

ERGONOMICS IN DENTAL PRACTICE

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ABSTRACT:

Ergonomics is the science of fitting the task to human capabilities and limitation in order to improve work place safety and productivity. Dental profession is not immune from MSDs or cumulative trauma disorders (CTD). Risk factors for work related MSDs with specific reference to dentistry include stress, poor flexibility, improper positioning, infrequent breaks, repetitive movements, weak postural muscles, prolonged awkward postures and improper adjustment of equipment. Proper ergonomic design is necessary to prevent repetitive strain injuries (RSJ), which can develop over time and can lead to long term disability. This article discusses the important issues of postures and offers different methods to ergonomize the dental operator so as to work with comfort, efficiency and ease.

Key words: Ergonomics, MSD, CTD, Prolonged static postures (PSP).



INTRODUCTION:

Dentistry is a social interaction between helper and recipient in their limited job setting and with personal characteristics. A healthy dentist is one of the most important component in a successful dental practice. It is estimated that more than half of practitioners have some kind of painful musculoskeletal disorder that is work related. Studies by Gorter et al, in 2000 show that one out of ten dentist's reports having poor general health and three out of ten dentists report having poor physical state. ^[1]

Literature suggests that the prevalence of skeletal or muscular pain in dentists, dental hygienists and dental students ranges from 93% to 64%. The most prevalent regions for pain in dentists have been shown to be the back (36.3% - 60.1%) and neck (19.5- 80%).^[2] Dentists and dental hygienists are at risk for work related musculoskeletal disorders compared to the general population. The most frequent injuries occur in the spine (neck and back), shoulders, elbows and hands. Although the causes of any

particular case of a MSD are exceedingly difficult to identify with complete accuracy, certain risk factors are typically discussed in the field of ergonomic studies. The primary occupational risk factors for MSDs discussed in the literature include:

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- Repetition
 - Force
 - Mechanical stresses
 - Posture
 - Vibration
 - Cold temperature
 - Extrinsic stress [3, 4, 5, 6, 7]
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Recently, “Ergonomics” has become a popular term. The term has been used with most professions but increasingly in the dental profession. The word ‘Ergonomics’ was derived from the Greek word: ‘Ergo’ which means work; and ‘nomos’ meaning natural laws. It is the science of fitting the job settings conducive to the worker. In simple terminology, Ergonomics is a way to work smarter- not harder, by designing tools, equipment, work stations and tasks to fit the job to the worker- NOT the worker to the job. Proper ergonomic design is necessary to prevent repetitive strain injuries (RSI), which can develop over time and can lead to long term disability. [8]

MUSCULOSKELETAL DISORDERS:

The world health organization defines MSD as “a disorder of the muscles, tendons, joints, intervertebral discs, peripheral nerves and vascular system, not directly resulting from an acute or instantaneous event but installing gradually and chronically.” Cumulative trauma disorders (CTDs) are health disorders arising from repeated biomechanical stress to the hands, wrist, elbows, shoulders, neck and back. [9]

Most common CTDs are carpal tunnel syndrome and Low back pain.” The common signs, symptoms and risk factors of MSD are:

Some Symptoms of MSDs:

- Excessive fatigue in the shoulders and neck
- Tingling, burning sensation in arms
- Weak grip. cramping of hands
- Numbness in fingers and hands
- Clumsiness and dropping of objects
- Hypersensitivity in hands and fingers

Signs of MSDs:

- Decreased range of motion
- Loss of normal sensation
- Decreased grip strength

- Loss of normal movement
- Loss of co-ordination

Some Risk Factors for MSDs :^[10]

- Repetition
- Forceful exertions
- Awkward postures
- Contact stress
- Vibration
- Poorly designed equipment workstation
- Improper work habits
- Genetics
- Medical conditions
- Poor fitness level
- Physical/mental stress
- Lack of rest/recovery
- Poor nutrition
- Environmental factors
- Poor lighting

With specific reference to dentistry, the risk factors include: stress, poor flexibility, improper positioning, in frequent breaks, repetitive movements, weak postural muscles, prolonged awkward postures and improper adjustment of equipment.

