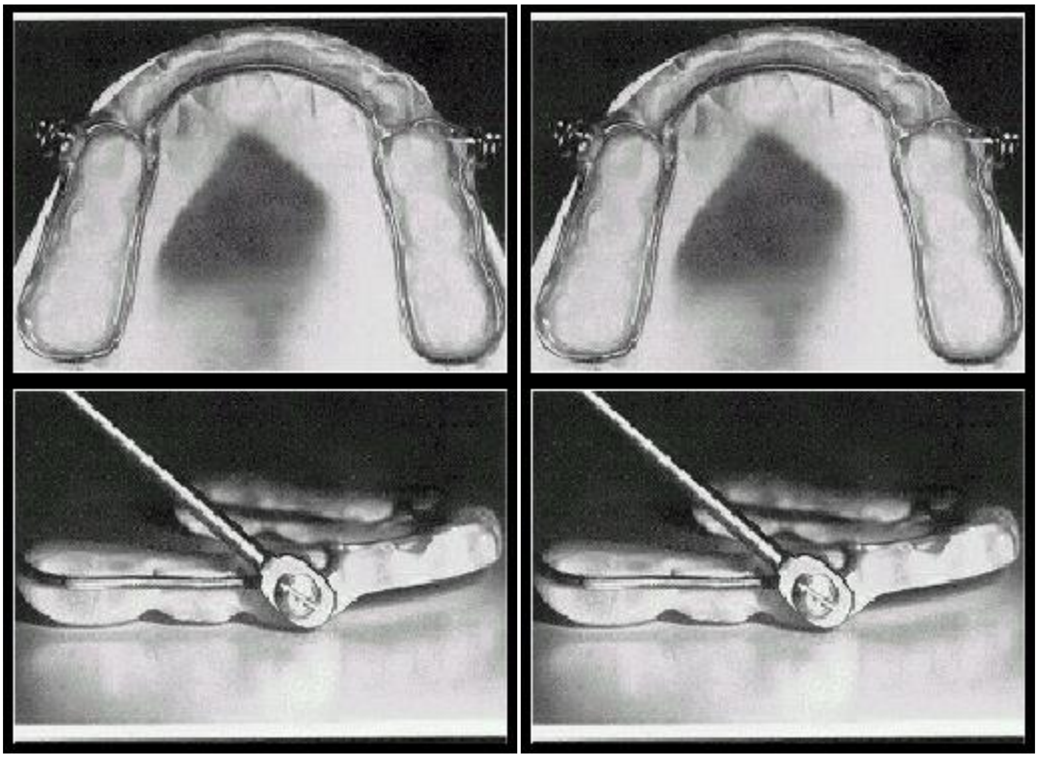
1) Lower part of appliance attached to the mandibular I premolar bands therefore use of appliance is limited to those patients witherupted mandibular first bicuspids. This requirement preventsmany younger patients in deciduous/mixed dentition stages fromwearing the appliance.

2)Repeated breakage and loosening of the appliance occursespecially on the lower bicuspid band area.

Longford has stated the placement of stainless steel crowns on theabutment teeth to prevent this.

9.10 MODIFICATIONS

1) Bonded Herbst applianceRaymond Howe in 1982 modified the original Herbst appliance toovercome the limitations of original Herbst appliance. The principle difference between the original and proposed appliance designs is that the paired telescoping elements, which had been attached to the lower bicuspid bands, are now attached to the entire lower dental arch by anacrylic bite.



Modifications

1)Short, stiff coil springs (0.020"spring wire) 3mm long, with aninside diameter slightly larger than the plunger shaft, can be placed between upper and lower telescoping elements. They are designed to provide a dampening effect as the plunger sleeves contact uponclosure. This may reduce shock-induced loosening of either theupper bands or lower splint. These springs can also be used toreactivate the appliance. By placing the spring over the lower plunger shafts, the upper sleeves are displaced distally, effectivelylengthing the telescoping mechanism and thereby advancing the mandible further forward.2)Rapid palatal expander can be incorporated into the Herbstappliance.3)Rotation of post teeth can be corrected by transpalatal arch bar.4)In vertical grower – vertical pull chin cup in order to restrict further vertical displacement.5)In patient with hyperactive mentalis muscle Frankel like labial pads attached in the buccal tube which is incorporate in mandibular splint.6)If distal component of force desired, mandibular lip bumper can beincorporated.

Instructions

Restrict sugar intake, brush carefully use of fluoride mouth-rinse.

Advantages of split design

1)Used at any stage of dental development.

2)Intrusion of mandibular bicuspid is minimized.

3)Tissue impingement of the lower lingual wire can be avoided.

4)The incidence of failure of the appliance due to breakage has beengreatly reduced.

Further modification by same author (Raymond Howe in 1983)

To overcome the limitations of bonded Herbst appliance like breakage, splint loosening, etc. author modified this appliance as fallows:-The splint is incorporated in maxillary arch, exclusive of themaxillary central and lateral incisors.-All mandibular teeth included in lower splint lower incisor coverage may be omitted if posterior anchorage is adequate and the patient has an anterior open bite.

2) Head gear - Herbst treatment in the mixed dentition.Lennar Wieslander in 1984

Jumping the mandible with the telescoping arms has a slighttipping effect on the maxillary splint. By using a high pull headgear withshort outer arms, the tipping tendency is counteracted. So headgear usednot only to try to increase the orthopedic effect, but also try to improvethe treatment result.Treatment results are due to anterior transformation of glenoid fossa.

3) Modified Herbst appliance for the mixed dentition.Phillip Goodman, Paul McKenna in 1985 Bonded form was used in mixed dentition. Stainless steel bonds onI upper molar and lower I molar and incisors. If max anchorage is critical, bonds may be also placed on maxillary I deciduous molars

4) Removable plastic Herbst retainerRaymond Howe in 1987 Single arch retainers are not effective for preventinganteroposterior relapse, which can result into reappearance of Class IIrelationship.In an effort to combine the useful properties of both single and dualarch retainers, Howe used removable plastic Herbst retainer. Its full upper and lower plastic splints function as conventional single arch retainers. Atthe same time, the removable splints are connected on each side bytelescoping Herbst mechanism, which acts as dual-arch anteroposterior retainer.

5) Edgewise bioprogressive - Herbst applianceTerry G. Dischinger in 1989 designed edgewise BioprogressiveHerbst to minimize certain limitations inherent in the Herbst design,incorporates edgewise brackets and Bioprogressive mechanics to correctClass II malocclusion.The mandibular first permanent molars are banded. The maxillaryarch is completely bracketed, but usually only the incisors are bracketedin the mandible. An 0.040" lingual wire joins the mandibular crowns and bands no transpalatal wire is used in the maxilla.

Advantages

1)Orthodontic tooth movements can be performed while theorthopedic Class I correction takes place

.2)The dumping of the lower incisors that has been associated withthe Herbst appliance is avoided by using a lower utility arch.

3)There is little chance of the appliance breaking or loosening.

4)Once the Class II relationship has been correct it is a quick andsimple transition to full fixed appliances for detailing and finishing.

5) Removable Herbst appliance for treatment of obstructive sleep apnea.

Ernest A. Rider in 1988

-Sleep apnea is a breathing abnormality that occurs during sleep.

Itis divided into:

1)Central-stoppage of air flow from lack of respiratory effort.

2)Obstructive-stoppage of airflow despite great effort to take in air.

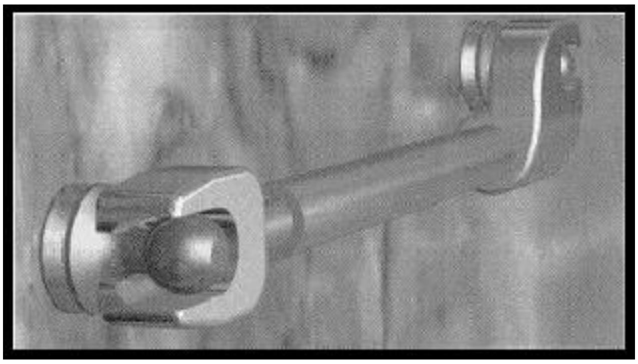
3)Mixed-starting as central, followed by obstructive.Obstructive sleep apnea is the most prevalent type and is usually associated with upper airway problems in both children and adults.Obstruction can occur from 10 to 500 times per night. Patients candevelop serious cardiovascular problems over an extended period.The removable Herbst appliance is available. Its plunger mechanism advances the mandible and tongue to a predetermined position.

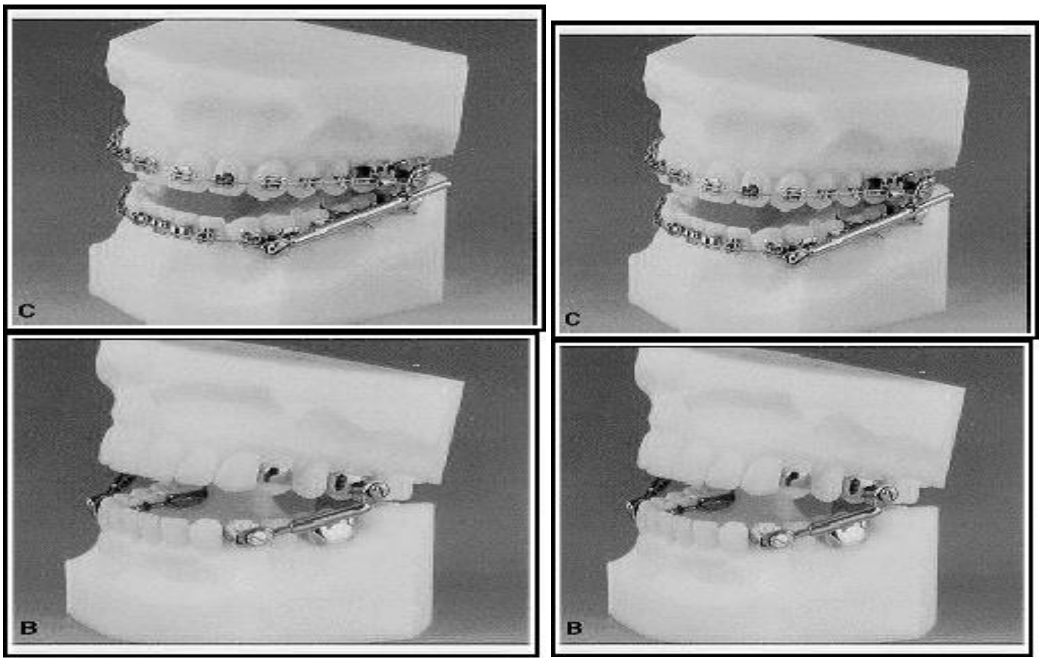
The mandible is usually brought forward to an initial edge toedge position. Current Herbst appliance therapyLarry W. White in 1994

Classified Herbst appliance as

1)Herbst appliance I – basic design

2)Herbst appliance II – With addition of fixed appliance.-They used cantilever Herbst appliance design.-Atlas axle with tube and piston held together by cotter pin.MALU attachment (Mandibular advancement locking unit) This uses dead soft wire to secure the maxillary tube of upper molar band. Frequently, the screw protrudes enough toencroach on the mucosal of the cheek and cause ulcerations. This problem is relieved by covering the screws with Hug-caps. The Swedish-style integrated Herbst appliancePaul Haegglund, Staffan Segerdal in 1997 Connecting the Herbst pistons directly to the mandibular archwiretend to cause loose brackets and arch wire breakage. Instead, author distributed force from Herbst appliance to the mandibular arch wirethrough a sliding auxiliary arch wire made of 0.9-1mm round stainlesssteel. This auxiliary arch wire is attached to main arch wire posteriorlywith buccal tube on the lower first molars and anteriorly with elastomericmodules to surgical ball, nooks, or crimpable hooks or with a postedarchwire.Initially they bent the distal ends of the lower first molars, andlocked in place with elastomeric modules. Disadvantage is it reduces thesliding range of Herbst appliance.





To connect the pistons to the auxiliary archwire, they first used MALU attachment with cotter pin opening. Later, they developed a modified piston that can be connected to the auxiliary-archwire at theanterior loop or distal to it.

