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Ergonomics: Need of the Hour

TARUN KALRA[1], GEETA KALRA[2], MOHIT BANSAL[3], SWATI UPPAL[4]

ABSTRACT

The success in any practice is dependent on efficient workflow, with minimum risk to injury and cumulative trauma. Work in a dental office calls for deftness in cognitive abilities and can, more often than not, be physically challenging. Repeated use of movements and postures that go against the natural or anatomical alignment and limitations of the human body often lead to what is known as cumulative trauma leading to development of musculoskeletal disorders. The whole idea of ergonomics in the workplace is to avoid any such exigencies. Through this review it is intended to bring forth the widely known yet often neglected aspect of dental practice; that is the human factor in workplace efficiency.

KEYWORDS: Musculoskeletal disorder, Trauma, Ergonomic, Dental practice

INTRODUCTION

A healthy dentist is one of the most critical factor guiding a successful dental practice. A fitting posture gives a dentist not only gilt edge working conditions, that is access, visibility and control in the operating area, but also, physical and psychological comfort. In the long term an ideal posture also results in more working energy, reduced stress levels, increased comfort and lack of pain and muscular tension. A "bad" posture, while on the contrary, leads to premature fatigue, pain of varying degrees and severity, unwarranted stress and a negative attitude towards one's work and a high-risk for musculoskeletal disorders that ultimately leads to a poor quality of work affecting both the dentist and the patient.[1] A narrow working area compounded with malapropos posture, inappropriate equipment and improper operatory design all contribute towards neck and lower back ailments.[2]

The concept of four handed dentistry was introduced by Glene Robinsonin in 1968 which involves work of coordinated nature involving both the dentist and assistant, working together as a team to perform those operations in a manner that has been carefully and deliberately planned.[3]

Dental practitioners are at an increased risk to a number of occupational hazards such as chemical, biological; with ergonomic hazard leading to musculoskeletal disorders. A number of studies indicate that up to 81% of dental clinicians suffer from back, neck and shoulder or arm pain;[4] and interestingly, 29.5% attributed musculoskeletal disorders to the prime reason for their early retirement.[5]

Such problems can be easily avoided by increasing awareness among dentists of the correct ergonomic postures used during their practice, redesigning their workstation to promote neutral positions and following healthy work practices to reduce the position-related stress on the practitioner's body.[6]

The term ergonomics word derives its origin form the word "ergon" which means work and "omics" meaning law. Simply put, ergonomics is the science of fitting the task to human capabilities and limitation in order to improve work place safety and productivity.[7] As per the International Ergonomics Association, ergonomics is defined as a "scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance."[8]

A failure to include this human engineering into the workplace can have serious consequences in the form of MSD (musculoskeletal disorders) and /or cumulative trauma. The World Health Organization defines a MSD as "a disorder of the

muscles, tendons, peripheral nerves or vascular system not directly resulting from an acute or instantaneous event (e.g., slips or falls)."[9]

WHAT LEADS TO MSDs[10,11]

A lack of proper posture can lead to a number of musculoskeletal disorders and associated cumulative trauma. Starting from lower and upper back pain due to abnormal posture, static postures, poor strength and endurance, these disorders also encompass neck, shoulder, hand and wrist problems.

Some of the common sign and symptoms of MSD are as follows:
•Inflammation
•Redness
•Decreased range of motion.
•Loss of function
•Tingling
•Numbness
•Stiffness
•Pain/tenderness
•Muscle weakness
•Fatigue
•Decreased grip strength

Specific disorders and their presentation can be summarized as

Neck And Shoulder Disorders

a) Myofacial Pain Disorder (MPD): Myofacial pain syndrome is a chronic pain related disorder wherein, pressure on sensitive points in muscles (called trigger points) cause pain and typically occurs after a muscle has been contracted repetitively. Clinical signs of MPD are deep aching pain in muscles, persisting or worsening pain, the presence of a tender knot in a muscle and difficulty in sleeping due to pain leading to restless nights and reduced concentration in the dental clinic.