MECHANISMS MSDS IN DENTISTRY:

Prolonged Static Postures (PSPs): When the human body is subjected repeatedly to PSPs, it can initiate a series of events that may result in pain, injury or a career-ending MSD.

Muscle Ischemia/Necrosis and Imbalances: During treatment, operators strive to maintain a neutral, balanced posture and find themselves in sustained awkward postures. These postures often lead to stressed and shortened muscles which can become ischemic and painful, exerting asymmetrical forces that can cause misalignment of the spinal column (Al Wazzan et al, 2001).^[11]

Hypo-mobile Joints: During periods of PSPs or when joints are restricted due to muscle contractions, synovial fluid production is reduced and joint hypo mobility may result.

Spinal Disc Herniation and Degeneration: In unsupported sitting, pressure in the lumbar spinal discs increases. During forward flexion and rotation, the pressure increases further and makes the spine & disc vulnerable to injury (Al Wazzan, et al 2001).^[11]

Neck and Shoulder Injury: Repetitive neck movements and continuous arm and hand movements affecting the neck and shoulder demonstrate significant associations with neck MSDs.

Carpal-Tunnel Syndrome (CTS): It has been associated with both repetitive work and forceful work. Symptoms can appear from any activity causing prolonged and increased pressure (passive or active) in the carpal canal (Shugars et al, 1987).^[12]

Low Back Pain: Low back discomfort has been associated with dental work in numerous studies.

Psychosocial Factors: Dentists with work-related MSDs show a significant tendency to be more dissatisfied at work. They are burdened by anxiety, poor psychosomatic health and thus feel less confident with their future (Shugars et al, 1987).^[12]

SITTING POSTURE:

Human spine has four natural curves; cervical lordosis, thoracic kyphosis, lumbar lordosis and sacral kyphosis (Fig: 1). When sitting unsupported frequent posture in dentistry the lumbar lordosis flattens. The bony infrastructure provides little support to the spine, which now is hanging on the muscles, ligaments and connective tissue at the back of the spine, causing tension in these structures. Ischemia can ensue, leading to low back strain and trigger points. Maintaining the cervical lordosis in the proper position is equally important (Fig. 2).

Forward-head postures are common among dentists, due to years of poor posture involving holding the neck and head in an unbalanced forward position to gain better visibility during treatment. In this posture, the vertebrae no longer can support the spine properly, and the muscles of the cervical and upper thoracic spine must contract constantly to support the weight of the head in the forward posture. This can result in a pain pattern, which often is referred to as tension neck syndrome. This syndrome can cause headaches and chronic pain in the neck, shoulders and inter-scapular muscles, and it occasionally can radiate pain into the arms.^[13]

The best way to reduce pressure in the back is to be in a standing position. However, there are times when the dentist needs to sit. When sitting the main part of the body weight is transferred to the seat. Some weight is also transferred to the floor, back rest and arm rests. Where the weight is transferred is the key to a good seat design.^[14]

When working in sitting postures a chair is required to support the seat and back. In this situation one should alternate active and passive sitting postures. The active posture could be defined as the correct body posture that is maintained by the muscles of the back, the back being leaned forward. This posture cannot be maintained for a very long time. The passive posture is (the one in which the back is sustained by the dentists' back of the chair).^[14]

Parameters of the correct working postures'^[15] (Fig: 3)

1. The sitting posture is upright and symmetrical.
2. The shoulders hanging down relaxed with the upper arms beside the upper body.
3. The forearms have been lightly elevated.
4. The angle between lower and upper legs is approx. 105-110.
5. The legs are slightly apart, making an angle of between 30-45°.
6. The patient's head is appropriately rotated in 3 directions.