The auxiliary archwire has the following advantages-Has a shock-absorbing effect due to its connection to the mainarchwire with elastomeric modules.-Distributes the forces from the Herbst appliance to the mainmandibular arch wire. Flip lock Herbst applianceRobert A. Miller in 1996 A new design, the flip-lock Herbst appliance, reduces the number of moving parts that can lead to breakage or failure. It is easy to use andmore comfortable for the patient than the conventional type of Herbstappliance. Instead of a screw attachment, it has a ball-joint connector andit needs no retaining springs.

EUREKA SPRING

Chapter10: Eureka spring

10.1 INTRODUCTION

Correction of Class II malocclusions has been accomplished by headgear, elastics, and various removable functional appliances. All of these methods require good patient cooperation for success. However, because of a trend toward reduced patient compliance, these methods often fail to correct the Class II malocclusion in a timely fashion. The latest addition is the Eureka Spring (ES) (Eureka Spring Co, San Luis Obispo, Calif), which is reported to have significant advantages over all of the aforementioned appliances. Before the ES can be used with confidence, it is important that its treatment effects are assessed. The purpose of this report is to evaluate cephalometrically the skeletal and dental treatment effects of the ES in a group of noncompliant patients.

10.2 HISTORY

The idea behind Eureka Spring, the first and original spring force device, was conceived by Dr. John P. DeVincenzo(1997), a clinical orthodontist in San Luis Obispo, California. The forerunner to this spring was a system devised by Northcutt (1974).

The process of development occurred over a period of more than two years. Initially, a design was established and tested in a laboratory until a product finally emerged that was considered the “perfect” intraoral model. Finally, after many trials and errors, a Eureka Spring design was found which was effective and sufficiently trouble free and was used for more formal clinical trials involving large groups of patients.

It was introduced in May of 1996 and the development of the Quick-Connect model followed. Since the first Eureka Spring was invented, others forces have been produced and sold, but because the Eureka Spring holds domestic and foreign patents, no one is able to match its slim and comfortable design.

Eureka Spring is a three part telescopic appliance fixed to the upper arch at the level of the molar band and to the lower arch distal to the cuspid. The main component of the Eureka spring is an open wound coil spring encased in plunger assembly.

It has esthetic acceptability because of its small size and produces forces of only 140 - 170 grams at the points of attachment as compared to 220 - 280 grams of Jasper Jumper. The appliance is universal and it can be applied to both right and left side.

10.3MECHANISM

Telescope rods with integral light force compression springs

10.4 ANCHORAGE

Fully banded U and L arch with torque control with TPA

10.5 INDICATIONS

- Dental bclass II malocclusion
- Upper molar distalization
- Lower incisor advancement

10.6 CONTRAINDICATIONS

- ClassII open bite
- Procumbent incisors
- Deep buccal overbite/posterior cross bite.

Fig: Eureka Spring

MARS APPLIANCES

CHAPTER 11:MARS APPLIANCE

[Mandibular Anterior Repositioning Splint]

Functional Appliances: Mara Appliance



INTRODUCTION

MARA (Mandibular Anterior Repositioning Appliance) is used to achieve Class II correction treatment goals in the “noncompliant” patient. For the MARA patient to close the mouth and occlude the teeth, they must posture the jaw forward into the desired Class I occlusion. With the MARA, the mandible is held forward in Class I occlusion by the labs positioning of the buccal attachments on the molars. The MARA is anchored to the molars in the same manner that a Herbst appliance is i.e. crowns, modified crowns or bands. The lower buccal attachments are fixed to the molars while the upper buccal attachments (called Elbows) are removable. Each MARA comes with both upper and lower archwire tubes to facilitate the option of fixed mechanics being used in conjunction with MARA treatment.

MARA stands for mandibular anterior repositioning appliance. MARA is an acronym for Mandibular Anterior Repositioning Appliance. This appliance is used to encourage forward growth of the lower jaw. It is felt that this appliance is the easiest to get used to and is the least obtrusive. The MARA appliance has been designed to correct the bite by aligning the lower jaw with the upper jaw. It can also improve facial profile in addition to correcting the way teeth fit together when chew. The MARA was custom-made to fit inside mouth. It has been cemented to the teeth using special fluoride-releasing cement.

The MARA guides the lower jaw forward using upper "elbows" and lower arms. Patients are usually chewing normally after approximately one week. Until then, it may want to eat soft foods and smaller pieces during the adjustment period. The upper and lower appliances are NOT connected together. It will still be able to open the mouth fully and not be restricted in side-to-side or chewing movements.

While first adapting to the MARA, the elbows or arms on each side may irritate the inside of cheeks. The cheeks will toughen up with time as the tissue adjusts to the presence of the appliance. It may appear that cheeks are slightly puffy initially. This will go away after a few weeks.

Although the MARA is resistant to breakage, nothing that cement into the mouth is indestructible. Stay away from extremely hard, sticky and very chewy candy and foods.

In order to continue making progress with jaw position and the correction of bite, it will periodically advance or "activate" the MARA." Following an activation appointment, will feel lower jaw being guided farther forward, which will once again change the way teeth meet when bite.

Fig: For proper appliance fabrication include a wax bite to the desired vertical opening and mandibular advanced position.

THE CHURRO JUMPER

CHAPTER 12:THE CHURRO JUMPER

Flexible fixed functional appliance that is the Churro Jumper by Ricardo Castanonand Larry White in 1986.

- INDICATIONS –CLASS II traction
- CONTRAINDICATIONS- deep bite
- MECHANICS—class II coil springs intention
- ANCHORAGE—fully banded lower arch with torque control.
- EFFECT ON UPPER MOLAR—extrusive

This is an inexpensive alternative force system for the anteroposterior correction of Class II and Class III malocclusions. The mesial and distal ends of the jumper are circles. The distal circle is attached to the maxillary molars by a pin and the mesial end is placed over the mandibular arch wireagainst the canine bracket.

The Churro Jumper is an efficient, inexpensive and uncomplicated fixed flexible functional appliance. It is used to evaluate the efficacy of the Churro Jumpe appliance in treatment ofskeletal Class II malocclusion with retrognathic mandible. Churro Jumper contributes in correction of Class II molar relationship by dentoalveolar effects on both jaws. There was uprighting of maxillary incisors and proclination of mandibular incisors. Churro Jumper is clinicallyeffective as well as efficient appliance in skeletal Class II malocclusion.

The Churro Jumper appliance therapy resulted in redirection of m a x i l l a r y g r o w t h , m e s i a l t o o t h movement in mandible and distal tooth movement in maxilla. It has been claimed that, with this appliance, orthopedic effect could be achieved. This a p p l i a n c e d e m o n s t r a t e d b o t h dentoalveolar movement and skeletal movement accomplish the class II correction..

Construction of Churro Jumper:

The Churro Jumper can be fabricated in a number of ways, as long as a series of 15-20 symmetrical and closely placed circles are formed in the wire. The wire size should be 0.028” to 0.032”. The coil can be formed free hand with a bird beak plier, but this is slow and laborious task that often results in asymmetrical circle. A turret can be made from wooden handle, a headed nail and a headless nail that approximates a thickness of 0.040 or 0.045 wire acts as a spindle around which circles can be formed. Another effective way to form symmetrical coil to hold the 0.040 or 0.045 spindle in a table top wise wind the wire around it.

ADVANTAGES

(1) it provides constant, indefatigable force that cannot be removed from mouth,

(2) it can be used either unilaterally or bilaterally,

(3) it can be used to correct class II or class III malocclusions,

(4) the cost of construction for material and labor is less,

(5) it helps to maintain anchorage, since it prevents maxillary molars and mandibular incisors from moving into extraction space.

Fig: Churro Jumper

MPA (MANDIBULAR PROTRACTION APPLIANCE)

CHAPTER 13:MPA[Mandibular Protraction Appliance]

INTRODUCTION

Carlos M.C.Filho(1995) introduced the mandibular protraction appliance for the treatment of classII malocclusion. It is a cost efficient appliance with ease of fabrication and rapid installation,with infrequent breakage. It is also comfortable to the patient.

FUNCTIONS

it slides distally along the maxillary archwire and mesially along the maxillary archwire upon opening and returns to rest against the mandibular archwise stop and the maxillay buccal tube on closing. However, to allow sufficient clearance for sliding along the mandibular archwire, bicuspid brackets must be omitted and a buccal offset in the lower archwire is often needed.

SEVERAL ADJUSTABLE INTERMAXILLARY FORCE SPRING(SAIF SPRING)

CHAPTER 14: SEVERAL ADJUSTABLE INTERMAXILLARY FORCE SPRING(SAIF SPRING)

1. SAIF spring is a fixed force system ,which are available in either 7 mm or 10 mm lengths . the 10 mm spring , extended from the second molar to the cuspid,provide the optimal horizontal force for anterio posterior correction
2. Placement of right and left springs takes 5 mins the procedures is as follows.
3. During mixed dentition treatment , while using a functional utility archwire,simply crimp a hook on to the vertical leg of the wire.with full fixed appliances ,make an offset bend in the maxillary to be placed.
4. Offset the islet end of the spring so that it points perpendicular to the spring and can slip easily over the molar hook.
5. Close the molar hook so that the islet will not slip off
6. Activate the spring 2-3 mm and cut off the excess leader coil.
7. After attaching leader over anterior hook , close both the leader and the hook so that they will not come apart.

UNIVERSAL BITE JUMPER

CHAPTER 15:UNIVERSAL BITE JUMPER

It can be used in all phases of treatment in the mixed or permanent dentition and with removable or fixed appliance.like other mandibular propulsion appliances, the UBJ uses a telescopic mechanism, an active coil spring can be added if necessary . It can be used in class II or III cases.

Its normal configuration , the UBJ is attached to the maxillary headgear tube with a ball pin. In the mandibular arch sliding rods end in a 90 degree hook that is fixed to the archwire. Lower cantilever type of UBJ is also available when used with removable acrylic splints: two lateral UBJs link the maxillary molar region and the mandibular 1st premolar area .They are attached to 1.2 mm ball clasp which are constructed on the working cast and the in corporate into the formed splints.

ADVANTAGES

1. Immediate orthopaedic action without waiting for dental alignment.
2. Used to treat midline or assymetrical problem
3. Simple sturdy inexpensive comfort and acceptance.
4. Inventory requirements are minimum
5. Used at any stage of treatment

VESTIBULAR SCREEN

CHAPTER 16:VESTIBULAR SCREEN

16.1 INTRODUCTION AND HISTORY

The vestibular screen is a simple and versatile myofunctional appliance used in early interceptive treatment of dental arch deformities. It was first introduced by Newell in 1912. vestibular screen is an acrylic resin removable curved shield covers the labial and buccal vestibules fitting between the oral mucosa and the teeth used to treat oral habits and to stimulate tooth movement. Different variations of oral screen had been designed by different researchers to fulfill different treatment need. Rehak, more recently Goyal .S has introduced different modifications. Vestibular screen is specially used in malocclusions aggravated by faulty muscle function. The screen prevents the pressures from cheeks to act on the dentition helping the tongue to exert free force on constricted dental arch. This causes passive expansion of the arches.

16.2 Uses

1) Mild distoclusions, with premaxillary protrusion and open bite in the deciduous and mixed dentition.
2) Correction of habits like mouth breathing, thumb sucking, lip biting, lip sucking, tongue thrusting.
3) Correction of flaccid, hypotonic orofacial musculature.

16.3Mechanism of Action :

 The screen prevents the oro-facial muscle pressures to act on developing dentition causing passive expansion of the dental arches by normal tongue pressure.
 The lip pressure is directed towards the incisors cause in lingual movement of the proclined teeth.
 The construction bite is taken directly in the patient‟s mouth by moving the mandible forward within 1-3 mm and the bite is opened 2 mm. So forward positioning of developing mandible is possible.
 Hypotonic lips are activated and thus improved by this specific appliance.

16.4 Modifications

1. Hotz modification-Holz added a loop made of stain less steel in the anterior aspect of the screen. Patient pulls the loop and resists the displacement of the appliance with lips simultaneously

2. Screen with breathing holes - multiple small holes are created in the anterior acrylic aspect of the oral screen to facilitate some amount of mouth breathing. Holes may be gradually reduced in size when nasal breathing is improved.

3. Double oral screen- A separate screen is fabricated lingual to oral screen with 0.9 mm wire bilaterally that passing through the bite in lateral incisor area or distal to the last molar area . It is helpful in the prevention of tongue thrusting.

