



## Research Article

### ERGONOMICS FOR PAIN FREE DENTAL PRACTICE –A REVIEW

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#### ABSTRACT

Occupational health hazards due to dental practice among dental professionals are on a continuous rise resulting in a significant negative impact on the overall quality of life. This wide range of occupational hazards includes the musculoskeletal disorders (MSDs) which markedly affect the long term efficiency and health of the dental health care workers. These problems can be avoided by increasing awareness of the postures used during work, redesigning the workstation to promote neutral positions, examining the impact of instrument use on upper extremity pain, and following healthy work practices to reduce the stress of dental work on the practitioner's body.

#### Keywords:

Ergonomics,  
Dentistry,  
Musculoskeletal Disorders,  
Occupational hazards.

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## INTRODUCTION

Dental professionals are constantly exposed to certain occupational hazards owing to their work environment. This wide range of occupational hazards includes the musculoskeletal disorders which markedly affect the long term efficiency and health of the dental health care workers (Lake J, 1995). The term work-related musculoskeletal disorders (MSDs) refers to musculoskeletal disorders to which the work environment contributes significantly or to musculoskeletal disorders that are made worse or longer lasting by work conditions or workplace risk factors. Common examples of such workplace risk factors include jobs requiring repetitive, forceful or prolonged exertions of the hands; frequent or heavy lifting, pushing or pulling, or carrying of heavy objects and prolonged awkward postures. The level of risk depends on the intensity, frequency and duration of the exposure to these conditions (Gupta A *et al*, 2014; Jodalli PS, 2015).

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The problem is common amongst dental personnel because they work in a restricted field that makes high demands on vision, and requires them to sit in a static or awkward posture, use excessive force, as well as undertake precise repetitive hand and wrist movements. (Lehto TU, 1999; Graham C, 2002; Lindfors P *et al*, 2006) Even dental students can manifest early signs of MSDs during their years of training. These findings were supported by research that revealed that more than 70% of dental students experienced neck, shoulder and lower back pain as early as the third year of their dental training (De Carvalho *et al*, 2009; Rising DW *et al*, 2005) These problems can be avoided by increasing awareness of the postures used during work, redesigning the workstation to promote neutral positions, examining the impact of instrument use on upper extremity pain, and following healthy work practices to reduce the stress of dental work on the practitioner's body (Bramson JB *et al*, 1998; Jabbar TAA, 2008). The term Ergonomics has been derived from Greek word 'Ergo' mean work and 'nomic' means natural loss to create a word that the science of work and a relationship to that.

Ergonomics is defined as a set of multidisciplinary knowledge applied to the organization of labor activity that makes up a job. The goal of ergonomics is to stabilize a safe, healthy and comfortable working environment, thereby preventing health problem and improving productivity. If ergonomic principles are applied in the field of dentistry, it helps to reduce cognitive and physical stress, prevent occupational hazards, thus, helps to improve productivity and more comfort to the dentist and patient (Castro SL and Figlioli MD, 1999; Sudarshan R and Ganesan, SV, 2012).

### **MECHANISMS LEADING TO MUSCULOSKELETAL DISORDERS (MSDs) IN DENTISTRY (Valachi B and Valachi K, 2003)**

- Prolonged Static Postures (PSPs): Dentists frequently assume static postures, which require more than 50 percent of the body's muscles to contract to hold the body motionless while resisting gravity. The static forces resulting from these postures have been shown to be much more taxing than dynamic (moving) forces. 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 Imbalances: During treatment, operators should strive to maintain a neutral, balanced posture. Even with best ergonomic postures can find themselves in sustained awkward postures. These postures often consist of forward bending and repeated rotation of the head, neck and trunk to one side. These stressed shortened muscles can become ischemic and painful, exerting asymmetrical forces that can cause misalignment of the spinal column and decreased range of motion.
- Muscle ischemia and necrosis: Even when using the best working postures, dental operators still maintain static contractions of the trunk muscles. As their postures deviate from neutral, their muscles must contract harder to maintain a working posture. As muscles become fatigued, this prolonged contraction can cause muscle ischemia. Under normal conditions, damaged tissue is repaired during rest periods. In dentistry, however, the damage often exceeds the rate of repair due to insufficient rest periods. Muscle necrosis can occur.
- Hypomobile Joints: During periods of PSPs or when joints are restricted due to muscle contractions, synovial fluid production is reduced dramatically and joint hypomobility may result.
- Spinal Disk herniation and degeneration: In unsupported sitting, pressure in the lumbar spinal disks increases 40% above the pressure from standing. During forward flexion and rotation, a position often assumed by dental operators, the pressure increases 400% making the structure vulnerable to injury.