7. The light beam of the dental operating light is as parallel as possible to the viewing.
8. The sitting location, between 09.00-12.00 o'clock, for left-handed people 03.00- 12.00.
9. The soles should be on the floor.
10. The patient's head is rotated and the sitting location adjusted.
11. Instruments held in 3 supporting points.
12. The upper part of the body should be perpendicular on the chair forward movements should be made without curving the spine.
13. The head could bend 20°-25°.
14. The arms should be close to the body.

POSTURAL AWARENESS TECHNIQUES [2,14,]

Maintain the low back curve: This facilitates proper posture and reduces pressure on disks and muscles. The following practices can help maintain the low back curve:

Tilted Seat Plan: It opens the hip angle by 110 degrees. Retrofit a non-tilting seat such as commercially available Fit—sit ergonomic cushion for accomplishing this.

Saddle Stools: Consider using saddle-style operator stool that promotes the natural low back curve by increasing the hip angle to approximately 130 degree. It is ideal for confined operatory spaces.

The doctor is now halfway between standing and sitting, so low back pressure is even less than when seated in traditional operator chairs.

Lumbar Support of the Chair: Must be used as much as possible by adjusting it forward to contact your back.

Avoid Static Postures: Dentists should vary their work positions as often as possible to shift the workload from one group of muscles to another.

ALTERNATE BETWEEN STANDING AND SITTING [10,16]

Standing uses different muscle groups than does sitting; therefore, alternating between the two positions lets one group of muscles rest, while the workload is shifted to another group of muscles. Alternating between standing and sitting also can be an effective tool in preventing injuries.

Reposition the Feet: Subtle changes in foot position can shift the workload from one group of low back muscles to another, allowing the overworked tissues to be replenished with nutrients.

Position Patients at the Proper Height: A common mistake among dentists is positioning patients too high. This causes elevation of the shoulders and abduction of the arms, leading to prolonged static muscular tension in the neck and shoulders. Operators should take the time to position their patients properly for mandibular and maxillary procedures. Generally, patients should be placed in a semi supine position for mandibular procedures and a supine position for maxillary procedures. Sit Close to the Patient and position knees under the

patients chair if possible. This can be facilitated by tilting the seat and using patient chairs that have thin upper backs and headrests.

Adjust the Chair: So your hips are slightly higher than your knees and distribute your weight evenly by placing your feet firmly on the floor. The forward edge of the chair should not compress the backs of your thighs. Sit close to the patient and position knees under the patient's chair if possible. This can be facilitated by tilting the seat and using patient chairs that have thin upper backs and headrests.

Adjust Armrests: Which are designed to decrease neck and shoulder fatigue and strain, to support elbows in the neutral shoulder position.

Avoid Twisting: When possible, dentists should position instruments within easy reach. Repeated unilateral twisting in one direction may result in muscle imbalances or structural tissue damage. Leading to low back pain.

MSD PREVENTION STRATEGIES [17, 18, 19]

Use Magnification: Magnification enables operators to maintain a greater working distance and position patients at the proper height, with the shoulders relaxed and the forearms approximately parallel with the floor. Operating telescopes or loupes are available with flip-up or through-the-lens designs. Working in postures with greater than 20 degrees of neck flexion have been associated with increased neck pain. The declination angle of the scopes should allow you to maintain less than 20 degrees of neck flexion

Selection of Instruments: Tool instrument design should be such that it reduces forceful exertion and maintains hand/wrist in neutral posture.

While using hand instruments look for:

1. Hollow or resin handles.
2. Round, knurled or compressible handles.
3. Carbon steel construction (for instruments with sharp edges).

While using automated instruments look for:

1. Light weight, balanced models (cordless preferred).
2. Sufficient power.
3. Built-in light sources.
4. Angled vs. straight shank.
5. Pliable, light weight hoses.
6. Easy activation.
7. Swivel mechanisms.

Exercise: It is important to stabilize the low back curve by contracting the transverse abdominal muscles. To do this while sitting, sit tall with a slight curve in the low back, exhale, pull your navel toward the spine without letting the curve flatten. Continue breathing while holding the contraction for one breath cycle. Repeat five times. Strive to maintain this stabilization regularly throughout the workday.