4. Oral screen used in open bite cases-in this appliance an acrylic projection is fabricated to keep the tongue away from the dentition.

5. Rehak"s modification- In this modification a pacifier is attached with the screen which projects out from the outer part of the oral screen. The pacifier has to be retained by the lips, therefore improve the hypotonic lips.

6. Modification of Goyal S **:** Incorporation of wire component by reducing acrylic part.

7. Present modification**:** With indigenous design of reducing the acrylic bulk with ovoid and criss cross wire.

16.5 Advantages

1. Light weight
2. Easy construction
3. Easily adjustable buccal loops
4. criss cross wires causing minimum or no distortion of extended loops.
5. Needs less chair side time for adjustment.
6. Less soft tissue ulceration in vestibules
7. Easy to clean.
8. More comfortable.
9. Low maintenance

16.6 Disadvantages

- Complete mechanotherapy is not possible with this appliance
- It is only an initial assault or phase 1 correction of orthodontic problem.
- Regular checkup is needed.
- Co-operation of patient is most essential
- Oral screen is also contraindicated for habitual mouth breathers due to specified nasal obstruction. ENT surgeon consultation is needed before treatment plan

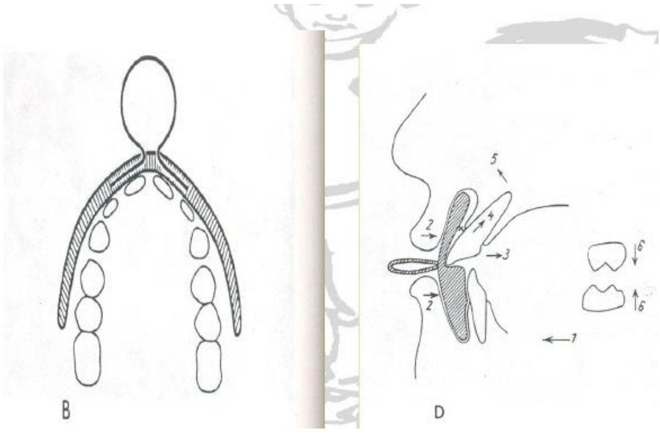


Fig: Modification of Hotz

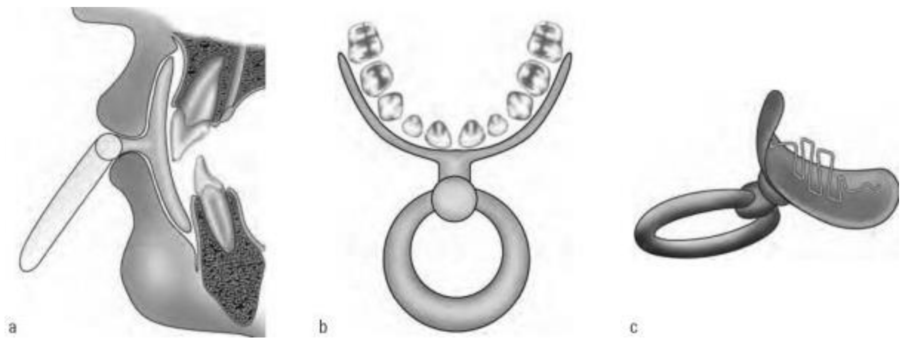


Fig: readymade oral screens

LIP BUMPER

CHAPTER 17: LIP BUMPER

17.1 INTRODUCTION

Lip Bumper is an appliance used in Dentistry, especially Orthodontics, for various purposes to correct a dentition by preventing the pressure from the soft tissue. Sometimes called as combined removable fixed appliance. Lip bumper is usually used in an orthodontic treatment where one has a crowded maxillary or mandibular teeth in an arch. The lip bumper can be called a modified vestibular screen that is used for muscular force application or force elimination. The appliance can be used in both the maxilla and the mandible to shield the lips away from the teeth.

Lip Bumper can be used for expansion of the teeth in the mandibular arch. In orthodontics, tooth-size discrepancy phenomenon occurs when there is crowding presented. As a treatment, either extractions of teeth or expansion of the arch can be done to correct the tooth-size discrepancy. Lip bumper is placed in front of the anterior teeth to keep the pressure of the lips and cheeks away from the front teeth and back teeth respectively. As cited by Werner et al., the lip bumper can be used for reduce lower anterior crowding, increase arch circumference, and move the permanent lower molars distally for the purpose of keeping anchorage.

17.2Components

Components of lip bumper include bands on the molar teeth, a thick Stainless Steel wire with loops made bilaterally and a thick acrylic or rubber shield that goes in the anterior part of the wire to not cause irritation to the mucosa of the lower lip.The lip bumper is a removable appliance, used in developing children, to create and hold space for erupting crowed teeth. The appliance is used in the attempt to avoid the extraction of adult teeth at a later age.

17.3Principles

The lip bumper works by both using and eliminating some of the natural forces of the soft tissues within the mouth. Pressure from the lower lip pushes against the front acrylic shield pushes back on the lower molars gently, creating space for erupting teeth in front. By keeping pressure away from the lower teeth at the same time, the tongue pressure gradually moves the front teeth forward to “unravel” crowding. The appliance is usually worn 12 to 18 months, although this will vary according to the severity of crowding and each child’s rate of growth.

17.4Side effects

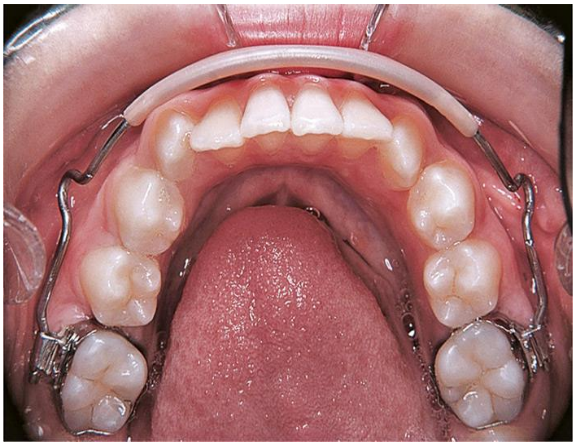
Side-effects caused by Lip Bumper includes the possible disruption in the eruption pattern of the 2nd molars in the mandibular arch. The pressure of the lips on the lip bumper, causes the 1st molar to tip distally which effects and causes the impaction of the 2nd molar.

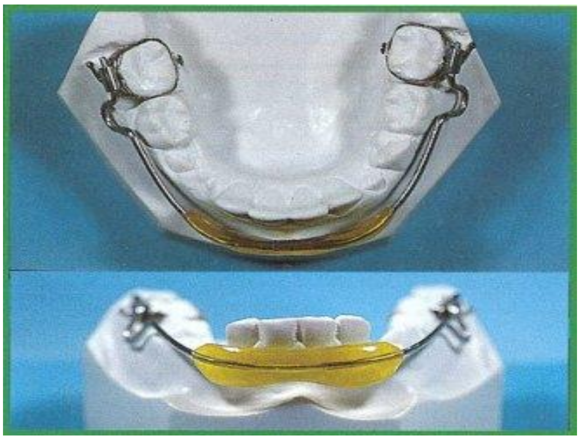
17.5Appliance wear

- The lip bumper should be worn 24 hours a day, except for brushing and flossing
- Brush at least three times a day, two minutes at a time, paying special attention to the lower bands, and around the gum line.
- Use your proxy brush specifically in the front area when brushing
- Do not eat anything hard, sticky, or chewy
- Use wax as needed

17.6Cleaning

Take the lip bumper out when brushing your teeth. Brush normally and do not forget to brush above and below the bands. Do not forget to brush the lip bumper once a day so it stays clean. Tenderness Since the lip bumper is applying pressure to the lower molars, they will often become sore for several days. This feeling is very common as the teeth get used to the appliance. It is very important to be consistent and wear your lip bumper all of the time. Missed time allows the teeth to shift back and thus slow treatment; it also results in another few days of soreness as the teeth readjust to the appliance.



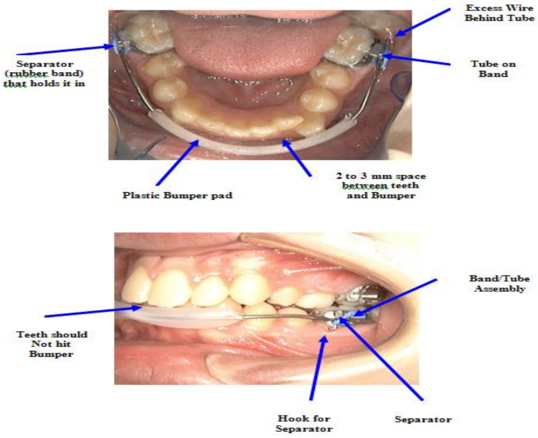


Fig: lip Bumpers

CONCLUSION

CHAPTER 18: CONCLUSION

Extensive experiences of Class II treatment using several types of functional appliance has been discussed.

Since 70% of all malocclusions are Class II and 80% of them have normal maxillas and retrognathic mandibles, clinicians must become proficient in the use of functional appliances.It seems completely illogical not to treat these problems with jaw repositioning appliances in mixed or early permanent dentition rather than wait until age seventeen and subject the patient to a surgical procedure with all its risks and limitations.
Functional clinicians are appalled at the fact that most patients are still not given the orthopedic, non-surgical, nonextraction option for treatment. The most common methods of treating Class II skeletal problems regrettably are still extraction of first permanent bicuspids and surgery.
When it is consider the risk of trauma we need to evaluate if the child is at risk because of their general activities.

It has been found that this appliance will reduce the overjet, mostly by tipping of the teeth but it will not change the skeletal pattern to a clinically meaningful degree (although, occasionally we 'strike lucky' and see patients with very favourable mandibular growth). Importantly, we cannot predict those patients who are going to grow well and those whose teeth will purely tip.

Fig: Pre-treatment Class II case with severe overjct

Fig:Twin Block to correct the overjet and overbite

Fig: Final occlusal result following a phase of fixed appliance treatment

The disadvantage is that while we can attempt to correct the overjet, the patient may still be unhappy with their final facial appearance and they may request orthognathic surgery later. This will, mean undoing the dento-alveolar compensation that is achieved in our earlier course of treatment which might add an extra 6 months to the fixed appliance phase of treatment. Furthermore, in severe cases where camouflage is attempted we may run the risk of over proclination of the lower incisors and compromise gingival health.

It is now many years ago that we carried out a multicentre trial that compared the Herbst and the Twin Block appliance. It has been concluded that the Herbst appliance was very effective but the trade-off was that we had major problems with breakages. As a result, several years later, my preferred appliance is still the Twin Block.

Their objective was to provide evidence on the efficacy of fixed and removable functional appliances in terms of both morphological and patient centred outcomes .

BIBLIOGRAPHY

BIBLIOGRAPHY

1. Schwarz, A.M., Gratzinger, M. Removable orthodontic appliances. W. B. Saunders Company, Philadelphia., 1966.

2. Kraus F. Vestibular and oral screens. Trans Eur Orthod Soc., 1956; 32: 217–224.

3. Hotz, R. Orthodontia in Everyday Practice. Hans Huber, Bern., 1980.

4. Nord, C.F.L. Loose appliances in orthodontia. Trans. Eur. Soc. Orthod., 1959; 246.

5. Nord, C.F.L. Een revolutie in die orthodontische apparatur. Ned. Tijdschr. Tandheelk. 1965; 72: 832.

6.Frankel, R.: The theoretical concept underlying the treatment with functional correctors, Trans. Eur. Orthod. Sot. 42: 233-254, 1966.

7. Frankel, R.: Funktionskieferorthopadie und der Mundvorhof als Apparative Basis, Berlin, 1967, VEBVerlag Volk und Gesundheit.

8. Frankel, R.: The practical meaning of the functional matrix in orthodontics, Trans. Eur. Orthod. SOC. 45:207-219, 1969.

9. Frankel, R.: The treatment of Class II, Division 1 malocclusion with functional correctors, AM. J. ORTHOD.55: 265-275, 1969.

10. Frankel, R.: Guidance of eruption without extraction, Trans. Eur. Orthod. Sot. 47: 303-315, 1971.

11. Friinkel, R.: Decrowding during eruption under the screening influence of vestibular shields, Am. J.Orthod. 65: 372-406, 1974.

