MAR Dental Sciences

Review Article

Ergonomics and dentistry: A Brief Review

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Abstract

Many dentists complained of musculoskeletal disorders and this is the most common cause for their early retirement from dentistry. The postures presume by the dental practitioner while performing any procedure has various effects on their body. Ergonomics plays a distinct role in preventing these work-related musculoskeletal injuries such as neck and back pain. Its application assures high productivity and increased satisfaction among dentists. The principle of ergonomics in the design of work is the key to prevent these occupational injuries.

***Keywords**: Musculoskeletal Disorders, Ergonomics, Body aches.*

Introduction

A dental practice requires both mental as well as physical concentration and a hectic working schedule makes them follow improper working postures. These conditions lead to various Musculoskeletal disorders (MSDs), or Repetitive motion injuries (RMI). It is also known as Cumulative Trauma Disorders (CTDS). These disorders can be either simple or complex injuries. **Simple** includes- upper back pain, neck, wrists, biceps pain, spine, pulled hamstring, pain at the base of the thumbs and **Complex** include- Tension neck syndrome, trigger finger, Guyon's Syndrome, Tenosynovitis, DeQueryain's disease, and

Carpel tunnel syndrome **(1)**. These injuries can even be irreversible and contribute to the most common reason for early retirement of the dentist about **(29.5%).** Ergonomics is derived from the Greek words **"ergon**" which means work and **"nomos"** which means natural laws **(2)**. Thus, it is a study on how human beings can best use the human body for maximum comfort, safety, and productivity. It is defined as an applied science concerned with structuring and organizing things commonly utilized by individuals with the goal that both people and things connect most efficiently and securely **(3)**. The word Ergonomics was coined in 1949 by British Psychologist Hywel Murrell. It modifies the tasks and tools to meet the need of the people rather than forcing people to accommodate the task or tool. To prevent these injuries dentists should consider ergonomics principles.

Symptoms of discomfort occur in Anton in 2002:

1. Upper back (56.8%)
2. Wrists (69.5%)
3. Neck (68.5%)
4. Shoulder (60%)
5. Lower back (56.8%)

Risk factors for musculoskeletal disorders (MSDs) (4)

The most common cause for musculoskeletal disorders in a dental professional is prolonged static posture and cumulative trauma.

1.Cumulative trauma:

1. **Repetitive motions-** scaling and polishing
2. **Vibrations-** use of vibrating hand tools
3. **Contact stresses-** repeated contact with hard or sharp objects such as nonrounded desk edges or unpadded that can inhibit nerve function and blood.
4. **Forceful exertions**- during tooth extractions

This microtrauma causes wear and tear on the muscle, tendons, and nerve tissue.

2.Prolonged static postures:

The human body is designed for movement. A dentist holds a posture that requires more than 50% of body muscle to contract to resist gravity. Muscle overload leads to decrease blood flow and increased pressure on joints and bone. These include:

i. **Durations** – grasping small instruments for a longer time

ii. **Awkward postures**- handling of objects with the bent back

iii. **Static postures-** static neck, back, and shoulders

3.Age-related changes:

1. Visual capabilities decrease.
2. Workload capacity decreases
3. Temperature related discomfort increases
4. Reaction time lengthens.

Signs and Symptoms of MSDs

1. Decreased range of motions
2. Decreased grip strength
3. Loss of normal sensation or movement
4. Loss of coordination
5. Excessive fatigue in the neck and shoulders
6. Pain and tingling in arms
7. Numbness in fingers and hands
8. Hypersensitivity in hands and fingers
9. Clumsiness and dropping of objects
10. Deformity

Goals of Ergonomics:

1. Improving the quality of work
2. Reducing the risk of musculoskeletal disorders
3. Increasing efficiency and productivity
4. Decreasing fatigue and errors
5. Increasing safety of clinicians
6. Increasing worker comfort
7. Reduce the potential for overextension injury
8. It takes accounts of the worker's capabilities

To prevent these musculoskeletal disorders three things, need to be considered:

1. Work postures
2. Handling of instruments
3. Handling of equipment

Work postures:

Correct posture is very important. The human spine consists of four natural curves. They are Cervical lordosis, Thoracic kyphosis, lumbar lordosis, Sacral Kyphosis. Poor posture increases wear and tear of discs, muscles, ligaments, and vertebrae leading to pain. While sitting, bent forward, or rotated position pressure on the disc increases which leads to flattening of the lumbar curve. As the spine is attached to only muscles and ligament not to bone, continuous bent forward increases the force on the lower back which causes muscle strain and painful trigger points. Sitting with thighs parallel to the floor causes the pelvis to roll backward and flatten the low back curve. This increases disc pressure and muscle strain**5**. Therefore, proper working posture is very essential in maintaining the cervical lordosis in a stable position. Maintain a neutral position supports the uncompromised musculoskeletal balance of the clinician.