Chair-side Directional Stretching: Having operators take frequent breaks and

reverse their positions is integral in an effective injury prevention program. Directional stretches can be performed in or out of the operatory and can be incorporated into a daily routine that facilitates balanced musculoskeletal health. Directional stretching involves a rotation, side-bending or extension component that generally is in the opposite direction of that in which the operator frequently works (Fig. 4). Figure 5 shows various hand exercises to be performed to reduce carpal tunnel syndrome (Fig 5). This strategy addresses the muscle imbalances that tend to develop. Frequent stretching breaks address the detrimental physiological changes that can develop while working in optimal or awkward prolonged static postures.

Micro breaks: To prevent injury from occurring to muscles and other tissues, the operator should allow for rest periods to replenish and nourish the stressed structures. In a study on the efficacy of microbreaks during the workday, Morris and colleague found that by complying with regularly Scheduled microbreaks. The subjects had less discomfort and that the addition of 30 second microbreaks showed no detrimental effect on worker productivity. [17, 19]

Weight Control: For each additional 10 pounds of weight you carry, 100 pounds of force is generated to the low back.

Scheduling: Goal would be to provide sufficient recovery time for the doctor and the staff to avoid chronic muscle fatigue.

Potential Strategies

- Vary procedures within the same appointment.
- Alternate tough and easy patients.
- Shorten patient's recall interval.

Goals of ergonomics in any work place should include" [19]

1. Reducing the risk of CTD.
2. Increasing productivity.
3. Increasing safety.
4. Improving the quality of work.
5. Decreasing fatigue and errors.

MSD Prevention Methods" [20]

1. Adopting a correct working posture.
2. Use of adequate light.
3. Good planning of dental care sessions.
4. Alternative planning of long and short sessions.
5. Alternating the body postures sitting and upright.
6. Having short breaks after each care session and long coffee or lunch breaks, the sink should be installed at distance.
7. The working day should not be longer than 7 hours.
8. Every 6 weeks a journey should be planned,

9. Sports activities should be practiced for about 45 minutes three times a week.

CONCLUSION:

Work-related pain is common among dental professionals. The development of four-handed operatory techniques has made delivery of dental care more efficient and productive; however, it also has contributed to an increase in prolonged static postures among operators. Because this problem is multifactorial, any possible solution should be multifactorial as well. Available research supports the idea that this

problem can be managed or alleviated effectively using a multifaceted approach that includes preventive education, postural and positioning strategies, proper selection and use of ergonomic equipment and frequent breaks with stretching and postural strengthening techniques. This represents a paradigm shift for daily dental practice. It is important that dentistry incorporate these strategies into practice to facilitate balanced musculoskeletal health that will enable longer, healthier careers; increase productivity; provide safer workplaces and prevent MSDs.

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FIGURES:

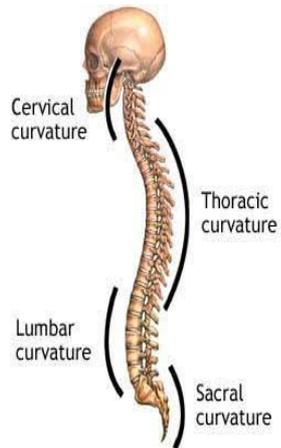


Figure 1: Four natural curves of human spine



Figure 2: Maintaining the cervical lordosis in the proper position

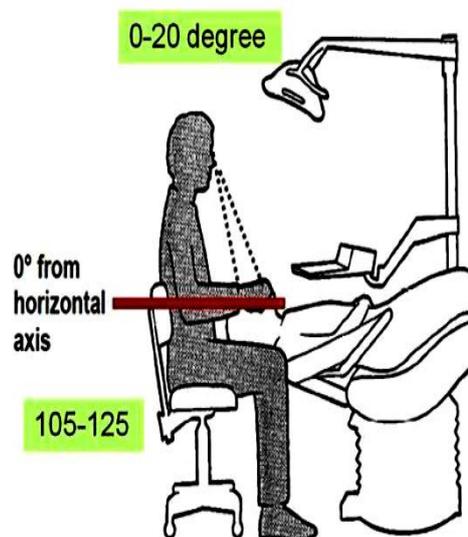


Figure 3: The upright and symmetrical sitting posture.