12. Frankel, R.: The artificial translation of the mandible by function regulators. In Cook, J. T. (editor):Transactions of the Third International Orthodontic Congress, St. Louis, 1975, The C. V. Mosby Company.

13. Franked, R.: Technik und Handhabung der Funktionsregler, Berlin, 1976, VEB Verlag Volk und Gesundheit.

14. Frankel, R.: A functional approach to orofacial orthopedics, Br. J. Orthod. 7: 41-51, 1980.

15. Franked, R.: Lip seal training in the treatment of skeletal open bite, Eur. J. Orthod. 2: 219-228, 1980.

16. Sammon, J. E.: Personal communication, 1980.

17. Shaye, R., Schwaninger, B., and Hoffman, D.: Activator construction simplified, J. Clin. Orthod. 13:773-778, 1979.

18. Fingeroth, A.L., Fingeroth, M.M. Early treatment: Theory and therapy. Orthod. Record., 1958; 1: 87–99.

19. Rokytova, K., Trefna, B. Use of a vestibular screen for rehabilitation of nasal breathing in children, Cesk. Otolaryngol., 1960; 9: 293.

20. Rogers AP. Exercises for the Development of the Muscles of the Face, with a View to Increasing their Functional Activity. Dent. Cosmos., 1918; 60: 857–897.

21. Graber, T.M., Neumann, B. Removable orthodontic appliances. W. B. Saunders Company, Philadelphia., 1977.

22. Selmer-Olsen, R.: Personal communication, May 23; 1975.

23. Weinberger BW. Orthodontics, an historical review of its origin and evolution. St. Louis: CV Mosby; 1926.

24. Pfeiffer JL. The emergence of man, New York: Harper & Row, 1967.

25. Guerini V. A history of dentistry from the most ancient times until the end of the eighteenth century. Philadelphia: Lea & Febiger, 1909.

26. Castro FW. A historical sketch of orthodontia. Dent Cosmos 1934;66:112.

27. De Medicina, Edition of Pincius for Fontana, Venice, 6 May 1497. Library #131881(incunabula), College of Physicians, Philadelphia. For English translation see FosterEW. “Celcus”. Dent Cosmos 1879;21:235-41.

28. Dental Register, 1891;45:369.

29. Fauchard P. The surgeon dentist or treatise on the teeth. (Translated from second edition of 1746 by Lilian Lindsay) London: Butterworth & Co, 1946:130.

30. Einleitung zur Nötigen Wissenschaft eines Zahnarztes, (Introduction to the important science of dentistry), Wien, 1766:182.

31. New York Daily Advertiser, Aug. 2, 1797.

32. Columbia- Sentinel, June 4, 1796.

33. Federal Gazette, Philadelphia, June 14, 1797.

34. Philadelphia Gazette, Jan. 1, 1813. Quoted by Weinberger BW, Historical Resume of the Evolution and Growth of Orthodontia. J Am Dent Assoc 1934;22:2006.

35. A practical guide to the management of the teeth, 1819:198
.

36. National Gazette, April 11, 1826.

37. Gunnell JS. A remedy for the protrusion of the lower jaw. Am J Dent Soc 1841;2:65.
38. Tucker EJ. Irregularities of the teeth. Dent Newsletter 1853;6:95.

39. Weinberger BW. [citing EJ Tucker]. Importance of regulating the teeth and employment of gum elastics. Am J Dent Soc 1850;11:28-31
.

40. Evans TW. Dental Newsletter 1854;8:30.

41. Angell EC. Treatment of irregularities of the permanent teeth. Dent Cosmos 1860;1:540.

42. Dent Cosmos 1860;1:281.

43. Swinehart EW. Orthodontic bands. In: Dewey M, Anderson M, eds. Practical Orthodontia. St. Louis: CV Mosby: 1955, p. 201.

44. Dent Cosmos 1864;5:503.

45. Dwinnell WH. Priority in the use of steel jack-screws. Dent Cosmos 1886;28;171-2.

46. Kingsley NW. Jumping the bite. Dent Cosmos 1892;33:788.

47. Kingsley NW. A treatise on oral deformities, 1880. Republished in classics in dentistry library, Birmingham, Alabama, 1980.

48. Kingsley NW. Dent Cosmos 1934;66:131.

49. Dent Cosmos 1887;29:275
.

50. Items Interest 1899;41:151.

51. Salzmann JA. Principles of orthodontics, 2nd ed. Philadelphia: JB Lippincott,1950:721.

52. Items Interest 1899;41:178.

53. Weinberger BW. The contribution of orthodontia to dentistry. Dent Cosmos 1936;78:844-53.

54. Items Interest 1900;42:43.

55. Angle EH. Evolution of orthodontia—recent developments. Dent Cosmos. Reprint August, 1912:5.

56. Castro FM. The trend of orthodontic treatment. Proceedings of the American Society of Orthodontists 1930 and 1932:119-23.

57. Dewel BF. The Case-Dewey-Cryer extraction debate: a commentary. AM J ORTHOD 1964;50:862-5.

58. Ainsworth GC. Some thoughts regarding methods and a new appliance for moving dislocated teeth into position. Int Dent J 1904;24:481.

59. Jackson VH. Some methods in regulating. Dent Cosmos 1886;28:372-5.

60. Pullen HA. Expansion of dental arches and opening maxillary suture in relation to development of the internal and external face. Dent Cosmos 1912;54:509-28.

61. Shankland WM. The American Association of Orthodontists. St. Louis: CV Mosby:1971.

62. Hawley CA. Determination of normal arch and its application to orthodontia. Dent Cosmos 1905;47;541-52.

63. Noyes FB, Schour I, Noyes H. A textbook on dental histology and embryology including laboratory directions. Philadelphia: Lea & Febiger: 1938.

64. Todd TW. Heredity and environment, facts in facial development. INT J ORTHOD 1932;18:799-808.

65. Ketcham A. Treatment by orthodontists supplementing that by the rhinologist. Dent Cosmos 1914;54:1312-21.

66. Bogue EA. Orthodontia of the deciduous teeth. Dent Digest 1912;13:671-7;1913;19:9-14;1919;25:193-210.

67. Lischer BE. What are the requirements of orthodontic diagnosis? INT J ORTHOD 1933;19:377-85.

68. Weinberger BW. The contribution of orthodontia to dentistry. Dent Cosmos 1936;78:849.

69. Rogers AP. Evolution, development, and application of myofunctional therapy inorthodontia. AM J ORTHOD ORAL SURG 1939;25:1-19.

70. Mershon JV. The removable lingual arch as an appliance for the treatment of malocclusion of the teeth. INT J ORTHOD 1918;41:478;1920;12:1002; Dent Cosmos 1920;62:698.
71. INT J ORTHOD 1924;10:471.

72. Hellman M. An introduction to growth of the human face from infancy to adulthood.INT J ORTHOD 1932;18:777-98.

73. Hellman M. The face in its developmental career. Dent Cosmos 1935;75:685-9
.
74. Hitchcock HP. Pitfalls of the Crozat appliance. AM J ORTHOD 1972;62:461-8.

75. McCoy JD. Applied orthodontics. 6th ed. Philadelphia: Lea & Febiger, 1946.

76. Simon PW. On gnathostatic diagnosis in orthodontics. INT J ORTHOD 1924;10:755-77.

77. Lundstrom A. Malocclusion of the teeth regarded as a problem in connection with the apical base. Svensk Tandl-Tidskr Supp, 1923. Reprinted in INT J ORTHOD 11:591, 724, 793, 933, 1022, 1109, 1925.

78. Dr. Robert H. W. Strang, 1881-1982 (Obituary). Angle Orthod 1983;53:1

79. Dewel BF. Orthodontics: midcentury recollections. Eur J Orthod 1981;3:77-8.

80. Andressen V. The Norwegian system of functional gnathoorthopedics. Acta Gnathol 1936;1:4.

81. Wachman C. Treatment of the teeth—Andressen method. AM J ORTHOD
1949;33:61.

82. Johnson JE. The twin-wire appliance. AM J ORTHOD ORAL SURG 1938;24:303-
27.

83. Krogman WM. Forty-years of growth, research and orthodontics. AM J ORTHOD1973;63:357-65.

84. Brodie AG. On the growth pattern of the human head from the third month to the eighth year of life. Am J Anat 1941;68:209-62.

85. Oppenheim A. Human tissue response to orthodontic intervention of short and long duration. AM J ORTHOD ORAL SURG 1942;28:263-301.

86. Atkinson SA. Albin Oppenheim. AM J ORTHOD 1957;43:46-51.

87. Björk A. The face in profile, an anthropological x-ray investigation on Swedish children and conscripts. Svensk Tandl Tidskr 1947;40 Suppl
.
88. Kesling HD. Coordinating the predetermined pattern and tooth positioner with conventional treatments. AM J ORTHOD ORAL SURG 1946;32:285-93.
89. Salzmann JA. Handicapping malocclusion assessment to establish treatment priority. AM J ORTHOD 1968;54:749-65.

90. Downs, William B., 1899-1966 (Obituary), Angle Orthod 1983;53:1.

91. Wylie, Wendell L., 1913-1966, (Obituary), Angle Orthod 1960;36:177.

92. McNamara JA. A method of cephalometric evaluation. AM J ORTHOD 1984;86:449.

93. Begg PR. Begg orthodontic theory and technique. Philadelphia: WB Saunders: 1965
.
94. Bates v. State Bar of Arizona, 433 U. S. 350, 364, 1977

95. Worms FW, Mesiiin LH, Isaacson RJ; Opetl-bite./lin 7 *Orthod* t971;59:589-595.

96. Subtetny JD, Sakuda M: Open-bite: Diagnosis and treattnent.*Am J Orihod* 1964;50:337-358.

97. Proffit WR: *Contemporary Orthodontics.* St Louis, CV Mosby Company, 1986, pp 47-49.

98. MeNamara JA Jr: Neuromuseular and sketetal adaptations to aitered funetion in tbe orofaciat region. *Am 3 Orthod* 1973; 4:548-006.

99. MeNamara JA Jr. Carison DS: Quantitative analysis of tettiporonaiidibular joint adaptations to protrusive function *Am J Orthod* t979;76:593-lill.

100. MtNamara JA Jr, Hinton RJ, Hoffman DL: Histologie analysis of temporomandibular joint adaptations to protrusive function in young aduit rhesus montceys *(Macaca mulatta) Am*
J Orthod 1982 ;82:288-298.

101.Anderson J P, Joondeph D R, Turpin D L 1973 A cephalometric study of profile changes in orthodontically treated cases ten years out of retention. Angle Orthodontist 43: 324-336

102.Battagel J M 1989 Profile changes in Class II, division 1 malocclusions: a comparison of the effects of Edgewise and Frankel appliance therapy. European Journal of Orthodontics 11: 243-253

103.Bishara S E, Peterson L C, Bishara E C 1984 Changes in facial dimensions and relationships between the ages of 5 and 25 years. American Journal of Orthodontics 85:238-252

104.Bishara S E, Hession T J, Peterson L C 1985 Longitudinalsoft-tissue profile changes: A study of three analyses.American Journal of Orthodontics 88: 209-223

105.Bjork A 1947 The face in profile (thesis). Swedish Dental Journal 40 Suppl. 5B: 1-180

106.Bjork A 1972 Timing of interceptive orthodontic measures based on stages of maturation. Transactions of the European Orthodontic Society 61-74

107.Burstone C J 1958 The integumental profile. AmericanJournal of Orthodontics 44: 1-25

108.Chaconas S J 1969 A statistical evaluation of nasal growth.American Journal of Orthodontics 56: 403-414

109.Eicke C, Wieslander L 1990 Weichteilprofilveranderungendurch Therapie mit dem Herbst-Scharnier. Schweizerische Monatszeitschrift der Zahnmedizin 100: 149-153
Falck F, Kobel E-M 1985 Veranderungen des

110. Weichteilprofils bei der Behandlung mitFunktionsreglern. Fortschritte der Kieferorthopadie 46:407-415

111.Finnoy J P, Wisth P J, Boe O E 1987 Changes in soft tissue profile during and after orthodontic treatment. European Journal of Orthodontics 9: 68-78

112.Forsberg C-M 1979 Facial morphology and aging: a longitudinal cephalometric investigation of young adults. European Journal of Orthodontics 1: 15-23

113.Forsberg C-M, Odenrick L 1979 Changes in the relationship between the lips and the aesthetic line from eight years of age to adulthood. European Journal of Orthodontics 1: 265-270

114.Forsberg C-M, Odenrick L 1981 Skeletal and soft tissue response to activator treatment. European Journal of Orthodontics 3: 247-253
Hambleton R S 1964 The soft tissue covering of the skeletal face as related to orthodontic problems. American Journal of Orthodontics 50:

115.Hansen K, Pancherz H 1992 Long-term effects of Herbst treatment in relation to normal growth development: a cephalometric study. European Journal of Orthodontics
14: 285-295

116. Hansen K, Pancherz H, Hagg U 1991 Long-term effects of the Herbst appliance in relation to the treatment growth period: a cephalometric study. European Journal of Orthodontics 13: 471-481

117.Haynes S 1986 Profile changes in modified functional regulator therapy. Angle Orthodontist 56: 309-315 Hillesund E, Fjeld D, Zachrissson B U 1978 Reliability of soft-tissue profile in cephalometrics. American Journal of Orthodontics 74: 537-550

118.Looi L K, Mills J R E 1986 The effect of two contrasting forms of orthodontic treatment on the facial profile. American Journal of Orthodontics 89: 507-517 Mauchamp O, Sassouni V 1973 Growth and prediction of skeletal and soft-tissue profiles. American Journal of Orthodontics 64: 83-94

119.Meng H P, Goorhuis J, Kapila S, Nanda R S 1988 Growth changes in the nasal profile from 7 to 18 years of age.

