

ERGONOMICS IN DENTISTRY-A REVIEW ARTICLE

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ABSTRACT

Work related musculoskeletal disorders are more common than ever among dentist's. The purpose of this review is to describe the musculoskeletal conditions that affect dental surgeons and dental students at work and is to recognise musculoskeletal problems based on how dental surgeons perceive pain and stiffness after doing demanding dental work.

Musculoskeletal disorders are the most frequent occupational hazards among dental practitioners because they are brought on by repetitive motions, excessive force and poor posture. Articles and studies that examine the prevalence, risk factors, symptoms and indicators of musculoskeletal disorders and application of ergonomics in dentistry are summarised in this review article.

KEY WORDS: Dental practitioners, Ergonomics, Musculoskeletal disorders,Prolonged static posture.

INTRODUCTION

Ergonomics -the term has derived from the Greek word “Ergo” which suggests “work” and “Nomos” which means “natural law of systems”(1).British psychologist Hywel Murrell first used the term ergonomics in 1949. Instead than making people adhere to the needs of the task or tool, it adjusts their needs to fit the tasks and tools. Dentists should take ergonomics considerations into account to prevent these injuries(5).Ergonomics is defined as “an applied science concerned with designing and arranging instruments so that the people and instruments interact most efficient and safely”. The social connection in dentistry involved a helper and recipient in the context of a certain task and their unique personalities(3).An appropriate posture is crucial for everyone working in dental health care. It not only improves access and visibility while working, but also ensures the avoidance of long-term impairment and repetitive strain injuries(2).However, poor or awkward posture increases a persons risk of developing musculoskeletal disorders (MSDs)(1,4).

The application of ergonomics in dentistry is discussed in this current article.It tries to review different MSDs among dental staff classifying them according to prevalence,signs and symptoms,and distribution. It also highlights the significance of ergonomic techniques and methods for invention and prevention of debilitating MSD’s among dental professionals.

Musculoskeletal disorders:

Disorders of the muscles, tendons, bones, ligaments, cartilage, and nerves are known as MSDs(3,4,7)as well as repetitive motion injuries or cumulative trauma diseases(5).Complicated biomechanical stress to the hands, wrists, elbows, shoulders, neck, and back can result in cumulative trauma disorders (CTDS), which are health issues. Carpal tunnel syndrome and low back pain are the most typical CTD’s(30).These type of Musculoskeletal disorders are largely caused by the employment environment and workplace risk factors, such as extended awkward postures, forceful, repetitive actions, and frequent lifting or carrying of heavy objects(10).Being the second greatest cause of disability, MSDs are a growing healthcare problem worldwide(2). Due to the extremely constrained workspace and rigid work position required for dental care, MSD prevalence is higher than that of other conditions. According to a survey of the international dentistry literature, 70% of dentists of both genders report experiencing musculoskeletal issues such as pain, discomfort, functional impairment, and extended working hours (7).

Prevalence:

According to the literature, skeletal or muscle pain affects between 93% and 64% of dental practitioners and dental students. The back region (36.3% - 60.1%) and neck (19.5% - 80%) have been shown to be the most common discomfort areas among dentists(3). Up to 81% of dental practitioners reported having back, neck, shoulder, or arm pain in 1998, based on research by Bramson et al (8). Dental hygienists were placed first among all occupations in a Bureau of Labour Statistics study from 2002 for the number of cases of CTD's per one thousand workers(2).

Factors that contribute to the early retirement among Dentists are

- Musculoskeletal disorders (29.5%),followed by cardiovascular diseases(21.2%), neurotic symptoms (16.5%), tumours (7.6%) and diseases of nervous system (6.1%)._(6)

Being the most common cause of early retirement among dentists,Researchers discovered that dental employees experience Musculoskeletal disorders as discomfort in their wrists/hands (69.5%), neck (68.5%), upper back (67.4%), lower back (56.8%), and shoulders (60%) areas. – (Anton-2002)(21)

Classification of MSD’s-(2),(4),(5).