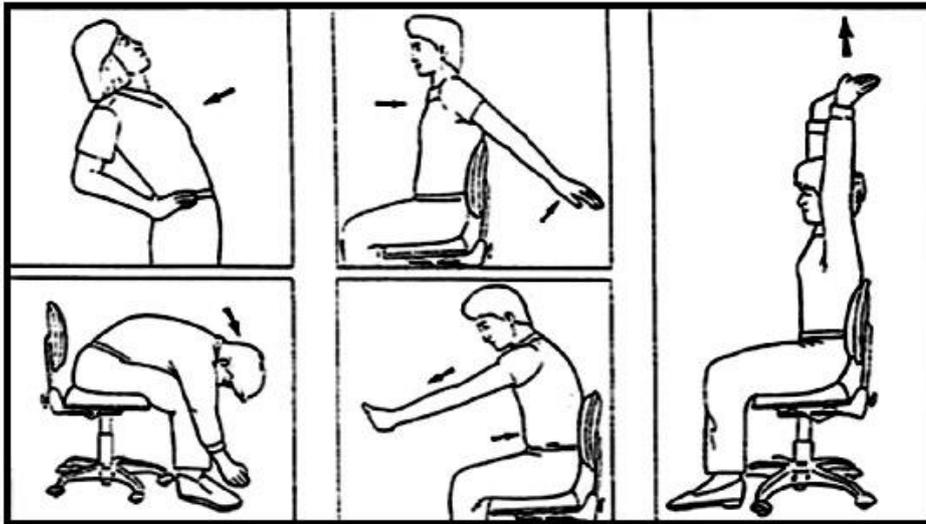


Figure 4: Body stretching exercises

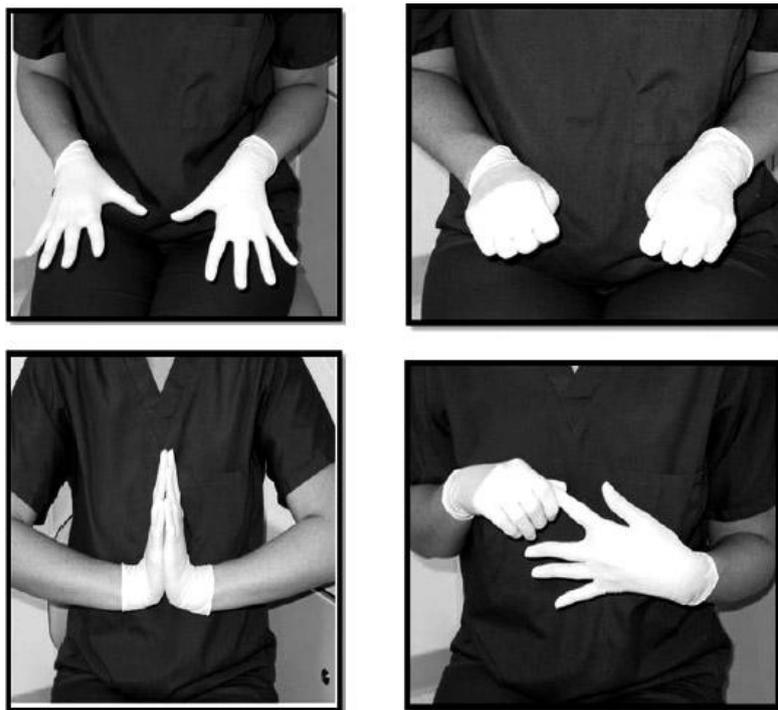


Fig 5: Different hand exercises