120.H. PANCHERZ AND M. ANEHUS-PANCHERzAmerican Journal of Orthodontics and DentofacialOrthopedics 94: 317-326

121.Owen A H 1986 Maxillary incisor-labial responses in Class II division 1 treatment with Frankel and Edgewise Angle Orthodontist 56: 67-87

122.Pancherz H 1979 Treatment of Class II malocclusions by jumping the bite with the Herbst appliance. A cephalometric investigation. American Journal of Orthodontics 76: 423-442

123.Pancherz H 1981 The effect of continuous bite jumping on the dentofacial complex: a follow-up study after Herbst appliance treatment of Class II malocclusions. European Journal of Orthodontics 3: 49-60

124.Pancherz H 1982a The mechanism of Class II correction in Herbst appliance treatment. A cephalometric investigation. American Journal of Orthodontics 82: 104-113

125.Pancherz H 1982b Vertical dentofacial changes during Herbst appliance treatment. A cephalometric investigation.

126.Swedish Dental Journal Supplement 15: 189-196

127.Pancherz H 1985 The Herbst appliance—its biologic effects and clinical use. American journal of Orthodontics 87: 1-20

128.Pancherz H 1991 The nature of Class II relapse after Herbst appliance treatment: a cephalometric long-term investigation. American Journal of Orthodontics and Dentofacial Orthopedics 100: 220-233

129.Pancherz H, Anehus-Pancherz M 1993 The head-gear effect of the Herbst appliance. A cephalometric long-term study. American Journal of Orthodontics and Dentofacial

Orthopedics 103: 510-520

130.Pancherz H, Fackel U 1990 The skeletofacial growth pattern pre- and post-dentofacial orthopaedics. A long-term study of Class II malocclusions treated with the Herbst appliance.
European Journal of Orthodontics 12: 209-218

131.Pancherz H, Hagg U 1985 Dentofacial orthopedics in relation to somatic maturation. An analysis of 70 consecutive cases treated with the Herbst appliance. American Journal of Orthodontics 88: 273-287

132.Pancherz H, Hansen K. 1986 Occlusal changes during and after Herbst treatment: a cephalometric investigation. European Journal of Orthodontics 8: 215-228

133.Pancherz H, Littmann C 1988 Somatische Reife und morphologische Veranderungen des Unterkiefers bei der

134.Herbst-Behandlung. Informationen aus Orthodontie Kieferorthopadie 20: 455-470

135.Pancherz H, Littmann C 1989 Morphologie und Lage des Unterkiefers bei der Herbst-Behandlung. Eine kephalometrische Analyse der Veranderungen bis zumnWachstumsabschluss. Informationen aus Orthodontien und Kieferorthopadie 21: 493-513

136.Peck H, Peck S 1970 A concept of facial esthetics. Angle Orthodontist 40: 284-317

137.Posen J M 1967 A longitudinal study of the growth of the nose. American Journal of Orthodontics 53: 746-756

138.Remmer K R, Mamandras A H, Way D C 1985

139.Cephalometric changes associated with treatment using the activator, the Frankel appliance, and the fixed appliance. American Journal of Orthodontics 88: 363-372

140.Ricketts R M 1957 Planning treatment on the basis of the facial pattern and an estimate of its growth. Angle Orthodontist 27: 14-37

141.Ricketts R M 1960 The influence of orthodontic treatment on facial growth and development. Angle Orthodontist 30: 103-133

142.Riedel R A 1957 An analysis of dentofacial relationships. American Journal of Orthodontics 43: 103-119

143.Riolo M L, TenHave T R 1986 The effect of different kinds of appliance therapy on the facial soft-tissue profile. From: Vig P S, Ribbens K. A (eds) Science and clinical judgement in orthodontics. Monograph 19 Craniofacial Growth Series. Center for Human Growth and Development, The University of Michigan, Ann Arbor,

144.MichiganRoos N 1977 Soft tissue profile changes in Class II treatment. American Journal of Orthodontics 72: 165-175

145.Rudee D A 1964 Proportional profile changes concurrent with orthodontic therapy. American Journal of Orthodontics 50: 421-434

146.Subtelny J D 1959 A longitudinal study of soft tissue facial structures and their profile characteristics, defined in relation to underlying skeletal structures. American Journal of Orthodontics 45: 481-507

147.Wieslander L 1984 Intensive treatment of severe Class II malocclusions with a headgear-Herbst appliance in the early mixed dentition. American Journal of Orthodontics 86: 1-13

148.Wisth P J 1974 Soft tissue response to upper incisor retraction in boys. British Journal of Orthodontics 1: 199-204

149.Zylinski C G, Nanda R S, Kapila S 1992 Analysis of soft tissue facial profile in white males. American Journal of Orthodontics and Dentofacial Orthopedics 101: 514-518

150.Fr~inkel R. The theoretical concept underlying the treatment with function correctors. Trans Eur Orthod Soc 1966;42:233-54.

151.Fr/inkel R. Lip seal training in the treatment of skeletal open bite. Eur J Orthod 1980;2:219

152. Frfinkel R. A functional approach to orofacial orthopaedics.Br J Orthod 1980;7:41-51.

153. Frfinkel R, Frfinkel C. Funktionelle Aspekte des skelettalen offenen Bisses. Fortschr Kieferorthop 1982;43:8-18.

154. Frfinkel R, Fr/inkel C. A functional approach to treatment of skeletal open bite. AM J ORTHOD 1983;84:54-68.

155. Frfinkel R, Fr/inkel C. Orofacial orthopedics with the function regulator. Basel: Karger, 1989:40-1, 46, 89, 186-208.

156. Frfinkel R. Technik und Handhabung der Funktionsregler Berlin: VEB Verlag Volk und Gesundheit, 1973:38-9, 86, 102-3, 103-5.

157. Greulich WW, Pyle SI. Radiographic atlas of skeletal development of the hand and wrist. Stanford, California: Stanford Oxford University Press, 1970.

158. Ingervall B, Bitsanis E. A pilot study of the effect of masticatory muscle training on facial growth in long-face children. Eur J Orthod 1987;9:15-23.

159. I~can HN, Akkaya S, Koralp E. The effects of the springloaded posterior bite-block on the maxillo-facial morphology. Eur J Orthod 1992;14:54-60.

1601. Kiliaridis S, Egermark I, Thilander B. Anterior open bite treatment with magnets. Eur J Orthod 1990;12:447-57.

161. . Woodside DG, Linder-Aronson S. Progressive increase in lower anterior face height and the use of posterior occlusal bite-block in its management. In: Graber LW, ed. Orthodontics.
State of the art: essence of the science. St. Louis: CV Mosby, 1986:209-18.

162. Herbst E. Dreissigjfihrige Erfahrungen mit dem Retentions-Scharnier. Zahn/irztl Rundschau. 1934;42:151- 1524, 1563-1568, 1611-1616, 1934.

163.. Pancherz H. Treatment of Class II malocclusions by jumping the bite with the Herbst appliance. A cephalometric investigation. AmJ Orthod 1979;76:423-442.

164. Pancherz H. The Herbst appliance-Its biologic effects and clinical use. AmJ Orthod 1985;87:1-20.

165. Wieslander L. Intensive treatment of severe Class II malocclusions with a headgear-Herbst appliance in the early mixed dentition. AmJ Orthod 1984;86:1-13.

166. MeNamaraJA, Jr, Howe RP, Dischinger TG. A comparison of the Herbst and Fdinkel appliances in the treatment of Class II malocclusion. AmJ Orthod Dentofacial Orthop 1990;98:134-144.

167. Windmiller EC. The acrylic-splint Herbst appliance: A cephalometric evaluation. Am J Orthod Dentofacial Orthop 1993;104:73-84.

168. Goodman R McKenna E Modified Herbst appliance for the mixed dentition.J Clin Orthod 1985;19:811-814.

169. Dischinger TG. Edgewise bioprogressive Herbst appliance. J Clin Orthod 1989;23:608-617.

170. Pancherz H, Hftgg U. Dentofacial orthopedics in relation to somatic inaturation. An analysis of 70 consecutive cases treated with the Herbst appliance. Am J Orthod 1985;88:273-287.

171. Valant JR, Sinclair PM. Treatment effects of the Herbst appliance. AmJ Orthod Dentofacial Orthop 1989;95:138- 147.

172. Pancherz H. The mechanism of Class II correction in Herbst appliance treatment. A cephalometric investigation. AmJ Orthod 1982;82:104-113.

173. Pancherz H. The effect of continuous bite jumping on the dentofacial complex: A follow-up study after Herbst *58 Lai and McNamara* appliance treatment of Class II malocclusions. Eur J
Orthod 1981;3:49-60.

174. Schiavoni R, Grenga V, Macri V. TreaUnent of Class II high angle malocclusions with the Herbst appliance: a cephalometric investigation. Am J Orthod Dentofacial Orthop 1992;102:393-409.

175. Wieslander L. Long-term effect of treatment with theheadgear-Herbst appliance in the early mixed dentition.Stability or relapse? Am J Orthod Dentofacial Orthop 1993;104:319-329.

176. McNamaraJA, Jr. Fabrication of the acrylic splint Herbst appliance. Am J Orthod Dentofacial Orthop 1988;94: 10-18
17. McNamaraJA, Jr, Howe RP. Clinical management of the acrylic splint Herbst appliance. AmJ Orthod Dentofacial Orthop 1988;94:142-149.

178. Riolo ML, Moyers RE, McNamaraJA, Jr, Hunter WS. An Atlas of Craniofacial Growth: Cephalometric Standards from The University School Growth Study, The University of Michigan. Ann Arbor, MI, The Center for Human Growth and Development, The University of Michigan,b1974. Craniofacial Growth Monograph Series, vol 2.

179. Mahon WT. A cephalometric appraisal of Class II functional appliance therapy (master's thesis). St. Louis, MO, Saint Louis University, 1982.

180. Johnston LE, Jr. A comparative analysis of Class II treatments, in Vig PS, Ribbens KA (eds): Science and Clinical Judgment in Orthodontics. Ann Arbor, MI, Center for Human Growth and Development, The University of Michigan, 1986: Craniofacial Growth Series, vol 19.

181. McNamaraJA, Jr, Bookstein FL, Shaughnessy TG. Skeletal and dental changes following functional regulator therapy on Class II patients. AmJ Orthod 1985;88:91-110.

182. Livieratos FA, Johnston LE,Jr. A comparison of one-stage and two-stage nonextraction alternatives in matched Class II samples. Am J Orthod Dentofacial Orthop 1995;108:118-131.

183. McNamaraJA,Jr. A method ofcephalometric evaluation. 3anJ Orthod 1984;86:449-469.

184. Lande MJ. Growth behavior of the human bony facial profile as revealed by serial cephalometric roentgenology. Angle Orthod 1952;22:78-90.