b) Cervical Spondylitis: most of the times, cervical spondylitis is not associated with any symptom(s). However, when symptoms do occur, the typical presentation includes pain and stiffness in the neck. Cervical spondylitis results in a narrowing of the space needed by the spinal cord and the nerve roots that pass through the spine to the rest of the body. Decompression of the spinal cord may lead to:

•Tingling, numbness and weakness in arms, hands, legs or feet
•Lack of coordination and difficulty walking
•Loss of bladder or bowel control

c) Thoracic Outlet Syndrome: Thoracic outlet syndrome belongs to a group of disorders that occur due to compression of the blood vessels or nerves in the space between the collarbone and the first rib (thoracic outlet), leading to pain in shoulders and neck and numbness in the fingers. The symptoms of thoracic outlet syndrome can vary, depending on the structures that are compressed (neurogenic, vascular or non-specific in nature).

Other signs and symptoms of neurological thoracic outlet syndrome include:
•Gilliatt-Sumner hand (Muscle wasting in the fleshy base of one's thumb)
•Numbness or tingling in arms or fingers
•Pain or aches in the neck, shoulder or hand
•Weakening grip

d) Rotatory Cuff Tendinitis/ Tears: A rotator cuff injury is described as:
• A dull ache, deep in the shoulder
• Disturbed sleep, particularly if one lies on the affected shoulder
• Make it difficult to comb one's hair or reach behind one's back
• Accompanied by arm weakness

Hand And Wrist Disorders

The various hands and wrist disorders affecting dentists include:
a) DeQuervain's Disease: De Quervain's tenosynovitis is a painful condition that affects the tendons on the thumb side of one's wrist. Actions such as turning the wrist, grasping and making a fist tend to be painful. Although the exact etiology of De Quervain's tenosynovitis is not known, any activity that relies on repetitive hand or wrist movement; which is the mainstream of dental treatment, can make it worse.

Symptoms of De Quervain's tenosynovitis include:
•Pain and swelling near the base of the thumb
•Difficulty moving the thumb and wrist when grasping or pinching
•A "sticking" or "stop-and-go" sensation in the thumb

b) Carpal Tunnel Syndrome: It is caused by a pinched nerve in the wrist and usually starts gradually in nature with numbness/discomfort/ tingling in the thumb, index and middle fingers that comes and goes.

c) Guyon's Syndrome: This condition arises where the ulnar nerve becomes trapped or squashed as it passes through the Guyon canal in the wrist. The condition may result from overusing the wrist or hand. Symptoms includes-

- Tingling in the little finger
- Burning wrist pain
- Burning hand pain
- Numbness in the hand
- Reduced sensation in ring finger
- Reduced sensation in the little finger
- Clumsy hand movements
- Weakened muscles in palm of hand
- Weakened thumb muscle
- Impaired hand grip
- Difficulty spreading fingers

Back disorders

The various back disorders affecting dental clinicians are:

a) Herniated Spinal Disk: Most herniated disks occur in lower back (lumbar spine), although they can also occur in the neck (cervical spine). The most common signs and symptoms are:

- Arm or leg pain
- Numbness or tingling
- Weakness

b) Lower Back Pain: Pain and stiffness in lower spine and surrounding tissues are the common presenting symptoms of a stressed lower back and arises due to crouching of the dentist over the patient rather that keeping a straight posture. This can also arise as most of the pre-clinical work by dentists is done standing rather than sitting.

c) Sciatica: It is described as a radiating pain along the path of the sciatic nerve. Typically, sciatica affects only one side of the body and most commonly occurs when a herniated disk, bone spur on the spine or spinal stenosis compresses a part of the spinal nerve. This causes inflammation, pain and often some numbness in the affected leg.

HOW MSDs OCCOUR[10]

Repeated subjection of the human body to prolonged static postures can initiate a series of events resulting in pain, injury or lead to career ending MSD.