### **RISK FACTORS FOR MSDs (Diaz-Caballero AJ et al, 2010; Yamalik N, 2007)**

- Elevated work area with permanent static positions would produce a reduction of blood flow in the supra spine tendon and would also originate high muscle tension on the trapezoids.

- Lack of support of the forearms during repetitive holding of instruments which would compromise different body segments such as spine, shoulder, and wrists.
- The handling of vibrating instruments is associated with specific lesions such as nerve trapping, early arthrosis and even, with Raynaud syndrome.
- Forced cervical static postures.
- Poor posture when seating: The flexion of the lumbar spine, when seating forward, produces marked pressure increments between the interdiscal spaces.
- Lighting at the work place: the lack or excess of light can generate myopia and irreversible retinal lesions, among others.
- Temperature, ventilation and humidity at the work place: If the temperature is high and the air is saturated with humidity, there is exhaustion, increased body temperature and, respiratory and circulatory disorders.
- Intermittent and continuous noise produced by high and low speed instruments

### **SYMPTOMS OF MSDs (Sarkar PA and Shigli AL, 2012)**

- 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

Although the causes of MSDs are varied and dependent to some extent on worker predisposing factors, anyone who is experiencing a MSD, wishes to minimize the risk of developing a MSD or who simply wants to improve comfort and efficiency. Interventions or prevention strategies require an awareness to manage and prevent injuries effectively. Applying ergonomics to the practice of dentistry provides safety benefits also improve performance objectives through greater productivity (Babaji P et al, 2011; Lehto TU et al, 1991).

### **INTERVENTION AND PREVENTION STRATEGIES TO REDUCE MSDs**

#### **Dental Chair**

Optimum position of the oral cavity of a patient seated in the dental chair is considered to be at the level of the seated clinician's heart. Adjustments can be made to facilitate functionality according to maxillary or mandibular arch as the area of working. Any position at higher or lower level causes strain and fatigue of shoulders. It will unnecessarily force the dentist to assume awkward bending or leaning forward. The body should be in a relaxed, natural position. Arms should not be elevated and tensed. The elbows and upper arms should stay close to operator's body.

The elbow and forearm should be at right angle to each other. Operator should be able to move freely with legs beneath the chair's headrest to prevent from undesirable forward leaning toward patient. The base-free dental chairs these days offer a better leg room. There should be sufficient room for the stool to move around in different O' clock positions. The use of retractable overhead variety of attachments is however controversial. The added weight of cords and resistance offered can often influence the muscle fatigue experienced by a clinician (Shipra N *et al*, 2014).

### Dentist's Seat

A dentist's seat should have a rigid base must to prevent tipping. The base should be rigid yet compact enough to allow proper functioning such as to allow free access to foot controls of dental chair, non-interfering with dental chair's base and do not hinder the freedom of movements of operator's feet. With the adoption of digitized control panels on chair and base – free dental chairs, the foot interference is less of a problem. The seat height should also be modifiable. With feet properly supported on the ground, the angle between back and thighs should be 90-110°. Flat footwears should be chosen for workplace. Researchers recommend height adjustment according to clinician's short and tall stature. The clinician's seat should be in a range where their thighs are nearly parallel to the ground and feet are fully supported. If the arm rest for elbow support is incorporated in the doctor's stool, it should be such that the elevation of shoulders should not occur while using these elbow rests. At the same time, the rests should not interfere with the access to the patient. Maintain an erect posture and adjust seating to minimize forward or lateral bending. In a seated posture, bending and twisting motions of the spine significantly increase the pressure in the lumbar discs when compared with standing (Sanders MJ and Turcotte CA, 1997; Shipra N *et al*, 2014).