1. Disorders of the Nervous System includes Carpal Tunnel Syndrome and Ulnar neuropathy
2. Disorders of the Neck include conditions like brachial plexus compression, cervical spondylosis, cervical disc disease, and tension neck syndrome.
3. Shoulder disorders include adhesive capsulitis, rotator cuff tears, rotator cuff tendonitis, and trapezius myalgia.
4. DeQuervains disease, tendonitis, tenosynovitis, and epicondylitis are conditions affecting the elbow, forearm, and wrist.
5. Hand-Arm Vibration Syndrome:Raynaud’s diseases
6. Back disorders: including upper back discomfort and low back pain
Signs of MSD’s: (10,28)
 - Reduced range of motion
 - loss of normal feeling
 - diminished grip strength
 - loss of normal movement and
 - loss of coordination

Symptoms of MSDs:(21,25,18)

- Excessive weariness in the shoulders and neck
- Tingling, burning, or other types of discomfort in the arms
- a weak grasp
- cramping in the hands, numbness in the fingers and hands,
- clumsiness and dropping of objects as well as
- hypersensitivity in the hands and fingers.

Risk factors for MSD's:

Prolonged static posture and accumulated damage are the most frequent causes of musculoskeletal diseases among dental professionals.

1. Prolonged static postures:

The human body was built to move. A dentist's posture requires contraction of more than 50% of the body's muscles in order to defy gravity. Overworked muscles result in reduced blood flow and increased pressure on bones and joints. These include Awkward postures, static postures and duration of the procedure

a).Awkward postures:

When dentist's are working, awkward postures are deviations from neutral or normal positions(1). One example is the difference between handling things with a bent back and a

straight back. Dental staff uses uncomfortable positions to co-operate with one another while doing treatments on patients (4,5,10). awkward postures are also assumed for a better field of vision (5,20). Poor positioning and inappropriate postures have been linked to muscular pain(11,12), and a study by Lindfors et al on female health workers found a link between awkward postures and upper extremity disorder(13). Diaz-Caballero et al also found that awkward postures could cause muscular pain(11). Dental professionals adopt these awkward positions to work comfortably inside the patient's mouth and to reach instruments and to coordinate with the assistant

b).Duration:

Procedures which requires prolonged working time call for repetitive movements of the same muscles or actions raise the risk of both localised and overall fatigue. In general, a longer period of nonstop work necessitates a longer period of recovery or rest(26).

2. Cumulative trauma:

a).Repetitive motions:

The risk of developing MSDs increases when dental practitioners perform repetitive motions often, continuously and for extended periods of time(1,10,12,14,15). The muscles and tendons get fatigued and strained as a result of repetitive motions(5). Longer-lasting procedures like scaling and root planing raise the

risk of MSDs(28). Scaling tasks had the highest ergonomics risk level, according to survey results from an ergonomic risk assessment of dental practitioners by baseline risk identification of ergonomic factors(15,16).

b).Forceful exertions:

Muscles, tendons, ligaments, and joints during activities that call for strong effort (such as tooth extractions)(5,10) gets higher loads on it. When there is not enough time for rest, prolonged encounters of this kind might result in musculoskeletal issues in addition to fatigue(27). Force requirements might increase as a result of the use of An incorrect posture, The quickening of motions, Using tools with tiny or narrow handles, which reduce grip strength and if the objects being handled are more slippery as well as Firmly grasping anything with the thumb and index finger(31).

c).Contact stresses:

Contact between delicate body parts and hard or sharp objects can cause contact stresses when it occurs repeatedly or continuously. The handle of the tool pushing into the sides of the fingers (5).

d).Vibration:

MSD's can result from vibration from repeated contact with certain body parts with any vibrating object, such as through extended use of power hand tools (7,8,10).

Other risk factors of MSD's:

Poorly built workstations with equipment (such as a small workspace), improper lighting, genetic causes, when there is less time for recovery and psychosocial aspects.

Prevention and Intervention of MSD's:

If care and safeguards are followed while working, MSDs can be greatly reduced(31). Musculoskeletal diseases (MSDs) are the issue (disease) that dentists are most susceptible to, and ergonomics is the answer. To improve dentists' health, more people need to be aware of proper ergonomics.

Application of ergonomics in dentistry:

When applying ergonomics, work postures(both operator and patient position), handling of instruments(hand as well as automatic instruments) and handling of equipment's(lightning and magnification) are taken into consideration.