A **neutral posture** is the ideal positioning of the body while performing work activities and is associated with a decreased risk of musculoskeletal injury. It includes- straight back and respect for body symmetry, avoid forward inclination of the body, arms placed along the body, feet symmetrically positioned below the operator's hand, and shoulder relaxed, parallel to the floor.

Correct working postures:

The supine position of the patient is the most effective position to maintain a neutral posture.

1.Adjust the height of the dentist chair and patient's chair to a comfortable level

The operator should be able to move freely the legs beneath the patient's head and headrest to avoid twisting or forward bending of the torso. 7 to 12:30 for right-handed and 12:30 – 5 o'clock for the left-handed operator.

2.Avoid short working distance- it is the distance between the doctor's eye and the occlusal surface of the patient. Greater working distance improves visibility, improve neck posture. Lower back pain occurs if the patient is placed too high or if the dentist hunches over the patient. Use of indirect vision is advised. The distance between the working field and the dentist's eye should be 35-40cm **(6)**.

3.Adjustable backrest- The combination that minimizes pressure on the lower back is having a backrest inclination of 120 degrees and lumbar support of 5 cm **(7)**.

4.Check the placement of the adjustable light- it should be in the patient's mid-sagittal plane. It is positioned around the head of the dentist so that the light beam is parallel to the viewing direction with a maximum deviation of approximately 15 degrees **(8)**.

5.Alternate work positions between sitting, standing, and side of the patient.

6.Maintain an erect position **(9).**

7.Minimize excessive wrist movements **(9).**

8.Use an adjustable chair/stool with arm, thoracic, and lumbar support such as Saddle stool, Brewer operator stool, Kobo chair, Posiflex stool.

Saddle stool: provide optimal seating allowing for proper positioning of the spine and the pelvis. The angle of the seat allows for the proper balance of core muscles and allows for the maintenance of normal curvature without the use of the backseat and any pressure on the spine.

9.Avoid excessive finger movements

10.Check the temperature in the room

11.Adjustable footrest

12.The patient chair should be pivoting or drop-down armrests.

13.The dentist chair should be wrap-around support and seamless upholstery

Handling of equipment and instruments:

Selection of instruments:

Instruments should be selected such that they are lightweight as it reduces force exertion and maintains hand, fingers, and wrist in a neutral position. The instrument with a round handle will reduce muscular distress and nerve compression as compared to the hexagonal handle **(10)**. Sharp instruments are important as they reduce excessive force during instrumentation. The use of durable automatic handpiece should be encouraged instead of manual hand instruments. The automatic handpiece should be lightweight, with sufficient power, inbuilt light source, and easy to maintain.

Factors to be considered while selecting instruments: -

1. Balance
2. Ease of operation and maintenance
3. Weight
4. Overall shape/size
5. Carbon steel construction (for instruments with a sharp edge)
6. Hollowed or resin handles
7. Knurled handles
8. Color coding instruments-for easy identification

Strategies in Ergonomics:

1.Microbreaks- a 30 seconds micro-break helps the dentist to prevent injury to muscles and allow rest to nourish the stressed structures.

2.Scheduling: the appointment should be scheduled to provide recovery time and to avoid any muscle fatigue. Cases should be undertaken with buffer periods. Constant extensions and flexion motions of the hand and wrist without any rest can lead to mechanical stress on the digital nerves.

3.Rheostat positioning: place it close to the operator so that the knee is at a 90–100 degree angle. If placed outside this zone, the dentist must shift weight to one side leading to asymmetrical stresses on the back and hence, pain in the lower back. It should be switched from one foot to another 2-3 times a day.

4.Endurance strengthening- these include specific trunk stabilizing muscles to prevent lower back pain. Trunk stabilizing muscles are- transverse abdominal muscle, erector spinae, internal oblique, external oblique, and quadratus lumorum.

5.Exercise11- periodic stretching exercise throughout the day is important.

- **Pointer dog exercise:** it is the most beneficial exercise that starts with hands and knees while keeping the trunk still. Pull the navel towards the spine. Arm and opposite leg together are lift upward and hold for 5-8 seconds and then lower.
- **Lumbar roll with an exercise ball:** it is started by extending the arm on the floor at shoulder height and palms up. Without letting the shoulder lift off the ground. The ball is slowly rolled to the left side and then in a reverse movement to the right.

Besides these other exercises such as the untwister, trunk rotation, the reversal can also be practiced.

6.Four hand dentistry:

The working area of the dentist around the patient is divided into four zones, also known as zones of activity. These zones are divided by considering the face of the patient as the face of a clock. These zones are:

1. Assistant's zone
2. Operator zone
3. Transfer zone
4. Static zone

Four hand dentistry is practicing dentistry in which both dentist and assistant work as a team to perform some procedure that ultimately benefits the patient **(12)**. The dental equipment and instruments should

be centered on the dental assistant promoting over the head and the patient delivery system. To practice it following criteria is followed:

1. All the equipment must be designed ergonomically
2. The operating team and patient must be seated comfortably.
3. Pre-set trays should be used
4. The patient's treatment plan should be followed in sequence.

