

Review Article

Prevention Is Better Than Cure: Ergonomics in Dentistry

Yogita Khalekar ¹, Amit Zope ², Lalit Chaudhari ³, Ujawala Brahmkar ⁴, Hemant Gadge ⁵, Swapnil Deore ⁶

^{1,4} Senior lecturer, ³Professor and Head, Department of Oral medicine and radiology, ACPM Dental College, Dhule

²Senior lecturer, Department of Orthodontics, ACPM Dental College, Dhule

⁵Senior lecturer, Department of Prosthodontics, ACPM Dental College, Dhule

⁶Senior lecturer, Department of Oral Pathology, ACPM Dental College, Dhule

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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 Musculoskeletal disorders (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. This article includes MSDs, the signs, symptoms and risk factors of these types of injuries, so that one can be aware of developing problems and can change his /her approach to work or alter the workstation setup to prevent further injury.

Introduction

Tooth Now a days most of the equipments in market are labelled as ‘with ergonomolmic design!’ What is ergonomics?and why dentist should be concern about it?

In Greek, “Ergo,” means work and, “Nomos,” means natural laws or systems. Ergonomics, therefore, is an applied science concerned with designing products and procedures for maximum efficiency and safety. It is also a study of the relationship among the personnel, equipment and environment in the work area. Proper ergonomic design is necessary to prevent repetitive strain injuries, which can develop over time and can lead to long-term disability. The international Ergonomics Association defines ergonomics as follows: Ergonomics is the scientific discipline concern with the understanding of interactions amons human and other elements of a system, and the profession that

applies theory, principles, data and methods to design in order to optimise human well being and overall system performance. Ergonomics first entered the modern lexicon when Wojciech Jastrzebowski used the word in his 1857 article ‘The Outline of Ergonomics, i.e. Science of work, Based on the Truths Taken from the Natural Science.’ The coining of term Ergonomics, however, is attributed to British psychologist Hywel Murrell, at the 1949 meeting at the United Kingdom’s admiralty, which leads to foundation of The Ergonomic Society.¹

The musculoskeletal health of dental professionals has been the subject of numerous studies worldwide, and their focus has been on the pain experienced by the practitioner. Because their work area is narrow, dental treatment is performed, in a very inflexible work posture. Studies indicate that back, neck and shoulder

* Corresponding author: Dr. Yogita Khalekar (MDS Oral medicine and radiology) Senior lecturer, ACPM Dental College, Dhule Email: yogitakhalekar@yahoo.co.in

or arm pain is present in up to 81% of dental operators.² A healthy dentist is one of the most important component in a successful dental practice. Despite the fact, that though 88% of dentists report good or excellent health,³ some studies show that one out of ten dentists reports having poor general health and three out of ten dentists report having poor physical state.⁴

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%).⁵ 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.

MSDs AND DENTAL PROFESSIONALS

MSDs are described as disorders of the muscles, nerves, tendons, ligaments, joints, cartilage or spinal discs. Dentists are more prone for MSDs as they often cannot avoid prolonged static postures which results in tendinitis, synovitis, tenosynovitis and bursitis. Occupational diseases have not only physical, psychological and social consequences, but also economic⁶ and security implications. A level of severity they reach when they reach a level of severity that directly affects work capacity, causing absences and early retirement.

RISK FACTORS FOR MSDs

Awkward postures: Refers to positions of the body that significantly deviate from neutral position while performing job tasks. (Figure 1)

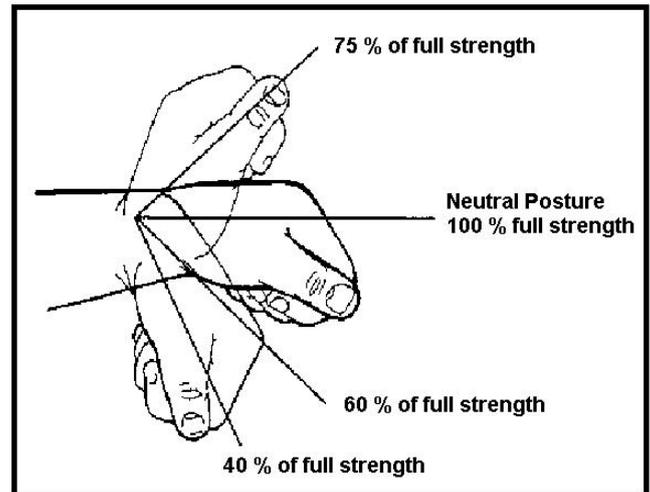


Figure 1: Diagram shows the reduction in strength which occurs as the wrist deviates further away from its neutral posture

Static postures: those which are held for a long period of time and may result in fatigue and injury .

Force: The amount of physical effort required to maintain control of equipment or tools, or to perform a task.

Repetitive movements: The risk of developing an MSD increases when same parts of body are used continuously with few breaks, like scaling, root planning.