185. Johnston LE, Jr. A statistical evaluation of cephalometric prediction. Angle Orthod 1968;38:284-304.

186. Hixon E, Klein P. Simplified mechanics: A means of treatment based on available scientific information. AnaJ Orthod 1972;62:113-141.

187. Greenberg LZ, Johnston LE, Jr. Computerized prediction:The accuracy of a contemporary long-range forecast. AnlJ Orthod 1975;67:243-252.

188. Baumrind S, Korn EL. Patterns of change in mandibular and facial shape associated with the use of torces to retract the maxilla. AmJ Orthod 1981;80:31-47.

189. Kerr WJ, TenHave TR, McNamaraJA,Jr. A comparison of skeletal and dental changes produced by function regulators (FR-2 and FR-3). EurJ Orthod 1989;11:235-242.

190. Jakobsson SO. Cephalometric evaluation of treatment effect on Class II, Division I malocclusions. AnlJ Orthod 1967;53:446-457.

191. Harvold EP, Vargervik K. Morphogenetic response to activator treatment. AmJ Orthod 1971;60:478-490.

192. Wieslander L, Lagerstr6m L. The effect of activator treatment on class II malocclusions. Am J Orthod 1979;75:20-26.

193. Proffit WR, Fields HW, Jr. Contemporary Orthodontics.(2nd ed) St. Louis, MO, Mosby-Year Book, Inc, 1993.

194. Pancherz H, Fackel U. The skeletofacial growth patternpre- and post-dentofacial orthopaedics. A long-term study of Class II malocclusions treated with the Herbst
appliance. EurJ Orthod 1990;12:209-218.

195. TannerJM, Whitehouse RH, Takaishi M. Standards from birth to maturity for height, weight, height velocity and weight velocity: British children. Arch Dis Child 1966;41:454, 613.

196. H/igg U, Pancherz H, Taranger J. Pubertal growth and orthodontic treatment, in Carlson DS, Ribbens KA, (eds): Craniofacial Growth during Adolescence. Ann Aa'bm, MI, Center for Human Growth and Development, The University of Michigan, 1987: Craniofacial Growth Monograph Series, vol 20.

197. Jay MS. Compliance: The adolescent/provider partnei~ship, in McNamaraJA, Jr, Trotman C-A (eds.): Creating the compliant patient. Ann Arbm; MI, Center for Human Growth and Development, The University of Michigan, 1997:47-58. Craniofacial Growth Monograph Series,
vol 33.

198. Pancherz H, Littmann C. Morphologie und Lage desUnterkiefers bei der Herbst-Behandlung. Eine kephalometrische Analyse der Ver/inderungen bis zum Wachstumsabschluss.
Inf Orthod Kieferorthop 1989;21:493-513.

199. Petrovic A, Stutzmann J0, Gasson N. The final length of the mandible: Is it genetically determined?, in Carlson DS (ed) : Craniofacial Biology. Ann Arbor, MI, Center for
Human Growth and Development, The University of Michigan, 1981, Craniofacial Growth Monograph Series, vol 10.

200. McNamara JA, Jr., Bryan FA. Long-term mandibular adaptations to protrusive function: An experimental study in Macaca mulatta. Am J Orthod Dentofacial Orthop 1987;92:98-108.

201. Harvold EP. The role of fimction in the etiology and treatment of malocclusion. Am J Orthod 1968;54:883- 898.

202. MossJE Cephalometric changes during functional appliance therapy. Europ Orthod Soc Trans 1962:327-341.

203. Evald BH, Harvold EP. The effect of activators on maxillary-mandibular growth and relationships. Am J Orthod 1966:252-257.

204. Hotz RP. Application and appliance manipulation of functional forces. AmJ Orthod 1970;58:459-478.

205. Pfeiffer JE Grobety D. Simultaneous use of cervical appliance and activator: An orthopedic approach to fixed appliance therapy. AmJ Orthod 1972;61:353-373.

206. Pancherz H, Hansen I~L Occlusal changes during and after Herbst treatment: A cephalometric investigation. EurJ Orthod 1986;8:215-228.

207. Janson I. Skeletal and dentoalveolar changes in patients treated with a bionator during prepubertal and pubertal growth, in McNamara JA, Jr, Ribbens KA, Howe RP, (eds): Clinical Alteration of the Growing Face. Ann Arbor, MI, Center for Human Growth and Development, The University of Michigan, 1983. Craniofacial Growth Monograph Series, vol 14.

208.Balters W. Die Technik und Übung der allgemeinen und speziellen Bionator-therapie. Quintessenz 1964;1:77.

209.Janson I. Skeletal and dentoalveolar changes in patients treated with a bionator during prepubertal and pubertal growth. In: McNamara JA Jr, Ribbens KA, Howe RP, eds. Clinical alteration of the growing face. Ann Arbor: Center for Human Growth and Development, The University of Michigan, 1983: Craniofacial Growth Monograph Series; vol 14.

210.Johnston LE, Jr. A comparative analysis of Class II treatments.In: Vig PS, Ribbens KA, eds. Science and clinical judgment in orthodontics. Ann Arbor: Center for Human Growth and Development, The University of Michigan, 1986: Craniofacial Growth Series; vol 19.

211. Fränkel R. The theoretical concept underlying the treatment with functional correctors. Trans Eur Orthod Soc 1966;42:233-54.

212. Fränkel R. The treatment of Class II, Division 1 malocclusion with functional correctors. Am J Orthod 1969;55:265-75.

213. Fränkel R, Fränkel C. Orofacial orthopedics with the function regulator. Munich: S. Karger, 1989.

214. McNamara JA, Jr, Bookstein FL, Shaughnessy TG. Skeletal and dental changes following functional regulator therapy on Class II patients. Am J Orthod 1985;88:91-110.

215. Pancherz H. Treatment of Class II malocclusions by jumping the bite with the Herbst appliance: a cephalometric investigation. Am J Orthod 1979;76:423-42.

216. Pancherz H. The Herbst appliance: its biological effects and clinical use. Am J Orthod 1985;87:1-20.

217. Wieslander L. Intensive treatment of severe Class II malocclusions with a headgear-Herbst appliance in the early mixed dentition. Am J Orthod 1984;86:1-13.

218. McNamara JA, Jr, Howe RP, Dischinger TG. A comparison of the Herbst and Fränkel appliances in the treatment of Class II malocclusion. Am J Orthod Dentofacial Orthop 1990;98:134-44.

219. Lai M, McNamara JA, Jr. An evaluation of two-phase treatment with the Herbst appliance and preadjusted edgewise therapy. Semin Orthod 1998;4:46-58.

220. Jasper JJ, McNamara JA, Jr. The correction of interarch malocclusions using a fixed force module. Am J Orthod Dentofacial Orthop 1995;108:641-50.

221. Clark WJ. The Twin-block traction technique. Eur J Orthod1982;4:129-38.

222. Clark WJ. The Twin-block technique: a functional orthopaedic appliance system. Am J Orthod Dentofacial Orthop 1988;93:1-18.

223. Clark WJ. The Twin-block technique. Part 1. Funct Orthod 1992;9:32-4,36-7.

224. Clark WJ. The Twin-block technique. Part 2. Funct Orthod1992;9:45-9
.

225. Clark WJ. Twin-block functional therapy. London: Mosby- Wolfe, 1995.

226. Clark WJ. The Twin-block technique. In: Graber TM, Rakosi T, Petrovic AG, eds. Dentofacial orthopedics with functional appliances. 2nd ed. St Louis: Mosby–Year Book, Inc, 1997:268-98.

227. Nanda RS. The rates of growth of several facial components measured from serial cephalometric roentgenograms. Am J Orthod 1955;41:658-73.

228. Björk A. Variations in the growth pattern of the human mandible: longitudinal radiographic study by the implant method. J Dent Res 1963;42:400-11.

229. Hunter C. The correlation of facial growth with body height and skeletal maturation at adolescence. Angle Orthod 1966;36:44-54.

230. Ekström C. Facial growth rate and its relation to somatic maturation in healthy children. Swed Dent J (Suppl) 1982;11:1-99.

231. Lewis A, Roche AF, Wagner B. Pubertal spurts in cranial base and mandible: comparisons within individuals. Angle Orthod 1985;55:17-30.

232. Hägg U, Pancherz H, Taranger J. Pubertal growth and orthodontic treatment. In: Carlson DS, Ribbens KA, eds. Craniofacial growth during adolescence. Ann Arbor: Center for Human
Growth and Development, The University of Michigan, 1987 Craniofacial Growth Monograph Series; vol 20.

233. Petrovic A, Stutzmann J, Lavergne J, Shaye R. Is it possible to modulate the growth of the human mandible with a functional appliance? Inter J Orthod 1991;29:3-8.

234. Petrovic A, Stutzmann J, Lavergne J. Mechanism of craniofacial growth and modus operandi of functional appliances: a cell-level and cybernetic approach to orthodontic decision making. In:Carlson DS, ed. Craniofacial growth theory and orthodontic treatment. Ann Arbor: Center for Human Growth and Development, The University of Michigan, 1990: Craniofacial GrowthMonograph Series; vol 23.

235. Petrovic A, Stutzmann J, Lavergne J. Biologische Grundlage für die unterschiedliche interindividuelle Gewebereaktion auf eine Kieferorthopädische Behandlung mit dem Bionator. In: Harzer W, ed. Kieferorthopädischer Gewebeumbau. Berlin: Quintessenz Verlags-GmbH; 1991. p. 49-62.

236. Malmgren O, Ömblus J, Hägg U, Pancherz H. Treatment with an appliance system in relation to treatment intensity and growth periods. Am J Orthod Dentofacial Orthop 1987;91:143-51.

237. Hägg U, Pancherz H. Dentofacial orthopaedics in relation to chronological age, growth period and skeletal development: an analysis of 72 male patients with Class II Division 1 malocclusion treated with the Herbst appliance. Eur J Orthod 1988;10:169-76.

238. Greulich WW, Pyle SI. Radiographic atlas of skeletal development of the hand and wrist. Stanford: Stanford University Press; 1959.

239. Hellman M. The process of dentition and its effects on occlusion.Dent Cosmos 1923;65:1329-44.

240. Lewis AB, Garn SM. The relationship between tooth formation and other maturation factors. Angle Orthod 1960;30:70-7.

241. Tanner JM. Growth at adolescence, 2nd ed. Oxford: Blackwell Scientific Publications; 1962.**170** *Baccetti et al American Journal of Orthodontics and Dentofacial Orthopedics August 2000*

242. Lamparski DG. Skeletal age assessment utilizing cervical vertebrae [dissertation]. Pittsburgh, PA: The University of Pittsburgh; 1972.

243. O'Reilly M,Yanniello GJ. Mandibular growth changes and maturation of cervical vertebrae—a longitudinal cephalometric study. Angle Orthod 1988;58:179-84.

244. Franchi L, Baccetti T, McNamara JA, Jr. Treatment and posttreatment effects of acrylic splint Herbst appliance therapy. Am J Orthod Dentofacial Orthop 1999:115;429-38.

245. Lund DL, Sandler PJ. The effects of Twin-blocks: a prospective controlled study. Am J Orthod Dentofacial Orthop 1998;113:104-10.

246. Mills C, McCulloch K. Treatment effects of the Twin-block appliance: a cephalometric study. Am J Orthod 1998;114:15-24.

247. Toth LR, McNamara JA, Jr. Skeletal and dentoalveolar adaptations produced by Twin-block appliance treatment. Am J Orthod Dentofacial Orthop 1999;116:597-609.

248. Riolo ML, Moyers RE, McNamara JA, Jr, Hunter WS. An atlas of craniofacial growth: cephalometric standards from the University School Growth Study, The University of Michigan. Ann Arbor: The Center for Human Growth and Development, The University of Michigan, 1974. Craniofacial Growth Monograph Series; vol 2.

249. Barrer HG. Protecting the integrity of mandibular incisor position through keystoning procedure and spring retainer appliance. J Clin Orthod 1975;9:486-94.

250. Halazonetis DJ. Computer-assisted cephalometric analysis. Am J Orthod Dentofacial Orthop 1994;105:517-21.

251. Hassel B, Farman A. Skeletal maturation evaluation using cervical vertebrae. Am J Orthod Dentofacial Orthop 1995;107:58-66.

252. Lavergne J, Gasson N. Operational definitions of mandibular morphogenetic and positional rotations. Scand J Dent Res 1977;85:185-92.