Advantages13:

1. It reduces stress significantly.
2. Dentists work around the operating field with limited hand or body movement.
3. He can focus entirely on the working field
4. He has better access to the instruments during the procedures.

7.Using matt surfaces- the surface of the instruments or equipment should be matt to prevent fatigue glittering effects to the eyes.

8.Cord management- the cord is wrapped around the arm to support the weight. This influences the level of muscle fatigue experienced by the dentist.

9.Ambidexterity:

The majority of dentists prefer to use their dominant hand while performing manual procedures. This can improve efficiency but can also result in a muscular overload of the dominant hand or arm. It is recommended to use alternate hands throughout the day whenever possible. However, this seems to be not practical.

10.Foot control dental unit: The foot control is designed with a pedal in which the foot is placed either entirely or partly. Placing an entire foot causes an unfavorable load which results in an unequal position of the right and left foot. This causes unequal strain on the vertebral column and pelvis. So, it is necessary to place the heel on the floor so that it can support the foot.

11.Gloves: The dentist must wear gloves that fit hands and fingers snugly and as it influences hand comfort. They should be lightweight and pliable. Gloves should not fit across the wrist too tightly.

Conclusion

According to the famous phrase "**Primum Nihil Nocere",** that means "**First Do No** Harm". Musculoskeletal disorders are very common among dentists. The possible prevention is to follow ergonomics designed work area, sitting posture, and instruments in day-to-day life. Yoga, exercise, and Four hand dentistry should be routinely incorporated in the practice to enhance the efficiency of work. Before initiating any strengthening exercise, trigger points should be resolved. A physical therapist, a neuromuscular therapist can be concerned. It is essential to seek prompt medical help for signs and symptoms of ergonomic stress or detect risk factors. Awareness among the dental clinicians through continuing dental education programs, workshops, and lecturers should be encouraged regularly. Chairside stretching is important throughout the day to prevent microtrauma and muscle imbalance.

References

1.Lindfors, P., Von Thiele, U. and Lundberg, U., 2006. "Work characteristics and upper extremity disorders in female dental health workers". Journal of occupational health, 48(3), pp.192-197.

2.Golchha, V., Sharma, P., Wadhwa, J., Yadav, D. and Paul, R., 2014. "Ergonomie risk factors and their association with musculoskeletal disorders among Indian dentist: A preliminary study using Rapid Upper Limb Assessment". Indian journal of dental research, 25(6).

3.Gupta, A., Bhat, M., Mohammed, T., Bansal, N. and Gupta, G., 2014. "Ergonomics in dentistry". International journal of clinical pediatric dentistry, 7(1), p.30.

4.Dajpratham, P., Ploypetch, T., Kiattavorncharoen, S. and Boonsiriseth, K., 2010. "Prevalence and associated factors of musculoskeletal pain among the dental personnel in a dental school".

5.Harrison, D.D., Harrison, S.O., Croft, A.C., Harrison, D.E. and Troyanovich, S.J., 1999. "Sitting biomechanics part I: review of the literature". Journal of manipulative and physiological therapeutics, 22(9), pp.594-609.

6.Deolia, S., Dubey, S., Chandak, A., Patni, T., Padmawar, N. and Sen, S., 2018. "Application of ergonomic postures during routine dental procedures in a private dental institute". Dentistry and Medical Research, 6(2), p.41.

7.Valachi, B. and Valachi, K., 2003. "Preventing musculoskeletal disorders in clinical dentistry: strategies to address the mechanisms leading to musculoskeletal disorders". The Journal of the American Dental Association, 134(12), pp.1604-1612.

8.Diniz, D.G. and Diniz, J.D., 2017. "Current considerations in dental ergonomics: Standards and guidelines, teaching and prevention". J Ergon, 7, p.200.

9.Chaikumarn, M., 2005. "Differences in dentists' working postures when adopting proprioceptive derivation vs. conventional concept". International Journal of Occupational safety and ergonomics, 11(4), pp.441-449.

10.Dong H (School of Dentistry, University of California-San Francisco, CA, USA), Barr A, Loomer P, Rempel D. "The effects of finger rest positions on hand muscle load and pinch force in simulated dental hygiene work". J Dent Educ 2005 Apr;69(4):453-460.

11.Valachi, B. and Valachi, K., 2003. "Mechanisms leading to musculoskeletal disorders in dentistry". The Journal of the American Dental Association, 134(10), pp.1344-1350.

12.Singh, N., Jain, A., Sinha, N., Chauhan, A. and Rehman, R., 2014. "Application of four-handed dentistry in clinical practice: A review". Int J Dent Med Res, 1(1), pp.8-13.

13.Dalai, D.R., Bhaskar, D.J., Agali, C.R., Gupta, V., Singh, N. and Bumb, S.S., 2014. "Four handed dentistry: An indispensable part for efficient clinical practice". Int J Adv Health Sci, 1(1), pp.16-20.

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