Contact stress: Results from occasional, repeated, or continuous contact between sensitive body tissues and hard or sharp objects like resting the wrist on the edge of a desk, or tool handles pressing into palms.⁷⁻⁹

SYMPTOMS OF MSDs

Excessive fatigue in the shoulders and neck

Tingling, burning, or other pain 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

Off-the-Job activities that can contribute to MSDs:

Home computer use
 Repetitive activities using the fingers Sports activities
 Prolonged/awkward postures at home
 Use of household tools
 Activities involving repeated heavy lifting, bending, twisting, or reaching

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 column¹⁰

Hypomobile Joints: During periods of PSPs or when joints are restricted due to muscle contractions, synovial fluid production is reduced and joint hypomobility 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 injury¹⁰.

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 canal¹¹.

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

Psychosocial Factors: Dentists with workrelated 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 future¹¹.

Some Elements of an Improper Workstation Setup¹²:

- Dentist's or patient's chair is too high/low.
- Dentist's chair has no lumbar, thoracic, or arm V support.
- Instrument table is not positioned properly.
- Lighting is inadequate for the task.
- Edges of tables/worksurfaces are sharp/uncomfortable.
- Ventilation makes workspace cold.
- Work environment is damp and cold.

APPLICATION OF ERGONOMICS:

Through ergonomics advances made over the years, dentists have been able to modify and optimise their working environments.

Equipment Layout (Figure 2)

Dental equipment should be located in a manner which allows you to maintain a

neutral working posture. It should require minimum adjustment and effort to access so as to reduce postural deviation while working. Frequently used items should be kept within a “comfortable distance” (22–26 inches for most people) and not above shoulder height or below waist height. Frequently used items such as the syringe, hand piece, saliva ejector and high volume evacuator should be positioned so they are within a normal horizontal reach which is the arc created while sweeping the forearm when the upper arm is held at the side.

Items that are used less frequently used should be placed within the maximal horizontal reach which created when the arm is fully extended. The following image shows the difference between a normal and maximum work area.

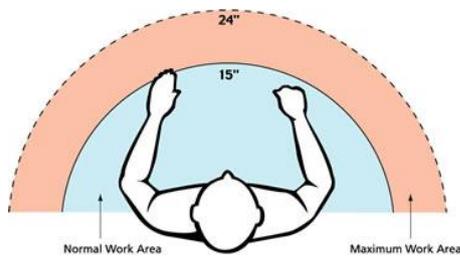


Figure 2 Equipment Layout

SITTING POSTURE:

Human spine has four natural curves; cervical lordosis, thoracic kyphosis, lumbar lordosis and sacral kyphosis. 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.

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 (he one in which the back is sustained by the dentists' back of the chair.¹⁴

Parameters of the correct working postures¹⁵ (Figure 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.

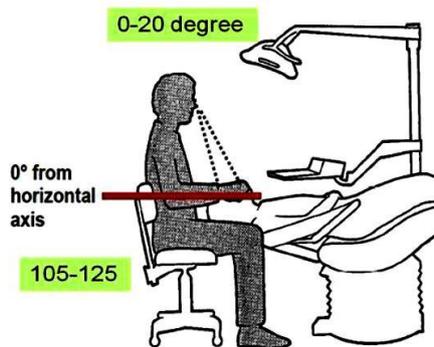


Figure 3: The upright and symmetrical sitting posture

POSTURAL AWARENESS TECHNIQUES:^{5,14}

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.

ALLERNATE BETWEEN STANDING AND SITTING^{2,16}

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 scat and using patient chairs that have thin upper hacks 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 tile patient and position knees under the patient's chair if possible. This can be facilitated by tilting the scat 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 arc 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

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 (Figure 4) 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.

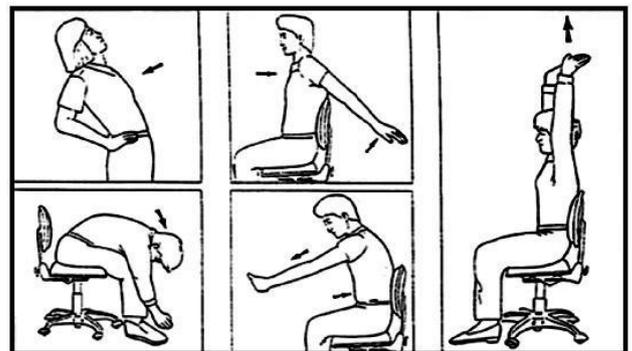


Figure 4: Body stretching exercises

Chair-side Directional Stretching: (Figure 4) 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. 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 include¹⁹

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

Points to Remember:

- Perform a variety of stretches throughout the workday
- Stretching should be gentle and gradual

- Do not stretch a muscle to the point of pain
- Stretches can be held up to 10 seconds and repeat 3-5 times
- Breathe normally while stretching
- If you suffer from a musculoskeletal condition consult a Physician before attempting new exercises which you are unfamiliar with.

CONCLUSION:

Every dentist has an opportunity for ergonomic improvement. 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. As a result, ergonomics should be a continuous and proactive measure for ensuring the proper fit between people and their working environment.

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