253. McNamara JA, Jr. Neuromuscular and skeletal adaptations to altered function in the orofacial region. Am J Orthod 1973;64:578-606.

254. McNamara JA, Jr, Carlson DS. Quantitative analysis of temporomandibular joint adaptations to protrusive function. Am J Orthod 1979;76:593-611.

255. McNamara JA, Jr, Hinton RJ, Hoffman DL. Histological analysis of temporomandibular joint adaptation to protrusive function in young adult rhesus monkeys (Macaca Mulatta). Am J Orthod 1982;82:288-98.

256. McNamara JA, Jr, Bryan FA. Long-term mandibular adaptations to protrusive function: an experimental study in Macaca Mulatta. Am J Orthod Dentofacial Orthop 1987;92:98-108.

257. Petrovic AG, Stutzmann JJ. Research methodology and findings in applied craniofacial growth studies. In: Graber TM, Rakosi T,Petrovic AG, eds. Dentofacial orthopedics with functional appliances,2nd ed. St Louis: Mosby–Year Book, Inc; 1997. p. 13-63.

258. Ruf S, Pancherz H. Temporomandibular joint growth adaptationin Herbst treatment: a prospective magnetic resonance imagingand cephalometric roentgenographic study. Eur J Orthod
1998;20:375-88.

259. Paulsen HU. Morphological changes of the TMJ condyles of 100 patients treated with the Herbst appliance in the period of puberty to adulthood: a long-term radiographic study. Eur J
Orthod 1997;19:657-68.

260. Woodside DG, Metaxas A, Altuna G. The influence of functionalappliance therapy on glenoid fossa remodelling. Am J OrthodDentofacial Orthop 1987;92:181-98.

261. Hinton RJ, McNamara JA, Jr. Temporal bone adaptations in response to protrusive function in juvenile and young adult rhesus monkeys (*Macaca mulatta*). Eur J Orthod 1984;6:155-74.

262. Windmiller EC. The acrylic-splint Herbst appliance: a cephalometric evaluation. Am J Orthod Dentofacial Orthop 1993; 104:73-84.

263. Graber TM. Foreword. Am J Orthod Dentofacial Orthop 1998;113:1-4.

264. Pancherz H, Hägg U. Dentofacial orthopedics in relation to somatic maturation: an analysis of 70 consecutive cases treated with the Herbst appliance. Am J Orthod 1985;88:273-87 Dentofacial Orthop 1991;100:220-33.

265. Pancherz H. The modern Herbst appliance. In: Graber TM, Rakosi T, Petrovic AG, eds. Dentofacial orthopedics with functional appliances, 2nd ed. St Louis: Mosby–Year Book, Inc;
1997. p. 336-66.

266. Hansen K, Pancherz H. Long-term effects of Herbst treatment in vrelation to normal growth development: a cephalometric study. Eur J Orthod 1992;14:285-95.

267. Pancherz H, Fackel U. The skeletofacial growth pattern pre- and postdentofacial orthopedics: a long-term study of Class II malocclusions treated with the Herbst appliance. Eur J Orthod 1990;12:209-18.

268.Ahlin, J, H., White, ***G.*** E., T s ~ ~ ~ s oAu,~ **Sa**s**a**,**d ia,** M. (1 984). MmiIZofacial
Urthopedics: ***A*** Clinical ***Approach*** for ***the*** Graving Child, Chicago, Iihois :Quintessence
Publishing Company.

269.Awn, M., Goret-Nicake, M., & Dhem, **A.** (1987). Unilaterd Section of **the**Lateral Pterygoid Muscle in the Growing Rat does not Alter Condylar Growth. EuropemJournal of Orthodontics, 9, 122- 128.

270.Baume, L. J. & Derkhsweiler, H. (1 ***96*** 1)- 1s the Condylar Growth CenterResponsive to Orthodontic Therapy? An Experirnental Shldy in Macaca mulatta. Oral***Surgery,*** Oral ***Medicine*** *and* Oral Pathology, 14 **(3),** 347-3 ***62.***

271.Baumrind, S. (1 **98** 8). Unbiased Quantitative Testing of Conventional OrthodonticB eliefs. Serninars in Orthodontics, 4 (l), **3** - **f** ***6.***

272.Baumrind, S., Kom, E. L., Isaacson, R J., West, E. E., & Molthen, **R** (1 **983)**

273.Superimpositional Assessrnent of Treatment-Associated Changes in theTemporomandibular Joint and the Mandibular Symphysis. Arnerican ***JournaI*** ofOrrhodontics, 84 (6), 443 **-465**

.

274.Clark W. **1.** (1995). Twin BZock Functional Therapy AppZications *in* Dentofaciui Orthopaedics. London, England :Times Mirror International Publishers Limited.

Clark W. J. (1988). The Twin **Block** Technique a Functional Orthopedic**A p** pliance S y **st** em ***American*** Journal of Orthodontics *md* Dento facial Orthopedics, 93(11, 1-18.DeVicenzo, I. P. (199 1). Changes in Mandibular Length Before, During, andAfter Successful Orthopedic Correction of Class II Malocclusions, Using a Functional**Ap pliance.** Ameriean Jounal of Orthodonties and Deniofacial Orthopedics, 99 **(3),** 24 1 ***-257,***

275.DeVrncenzo, J. P., Huffer, R **A.,** & Winn, M. W. (1987). **A** Study in Human Subjects Using a New Device Designed to Mimic the Protrusive Functional Appliances Used Previously in Monkeys. American J o dof Orthodontics ***and*** Dentofacial Orthopedics, 9 1 (3), 2 13 - 224.

2 76.Elgoyhen, J. C., Moyers, R E., **McNarnara,** J. C., & Riolo, M. L. (1972).

278.Craniofacial Adaptation to Protmsive Function in Young Rhesus Monkeys. American
Journal of Orfhodontics, 62 ***(5),*** 469-48 **0.**

279.Ferrari, ***C.*** S. & Hemng, S W (1995). Use of a Bite-Opening Appliance in theMiniature Pig: Modification of Craniofacial Growth. ***Ac&*** Anatomica, 154, 205-2 15.

280.Frankel, **R** (1 **982)** Biomechanicd Aspects of **the** Fodunction Reiationship inCraniofacial Morphogenesis: A Chnician' **s** Approach. In McNamara, J. A Ir., Rib bens,K. A, & Howe, R P. (Editors) Clinical Alteration of the Grwing Face, **@p.** 107-1 3 0).

281.Monograph Number 14, Craniofacial Growth Series, **Am** Arbor: Center for Human Growth and Development, **The** University of Michigan.Ghafari, J. & Heeley, J. D. (1982). Condylar Adaptation to Muscle Alteration **in**the Rat. The Angle Orthodontist, 52 (l), 26-3 7.

282.Graber, T. M. (1 **985).** PhysioZogic Principles of Functional Applimces. S t.Louis, Missouri : **C.V.** Mosby Company.

283.Karvold, **E.** P. (1 974) ***me*** Activaior in Infercepive Orthodonrics. S t. Louis,Missouri : C. **V.** Mosby Company.

284.Hintoq R J. & **McNamara, J.** A. Jr. (1 **984).** Temporal Bone Adaptations inResponse to Protrusive Funcion in Jwenile **and** Young Adult Rhesus Monkeys (Macacamulatta). European JO& of Orthodontics, 6, 1 55- **174.**

285Illing, H. M., Moms, D. O., & Lee, R T. (1998). A Prospective Evaluation of Bass, Bionator and **Twin** Block Appliances. Part **1-** The Hard Tissues. European Journal of Orthodontics, 20, 50 1 -5 1 ***6.***

286.Isaacson, K. ***G.,*** Reed, R T., & **Stephens, *C.*** D. (1990). Functional Orthodonfic Appliunces. Oxford, England : BlackweU Scientific Publications.Iscaq H.N. & Sarisoy, L. (1997). Cornparison of the Effects of Passive PosterioBite-BIocks with DEerent **Construction** Bites on the Craniofacial and DentoalveolarStructures. ***American*** Jmrnal of Orrhodontics ***and*** DentofacïaZ Orfhopedics, 1 **2** 2 *(2),*

287.Lund, D. I., & Sandler, P. J. (1 ***998).*** The Effects of Twin Blocks: A ProspectiveControlled *Study.* American Journal of Orthodontics ***und*** Dentofacial Orthopedics, 1 13(11, 104-1 10.

288.Mamandras, A. **H.** & ***Men,*** L. P. (1 990). Mandibular Response to the Bionator Ap pliance. Americun Journal of Orthodoniics ***and*** Dentofacial Orthopedics, 97, 1 13 120

.

289.McNamara, J. A. Jr., Bookstein, F. L., & Shaughnessy, ***T. G. (1985).*** Skeletai and Dental Changes Following Functional Regulator Therapy on Class II Patients. Americm
Journal of Orthodontics, 88 **(21,** 9 1-1 1 O.

289. Meikle, M. C. *(1970).* The Effect of a Class II Intennaxillary Force on the Dentofacial Cornplex in **the** Adult Macaca mulatta Monkey. *American Journal of Orrhodontics, 58* **(4),** *323-340.*

290. Melsen, B., McNamara, J. A **Jr.,** & Hoenie, D. C. *(1995).* The Effects *of* Biteblocks with **and** without Repelhg Magnets Studied Histomorp hometricaily in the Rhesus Monkey (Macaca mullata). *Arnerican Journal of Orthodontics* ***and*** *DenlofacialOrfhopedics, 108 (5), 500-509-*
m s , C. M., & McCdoch, K. J. *(1998).*

291. Treatment Effects of **die** Twin BlockAppliance: *A* Cephalometric **Study.** *Americm Journal of Orihodontics and DenlofacialOrfhopedics, 114* (l), *15-24.*

292.Moss, M.L., & Salentijn, L. *(1969).* The Primary Role of Functional Matrices in Facial Growth. *Americm* ***Journal*** *of Orthodontics, 55(6), 566-5* ***77.***

293.Nahoum, H. **1.** *(1971).* Vertical Proportions *and* the Palatal *Plane* in Anterior Open-bite. *American Journal of Orthodontics, 59* **(3),** *273-282.*

294.Nelson, ***C.,*** Harkness, M., & Herbison, P. *(1993).* Mandibular Changes During
Functional **Ap** pliance Treatment . *Arnericm Journal of Orthodontics* ***and*** *Dento facial*
Orthopedics, 104 ***(2),*** *153-161.*

295.Pearson, L. E. *(1978).* Vertical Control *in* Treatment of Patients Having BackwardRotational Growth Tendencies. ***The*** *Angle Orthodontist, 48, 1 3* ***2-*** *140.*

296.Petrovic, *A.* G. *(1 98* **5).** Research Findings in Craniofacial Growth and the Modus Operandi of Functional Appliances. In: Graber, T. M., **Rakosi,** T. & Petrovic, *A. G. Dentofacid Orthopedics* ***with*** *FuncfionaZ Apphces,* St . Louis Missouri: C. V. Mo sb y Company.

297.Pro ffit, W. R (**1993).** *Contemporary Orthodontics Second Edition.* S t. Louis Missouri: Mosby- Year Book **hc.**

298.Richardson, *A. (1969).* Skeletal Factors in Anterior Open-bite and Deep Overbite.*Americm Journal of Orthodontics, 56 (2),* 1 **14-** *127.*

299.S assouni, V. (1 *969).* A Classification of Skeletal Facial Types. *American Journal of Orthodontics, 55* ***(2),*** 109- **123.**

300.Schendel, **S. A.,** Eisenfeld, J., Bell, W. *H., Epker, B.* N., & Mishelevich, D. J. (*1 976).* The Long *Face* Syndrome: Vertical **Maxillary Excess.** *American Journal ofOrthodontics, 70* **(4),** *398-408.*

301. Schudy, F. **F.** (1968)- The Control of Vertical Overbite **in** Chcal Orthodontics.The ***AngIe*** Orthodontist, 3, 19-3 9.