### Patient Positioning

Supine positioning of the patient in the chair is usually the most effective way to help to maintain neutral posture. The chair should be raised so the operator's thighs can freely turn beneath the patient's chair. Clearance around the patient's head should at least allow unimpeded operator access from the 7 to 12:30 o'clock position, for right-handed operators. For most intraoral access sites, the maxillary plane should be extended 7° beyond the vertical. For treating the maxillary second and third molars, the maxillary plane should be 25° beyond the vertical. For the mandibular anterior teeth, bring the patients chin down so the maxillary plane is 8° ahead of the vertical (Gupta A *et al*, 2014).

### Hand Instruments

A round handle, as opposed to a hexagonal handle, with hard edges will reduce muscular stress and digital nerve compression. However, a smooth, round-handled instrument requires more pinching force to keep the handle from spinning in the hand. Handles with shallow, circumferential grooves or with knurling allow better friction with the fingers so that a secure grasp requires less force. Small diameter, hexagonal shaped instrument handles produce a mechanical stress that may cause digital nerve compression. When working edges are sharp, the instrument performs more of the work; when the edges are dulled; additional operator force is required to achieve

the same result. Sharp instruments are important for reducing excessive force during instrumentation (Gupta A *et al*, 2014).

### Positioning hand instruments for the dentist

Tray for hand instruments to be at a distance of 20 to maximally 25 cm of the body of the dentist. Minimum working height of 78 cm and a maximum working height of 107 cm for the sitting dentist. The distance from the underside of the instrument console to the tray has to be about 9-10 cm. The tray holder attached to the unit via firstly, a horizontal arm with a swivel coupling that is placed directly below the console (Sudarshan R and Ganesan, SV, 2012).

### Positioning instruments for the dental assistant

The instruments for suction and other instruments with tubing must be positioned as far as possible toward the front of the upper body of the dental assistant. Minimum working height of 78 cm and a maximum working height of 116.2 = 116 cm, for use in a sitting and standing position. When these instruments are also used by the dentist the reach must fulfill the requirement of being at a distance of 30-40 cm (Sudarshan R and Ganesan, SV, 2012).

### Automatic Instruments

Practitioners should consider use of automatic instruments (high-speed handpiece, slow-speed handpiece, belt driven drills, lasers, ultrasonic scalers, endodontic handpieces) instead of manual hand instruments. Handpieces should be as light as possible and well balanced. Hose length should be as short as possible; extra hose length adds weight. Avoid retractable or coiled hoses. The tension in the hose is transferred to the wrist and arm as the hose is stretched. Ideally, a pliable hose with a swivel mechanism in the barrel of the hand-piece so that it can rotate with minimal effort should be used. (Gupta A *et al*, 2014).

### Dental operating light

The requirements laid down in national and international standards and draft standards provide helpful guidelines for optimum illumination. General room illumination with 500 lx and illumination of the working area with 1000 lx are best achieved with a larger number of fluorescent lamps on the ceiling above and in front of the dental chair. Daylight white lamps with good color rendering are a good combination with changing daylight and the color of light of the operating light. The color of external skin, mucous membrane and teeth appears natural. The maximum illuminance is between 9000 and 21 000 lx and is thus sufficiently high. If the patient looks into the operating lights, maximum luminances of 5 cd/cm<sup>2</sup>-20 cd/cm<sup>2</sup> occur 8 cm above the illuminance maximum in six operating lights. Luminances of more than 20 cd/cm<sup>2</sup> cause squinting and running eyes. A light fitting with more than 200 cd/cm<sup>2</sup> should not be used. A sharp fall in illuminance (distinct light/dark threshold) and low luminances to the patient's eyes can be achieved with much directed light. Very directed light leads to very heavy shadows. Similarly, less specifically directed light leads to softer shadows so that objects in the oral cavity can be discerned easily, but the patient is no longer dazzled (Viohl J, 1979).

## Conclusion

A thorough understanding of the ergonomics is essential to know about the musculoskeletal problems that could arise because of improper ergonomics in dentistry. This would enable the clinicians to work in a comfortable posture, to lead a healthy life and render appropriate care for the patients in need. By practising correct postures, the working capacity and productivity of dental professionals will enhance. They can work in a pain-free environment for quality dental care to their patients. The prevention and reduction of MSDs among dentists should include their education in dental ergonomics through regular CDE programmes and awareness regarding the importance of work-related risk factors.

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