Sustained awkward postures during dental treatment can often lead to stressed and shortened muscles, which, in time tend to become ischemic and painful. These asymmetrical forces may eventually cause misalignment of the spinal column. Some important risk factors, especially when occurring at high levels and in combination include:

a) Awkward Postures: A bent or twisted posture during lifting, lowering or handling objects places more stress on the spinal disks as compared when the back is straight. More strenuous the task, more is the strain on the back. The dentists should coordinate with the assistant to obtain an optimal view of teeth in the patient's mouth and make a constant, conscious effort to avoid awkward postures.

b) Forceful Exertions: Tasks, such as tooth extractions, require high magnitude forceful exertions that can give rise to fatigue and MSD when there is inadequate time for rest or recovery. Such procedures also strain the muscles of the wrist.

c) Repetitive Motions: Motions repeated frequently and for prolonged periods cause fatigue and muscle-tendon strain to accumulate. Effects of repetitive motions increase when awkward postures and forceful exertions are involved. For example, extraction, use of airotors, impression taking, scaling etc. are some of the repetitive motions done by dentists in their routine dental practice.

HOW TO AVOID MSDs

Dentist's Posture[12]

Tilting the head forward to gain greater visibility makes the muscles of the cervical and upper thoracic spine contract constantly to support the weight of the head in the forward posture. This can result in tension neck syndrome, that is,

headaches and chronic pain in the neck, shoulders and inter-scapular muscles, and occasionally radiating pain into the arms.[13] Among various dental positions, the standing position puts least amount of pressure on the back but, it is not always a practical proposition. Also, it becomes even more difficult to stand and practice dentistry with advancing age. It is therefore, important to support the back either actively, (with the back leaned forward the correct posture is maintained by the muscles), or passively (wherein the posture is sustained by the back rest of dentist's stool).

Various parameters need to be fulfilled in order to attain an ergonomic working posture. They are:[10]
1. The sitting posture is upright and symmetrical
2. The shoulders should be relaxed (with no contraction of trapezius muscle) with the upper arms beside the upper body
3. The forearms have been lightly elevated
4. The angle between lower leg (calf muscle) and upper legs (thighs) is approximately 105°-110°
5. The legs are slightly apart, making an angle of 30-45°
6. The patient's head is appropriately rotated in three directions
7. The light beam of the dental operating light is as parallel to viewing as possible
8. The sitting position for the operator should be between 09.00-12.00 o'clock (and for left-handed dentists 03.00-12.00) with respect to the patient's head
9. Instruments should be held in a grasp with three supporting points

Though the above mentioned nine points give an overview of an ergonomically acceptable posture, the following practices would help the practitioner to actually attain them. As mentioned earlier, it is important to maintain the natural curves of the spine to reduce or prevent low back pain[14,15]. The following practices can help maintain the low back curve-

1. Sit with the buttocks snugly against the back of the chair
2. Keeping feet flat on the floor, adjust the seat height up until thighs gently slope downward
3. Nestle the lumbar support into the natural lumbar curve of the lower back. Then, angle the lumbar support forward to facilitate contact with the low back
4. Tilt the seat forward about five to fifteen degrees
5. Arm rests are designed to decrease neck and shoulder fatigue and strain, and to support elbows in the neutral shoulder position. Adjust these according to your height and comfort
6. It is advisable to work as close to your body's centre of gravity as possible. For this, use patient chairs that have thin upper backs and headrests and sit close to the patient positioning your knees under the patient's chair

Further help for dentists

- Use a saddle-style operator stool; this promotes the natural low back curve by increasing the hip angle to approximately 130 degrees
- 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
- Stabilize the low back curve by contracting the transverse abdominal muscles.
- Pivot forward from your hips, not your waist[3]
- Avoid prolonged static postures
- Alternate sitting and standing between procedures
- Avoid twisting from the waist

Patient Positioning[16]