302. Thompson, W. **J.** (1 979). Occlusal Plane and Overbite. The Angle Orthoduntist,49,47-55.

303.Throckmorton, ***G.*** S., **Fian,** R **A,** & Bell, W. H. (1980). Biomechanics of DEerences in Lower Facial Height. Arnerican Journal of Orthodontics ***rmd*** Dentofacial Orthopedics, 77 (4), 410420-Toth, L. R & McNamara, **J.** A (1999)-

304. Treatment Effects Produced by the TwinblockAppliance and the FR-2 Appliance of Frankel Compared with an Untreated Class II**Sample.** Americm Journul of Orrhodontics *and* DentofaciaZ Orthopedics, 1 1 6 (6), **597-***609*

305. Tulloch, J.F.C., **Phillips, *C.,*** Toch, G., & Proffit, W.R (1997). The Effect of EarlyIntervention on Skeletd Pattern in Class **II** Malocclusion: A Randomîzed Clinical Triai-American Journal of Orthdon ***fics*** and Dentofacial Orthopedics, 1 1 1 **(4),** 3 9 1 -40 0.

306.Tulloch, J. F. C., **Phillips,** C., & Proffit, W. R (1998). Benefits of Early Class IITreatment: Progress Report of a Two-Phase Randornized Clinical Trial. AmericcmJournal of Orrhodonrics and Dentofacial Orthupedics, 1 ***2*** 3 (1), 62-72.

307 Tdoch, J. F. ***C.,*** **Medland,** W., & **Tuncay,** O. C. (1990). Methods Used to Evaluate Growth Modification in Class II Malocclusion. ***Arnerican*** Journal of Orfhodontics ***and*** Dentofacial Or fhopedics, 98 **(4), 3** 40-3 **47.**

308. Uner, O., Yucel-Eroglu, E. (1996). Effects of a ModSed **Maxillary** Orthopaedic **Sptint:** A Cephaiometric Evaluation. European ***Journal*** of Orthodontics, 1 8,269-286.

309. Varge* K-, & Harvold, E. P. (1985). Response to Activator Treatment in Class II Malocclusions. American Journal of Orthodontics, 88 **(3),** 242-25 1.

310. WuidmiIler, **E.** ***C.*** (1 **993).** The Acrylic-Splint Herbst Appliance: A Cephalometric Evaluation. American Journal of Orthodontics and Dentofacial Orthopedics, 1 04 (l), 73 -84.

311.Woodside, D. G., Metaxas, **A.,** & **Altuna,** *G.* (1987). The Infiuence of Functionai **Appliance** Therapy on Glenoid Fossa Remodeling. Americm Journal of Orthodontics ***and*** Dentufacial Orthopedics, 92 **(3),** 1 **8** 1 - **198.**

312.Woodside, **D. *G.,* Altuna,** G., Harvold, E., Herbert, M., & Metaxas, A (1983).Primate Experiments in Malocclusion and **Bone** Induction Americrm ***Journal*** of Orthodontics and Dentofacial Orthopedics, 83 ***(6),*** 460-468

313.Konik M, Pancherz H, Hansen K. The mechanism of Class IIcorrection in late Herbst treatment. *Am J Orthod Dentofac Orthop.* 1997;112:87–91.

314. McNamara JA Jr, Howe R, Dischinger TG. A comparison of the Herbst and Fra¨nkel appliances in the treatment of Class II malocclusion. *Am J Orthod Dentofac Orthop.* 1990;98:134–144.

315. Obijou C, Pancherz H. Herbst appliance treatment of Class II division 2 malocclusions. *Am J Orthod Dentofac Orthop.* 1997; 112:287–291.

316. Pancherz H. Treatment of Class II malocclusions by jumping the bite with the Herbst appliance. *Am J Orthod.* 1979;76:423– 442.

317. Pancherz H. The mechanism of Class II correction in Herbst appliance treatment: a cephalometric investigation. *Am J Orthod.* 1982;82:104–113.

318. Pancherz H. The effect of continuous bite jumping on the dentofacial complex: a follow-up study after Herbst appliance treatment of Class II malocclusions. *Eur J Orthod.* 1981;3:49–60.

319. Pancherz H. The effects, limitations, and long-term dentofacial adaptations to treatment with the Herbst appliance. *Semin Orthod.*1997;3:232–243.

320.. Pancherz H, Anehus-Pancherz M. The headgear effect of the Herbst appliance: a cephalometric long-term study. *Am J OrthodDentofac Orthop.* 1993;103:510–520.

321. Wieslander L. Intensive treatment of severe Class II malocclusions with a headgear-Herbst appliance in the early mixed dentition.*Am J Orthod.* 1984;86:1–13.

322.. Pancherz H. The mechanism of Class II correction in Herbst appliance treatment. A cephalometric investigation. *Am J Orthod.* 1982;82:104–113.

323. Pancherz H, Ha¨gg U. Dentofacial orthopedics in relation to somatic maturation. An analysis of 70 consecutive cases treated with the Herbst appliance. *Am J Orthod.* 1985;88:273–287.

324. Manfredi C. UNI-CEPH, a new cephalometric diagnostic telecommunication system. Poster presented at: 73rd EOS Congress;1997; Valencia, Spain.

325 . Bhatia SN, Leighton BC. *A Manual of Facial Growth. A Computer Analysis of Longitudinal Cephalometric Growth Data.* NewYork, NY: Oxford University Press; 1993.

326. Pae E-K. Cephalometry needs innovation, not renovation. *Angle Orthod.* 1997;67:395–396.

327. Rudolph DJ, White SE, Sinclair PM.Multivariate prediction of skeletal Class II growth. *Am J Orthod Dentofac Orthop.* 1998;114:283–291.

328 . Droschl H. *Die Fernro¨ntegenwerte unbehandelter Kinder zwischen dem 6. und 15. Lebensjahr.* Berlin: Quintessenz Verlags-GmbH; 1984.

329. Valant JR, Sinclair PM. Treatment effects of the Herbst appliance.*Am J Orthod Dentofac Orthop.* 1989;95:138–147.

330. Wieslander L. Long term effect of treatment with the headgear-Herbst appliance in the ‘‘early’’ mixed dentition. *Am J OrthodDentofac Orthop.* 1993;104:319–329.

331. Schiavoni R, Grenga V, Macrı` V. Treatment of Class II high anglemalocclusions with the Herbst appliance: a cephalometric investigation.*Am J Orthod Dentofac Orthop.* 1992;102:393–409.

332. Paulsen HU. Morphological changes of the TMJ condyles of 100patients treated with the Herbst appliance in the period of pubertyto adulthood: a long-term radiographic study. *Eur J Othod.* 1997;

333. Paulsen HU, Karle A, Bakke M, Herskind A. CT-scanning andradiographic analysis of temporo-mandibular joints and cephalometricanalysis in a case of Herbst treatment in late puberty. *EurJ Orthod.* 1995;17:165–175.

334.. Ruf S, Pancherz H. The mechanism of Class II correction duringHerbst therapy in relation to the vertical jaw base relationship: acephalometric roentgenographic study. *Angle Orthod.* 1997;67:271–276.

335.. Ruf S, Pancherz H. TMJ growth adaptation in young adults treatedwith the Herbst appliance. A prospective MRI and cephalo176MANFREDI, CIMINO, TRANI, PANCHERZAngle Orthodontist, Vol 71, No 3, 2001metric roentgenographic study. *Atti XIV Congresso SIDO Internazionale,Venezia.* 1997:3–16.

336. Pancherz H, Littmann C. Morphologie und Lage des Unterkiefersi der Herbst-Behandlung. Eine kephalometrische Analyse derVera¨nderungen bis zum Wachstumsabschluss. *Informationen Orthod.u.Kieferorthop.* 1989;21:493–513.

337. Pancherz H. The nature of relapse after Herbst appliance treatment.A cephalometric long-term investigation. *Am J OrthodDentofac Orthop.* 1991,100:220–233.

338. Manfredi C, Martina R, Grossi GB, Giuliani M. Heritability of 39orthodontic cephalometric parameters on MZ, DZ twins and MNpairedsingletons. *Am J Orthod Dentofac Orthop.* 1997;111:44–51

339. Pancherz H. Ruf S., The Herbst Appliance. Research BasedUpdated Clinical ossibilities, *World J Orthod*, 2000; 1: 17-31

340. Dischinger T. G., Edgewise Bioprogressive Herbst Appliance,*JCO* 89, September, 608–617.

341. Howe R. P., McNamara J., Clinical Management of theBonded Herbst Appliance, *JCO* 83; July 456-463.

342,Rondeau B., The Twin block Appliance, Part I, *TheFunctional Orthodontist*, March/April 1995.

343. Rondeau B., The Twin Block Appliance, Part II, *TheFunctional Orthodontist,* March/April 1996.

344. Woodside D. G., Altuna G., Harvold E., Herbert M.,Metaxas A., Primate Experiments in Malocclusion and Bone Induction, *Am J Orthod*, 1983; 83:460-468.

345. Garry, James F., Upper Airway Compromise and Musculo-Skeletal Dysfunction of the Head and Neck (MSD).

346. White L. W., Current Herbst Appliance Therapy, *JCO*, 94;May, 296-309.

347. Champagne M., Herbst Appliance Therapy Related toMandibular Plane Angle, *The Functional Orthodontist,*November/December, 1989.

348. Howe R. P., The Bonded Herbst Appliance, *JCO,* 82; October,663-667.

349. Takeh Z., A Fixed-Removable Herbst Appliance, *JCO,* 94:April, 246-248.

350. Rondeau B., Second Molar Debate, *The FunctionalOrthodontist,* October/November, 1999.

351. Pancherz H. Ruf S., Temporomandibular Joint GrowthAdaptation in Herbst Treatment: A Prospective MagneticResonance Imaging and Cephalometric RoentgenographicStudy, *Eur J Orthod*, 1998; 20: 375-388.

352. Pancherz H. Ruf S., Thomalske Faubert C., MandibularArticular Disc Position Changes During Herbst Treatment: AProspective Longitudinal MRI Study, *AM J Orthod Dentofacial Orthop,* 1999; 116: 207-214.

353. Lundh H., Westesson P.L., Jisander S., Eriksson L., DiskRepositioning Onlays In the Treatment of TemporomandibularJoint Disk Displacement: Comparison with a Flat

Occlusal Splint and with No Treatment, *Oral Surg Oral MedOral Pathol,* 1988; 66: 155-162.

354. Clark, William, Twin Block Functional Therapy,Applications in Dentofacial Orthopedics, Mosby-Wolfe, 1998.

355. Rondeau B., The Rick-A-Nator Appliance, *The FunctionalOrthodontist,* July/August, 1990.

356. Garry, James F., The Role of a Dentist in Sleep Apnea.

357.Pancherz H. Ruf S., The Mechanism of Class II Correction inHerbst Appliance Treatment: A Cephalometric Investigation, *AmJ Orthod,* 1982; 82: 104-113.

358. Jasper JJ. The Jasper Jumper—a fixed functional appliance. Sheboygan, Wisconsin: American Orthodontics, 1987.

359. Blackwood HO. Clinical management with the Jasper Jumper. J Clin Orthod 1991;25:755-6

360.Fraser ED. A pilot study on the evaluation of short-term effects of Jasper Jumper therapy. [Master's thesis.] Loma Linda, California: Loma Linda University, 1992

361. 4 May TW, Chada J, Ledoux WR, Wineberg R, Block MS, McMinn RW. Skeletal and dental changes using a Jasper Jumper appli-ance. J Dent Res 1992:IADR Supplement.
5 Cash RG. Case report: adult nonextraction treatment with a Jasper Jumper. J Clin Orthod 1991;25:43-7.

362. 6 Meikle, M.C.: The effect of a Class II intermaxillary force upon the dentofacial complex in the adult Macaca mulatta monkey, master's thesis, University of Washington, Seattle, 1969,p.91.

363. Brown, P.A.: A cephalometric evaluation of highpull molar headgear and face-bow neckstrap therapy, Am. J. Orthod. 74:621- 632, 1978.

364. Teuscher, V.: An appraisal of growth and reaction to extraoral anchorage. Am . J. Orthod. 89: 113-121. 1986.

365. Korkhaus, G.: Present orthodontic thought in Germany—Expe-riences with the Norwegian method of functional orthopaedics in the treatment of distoclusion, Am. J. Orthod. 46:270-287, 1960.

366. Frankel, R.: The treatment of Class II, division 1 malocclusion with functional correctors, Am. J. Orthod. 55:265-275, 1969.
367. DeVincenzo, J.P.: Changes in mandibular length before, during and after successful orthopedic correctin of Class II malocclu-sions using a functional appliance, Am. J. Orthod. 99:241-257, 1991.