1. Work postures:

a).Importance of posture:

The human spine naturally has four curves. When sitting in an uncomfortable, unsupported position repeatedly for an extended period of time, the lumbar lordosis flattens. The spine receives insufficient support from the skeletal system, which leads to tension, strain, and trigger points. As a result, maintaining a good working posture is crucial to keeping the cervical lordosis stable(12).

b).Operator position and sitting posture:

The greatest technique to relieve any back pressure is to stand straight. Dental professionals must, however, sit for the majority of treatment objectives(4).To ensure the

dental staff's uncompromised musculoskeletal balance, they must maintain a neutral posture

when sitting(28)

The oral cavity should be fully accessible to the doctor. To prevent the torso from twisting or bending forward, the operator should have unrestricted movement of the legs underneath the patient's head and headrest. For the right-handed operator, the optimal position is from 7 to 12:30 o'clock and from 5 to 12.30 for the left-hand dental practitioner.(29)

The operator should

- maintain an upright posture
- Use a chair which is adjustable with lumbar, thoracic and arm support
- Reduce unnecessary wrist motions by working close to your body.
- Avoid excessive finger motions
- Try to Switch working posture between sitting in the chair, standing, and sides of the patient

- Set the patient's chair and your own chair's height to a comfortable level
- Verify where the adjustable light is placed

These factors will reduce back and shoulder fatigue of the Operator and also supports placed(13).By engaging the transverse abdominal muscles the operator can maintain a natural lower back curve(3).

2. Patient positioning:

The patient should be allowed to rest on the chair in a supine or semi supine position.The patient must be able to lie comfortably without experiencing pressure from the back.For intraoral access sites, the maxillary plane should be extended 7° beyond vertical, whereas for treating maxillary second and third molars, the maxillary plane should be extended 25° beyond vertical. The patient's chair should also be raised to allow free movement of the operator's

thighs beneath the patient's chair. Bring the patient's chin down while working on the mandibular anterior teeth such that the maxillary plane is 8 degrees forward of the vertical (5,20)

3. Hand instruments:

Sharpness of hand tools should be examined. if the instrument's edges are dulled,the operator will need to exert more energy to attain the similar outcomes.As a result, cutting tools must always be utilised. Second, it's best to use a tool with a rounded handle and sharp edges.as a result of this the finger pads and sides will no longer experience muscular strain or nerve compression. Instruments with hexagonal handles should be avoided since they don't release stress and hence demand more pinching power than round, smooth

handles. Use handles with shallow circumferential grooves or knurling as they provide superior friction and reduce the amount of force needed to grab the tool(5). Instruments made of carbon steel are preferred(20).

4. Automatic instruments:

To avoid using too much force when working, automatic tools should be chosen over manual ones. Handpieces ought to be balanced and lightweighted. It is best to use handpieces with an integrated light source since they offer a wide field of vision. The automated

instruments' hose lengths should be as short as possible. Hoses that retract or coil up ought to be avoided. It is preferable to have handpieces with swivel mechanisms since it allows them to rotate effortlessly (1,5).

5. Workstation:

The configuration of the equipment and workstations should be such that the risk of MSDs is reduced. The dental team should work in a neutral position at all times. The arrangement of all necessary dental equipment should be such that reaching for objects requires the least amount of postural change(7). Instruments should be easy to reach while working, thus they should be placed at a reasonable distance (for most people, this is 22–26 inches) and not above or below waist level when the dental practitioner's sits in an erect posture, the working space is divided into two areas. one is normal working area and maximum working area. the arc formed by sweeping the forearm while holding the upper arm at the side is the normal working area. The arc formed when the arm is fully extended is the working area's maximum. Diagnostic instruments, such as the handpiece, saliva ejector, high-volume evacuator, etc., should be placed in the normal horizontal reach for easy access. The maximum horizontal reach should be used for items that are used infrequently(1).

6. Magnification:

Operating telescopes or loupes, which are available in many forms, can magnify objects[20]. Dental loupes have a magnification range of 2 to 5x [21]. These allow for a wider field of vision and enable the operator to keep a longer operating distance[4]. This keeps the body in a neutral position while operating (20).