It must always be remembered that the patient is mostly seated in the dental chair for a maximum of one or two hour(s), whereas the dentist is in his operatory for a majority of his day. It therefore becomes important to give priority to ergonomically viable posture for the dentist. For the patient, making him lie supine in the chair is usually the most effective way to maintain neutral posture. An important consideration is that the chair should be high enough to accommodate free movement of the operator's thighs beneath it. Clearance around the patient's head should allow unimpeded operator access from the 7 to 12:30 o'clock position. For most intraoral access sites; the maxillary plane should be extended 7° beyond the vertical while for the maxillary second and third molars, the maxillary plane should be 25° beyond the vertical. While treating mandibular anterior teeth, bring the patients chin down so the

maxillary plane is 8°ahead of the vertical.

Equipment Layout in the dental setting[1]

The working posture of the dentist is directly associated to the relationship between his body and the different elements present in his workstation, which include both movable (dentist's stool, x-ray machine etc) and immovable elements (furniture, dental chair, compressor etc). An incorrectly designed and/or used workstation affects the posture of the dentist.[16]

Dental equipment should be located in a manner which allows maintaining a neutral working posture. Minimum adjustment and effort should be required to access what is needed so as to reduce postural deviation while working. 22–26 inches is the average comfortable distance within which frequently used items should be placed and not above shoulder height or below waist height. 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 should be placed within the maximal horizontal reach, which is created when the arm is fully extended. The following image shows the difference between a normal and maximum work area.[1]

Fit Body Fit Mind

Last but not the least, the importance of regular exercise cannot be overemphasized. To counter the effects of prolonged and repetitive muscle actions it is important to regularly stretch them and workout to increase oxygen flow thereby avoiding ischemia. Simple chairside stretching between patients and a twenty-minute workout thrice a week is all it takes to avoid long-term problems.

Exercises particularly of use to the dentist include-

- Neck stretches- alternate right and left
- Chin tucks – a repetition of 15 twice a day
- Shoulder rotations- a repetition of 5 each in clockwise and anticlockwise direction
- Shoulder lifts- a repetition of 10 twice a day
- Wrist rotations- a repetition of 5 each in clockwise and anticlockwise direction
- Yoga- poses such as bhujangasan are known to be helpful in lower back pains. Also a regular practice of Surya Namaskar caters to the whole body in terms of cardio as well as strengthening exercise.

CONCLUSION

"If eyes do not see what the mind does not already know"

Unless one is aware of what constitutes an ergonomically viable posture and working style and also the consequences of not following the same, it is next to impossible to include it in one's practice. Dentists should therefore, in their own interest, seek out and receive education about musculoskeletal health, injury prevention and dental ergonomics. Secondly, one should know the difference in self-preservation and selfishness. While making a patient comfortable is of prime importance, equally or maybe more critical is the comfort of the operator. A fatigued and stressed worker will not be half as good. Hence one should not consider including ergonomics as a hindrance to speed and patient comfort but as a way towards attaining long term success and overall wellbeing.

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AUTHOR AFFILIATIONS:
1. MDS, Principal, Professor and Head, Department of Prosthodontics, Rayat Bahra Dental College & Hospital, Mohali (Punjab), India
2. MDS, Assistant Professor, Department of Oral and Maxillofacial Surgery, BRS Dental College and Hospital, Panchkula, (Haryana), India
3. MDS, Reader & Head, Department of Public Health Dentistry, Rayat Bahra Dental College & Hospital, Mohali (Punjab), India
4. MDS, Ex- Senior Lecturer, Department of Prosthodontics, Rayat Bahra Dental College & Hospital, Mohali (Punjab), India

Corresponding Author:
Dr. Tarun Kalra
MDS, Principal
Professor and Head, Department of Prosthodontics
Rayat Bahra Dental College & Hospital
Mohali (Punjab), India

For article enquiry/author contact details, e-mail at:
manuscriptenquiry.ihrj@gmail.com