7. Lighting:

Lighting is necessary for good visibility in the operating room, which prevents the dental staff from bending their necks and straining. Only the operational area should be illuminated by the above light, without any shadows that can impair visibility. The location of the light source should be directly above and slightly beyond the patient's oral cavity in the sagittal plane of the patient body. It should be angulated at 5° toward the operator's head in 12 o'clock position(4,5).

8. Gloves:

When working, gloves of the proper size and fit are vitally necessary. Aside from being uncomfortable while wearing them, ill-fitting gloves can also harm the hands and fingers, particularly the base of the thumb[4,5].

In order to prevent detrimental effects on dexterity and grip strength, it is advised to maintain proper temperatures above 25°C[4].

9. The operator's stool:

- An adjustable lumbar support is important.
- Height-adjustable seats.
- Modular footrests.
- Body support with wraparound
- Seamless furniture(12)

By raising the hip angle to 130° and positioning the pelvis in a more neutral posture, saddle-style stools help to retain the lumbar curvature of the lower back. It works well in small operating rooms(23).

10. Patient chair:

Promoting patient comfort and maximizing patient access are the main objectives.

- Look for a chair with a flat seat(7)
- Constancy
- Arm rest that pivot or lower. Neck and head support.
- Forearm and wrist support.

Recent advances and strategies:

1. Four handed dentistry:

One of the most current dental practice developments is four-handed dentistry. It is the most beneficial approach to operate from an ergonomic standpoint(11). It optimises efficiency while minimising unwanted dental staff movements. The dental chair's placement and work space should be proportionate to the assistant's workspace. The dental assistant ought to be the main consideration when selecting a dental unit for ergonomic practice. When the dentist is working, the assistants should be in charge of handling tools and handpieces(15,5). Due to the restricted movement of the hands, arms, and body, the worker can concentrate entirely on their work. Because it fosters a stress-free and productive workplace, ergonomics is regarded as the most effective method of providing dental treatments.

2. Appointment scheduling:

To prevent any injuries to muscles and other tissues, the appointment schedule should be spread such that the dental staff avoids working on cases constantly without any breaks(3). The difficulty of the case, the length of the procedure, busier periods, etc. can all be taken into consideration when scheduling and altering appointments. In order to prevent muscle fatigue, this will

provide the dental practitioners enough recuperation time[1,5].

3. Microbreaks:

The operator can take a break to avoid straining their muscles and to enable recovery time for the stressed structures(22). A 30-second microbreak could aid the dentist's productivity and efficiency(19)

4. Ambidexterity:

When performing manual tasks, the majority of people prefer to utilise their dominant hand(2). While this could increase productivity, it might also cause the dominant hand or arm's muscles to get overworked. When possible, it is advised that people try to switch hands throughout the course of the workday(5). This might not be realistic, though.

5. Stretching and Exercises:

Regular exercise, stretching, and relaxation techniques (such as yoga, biofeedback, and meditation) improve quality of life by preventing injuries and reducing stress. Exercises to Strengthen Your Body (According to Valachi & Valachi, 2003) (11)

A. The muscles that support the back and neck, as well as those employed in the forearm, wrist, and hand, can be kept strong and healthy by stretching and strengthening them.(11)

B. Stretching breaks during the working day(17).

C. One of the most crucial elements in preventing CTS is constantly resting the hands.

D. Look up from the task and focus your eyes for about 20 seconds at a distance to

relieve eyestrain brought on by prolonged, intense focus at one depth of vision.

E. Hold for a few seconds while lowering the head slowly and letting the arms and head fall between the knees. By tightening the abdominal muscles and rolling up, raise carefully, lifting the head last.

F. If your neck is stiff, try rotating your head. In order to rotate the head, the head must be tilted from right to left, forward and backward, and only to the extent that is comfortable.

G. The muscles in the shoulder that can be tight from holding a telephone, instruments, or an oral evacuator can be stretched by shrugging the shoulders. Roll the shoulders in a circular motion backward, then forward, pulling them up toward the ears.

Conclusion:

Dental professionals should educate themselves on health issues, Due to their susceptibility to various MSDs. Furthermore, they need to be aware of ergonomic solutions that not only reduce muscle tension and tiredness but also avoid career-ending detrimental effects on the muscles and spine. The ergonomic techniques and strategies ensure high productivity and healthy dental practice. Hence, dental professionals should begin to operate ergonomically which will also enable them to retain optimal health.

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