

Review Article

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Ergonomics in dentistry- a review

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ourselves away from hazards and musculoskeletal disorders.

Abstract

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INTRODUCTION

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 [1].

Ergonomic conditions are simply the safest, most efficient, and easiest way to work. Improving the ergonomic delivery of dental services and accounting for working conditions in dental offices enhance the well-being and safety of patients, staff, and practitioners [2].

Dentists and dental hygienists are at a greater risk of work-related musculoskeletal disorders than is the general population. These disorders can result in pain and dysfunction of the neck, back, and hands and fingers. It has been estimated that work-related musculoskeletal injuries occur in 54% to 93% of dental professionals, with the most frequent injuries occurring in the spine (neck and back), shoulders, elbows and hands. Dental hygienists in one study reported neck pain associated with working in a bent neck position, and neck symptoms were reported by 72% of a sample of 94 experienced hygienists (mean age: 46 years) [3].

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Occupation related diseases are increasing day by day and one amongst them is musculoskeletal

disorders due to improper ergonomics in dentistry. So, Dental surgeons had to update themselves regarding the occupational hazards in dentistry so that they could overcome these disorders. This

review gives a bird's eye view about the basics of ergonomics, positioning, viewing, handling

Lake in 1995 implicates several mechanisms in the generation of pains and soreness in dentists, such as[4].

a) Elevated work area with permanent static positions of more than 30 degrees, which would produce a reduction of blood flow in the supra spine tendon and would also originate high muscle tension on the trapezoids.

b) Lack of support of the forearms during repetitive holding of instruments which would compromise different body segments such as spine, shoulder, and wrists.

c) The handling of vibrating instruments is associated with specific lesions such as nerve trapping, early arthrosis and even, with Raynaud syndrome.

d) Forced cervical static postures.

e) Poor posture when seating. The flexion of the lumbar spine, when seating forward, produces marked pressure increments between the interdiscal spaces.

f) Lighting at the work place: the lack or excess of light can generate myopia and irreversible retinal lesions, among others.

g) 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.

h) Intermittent and continuous noise produced by high and low speed instruments

i) Present dental chairs allow adaptation of the patient's position in height, inclination of the torso, flexion or hyper extension of the head of the patient.

Role of ergonomics in dentistry

The Ergonomic Standard mandated by the Occupational Safety and Health Administration (OSHA) recommended that the most efficient and effective way to remedy "ergonomic hazards" causing musculoskeletal strain should be through engineering improvements in the workstation [5].

In dentistry, bad working habits, repetitive tasks – such as scaling, root planning, and uncomfortable physical postures contribute greatly to musculoskeletal disorders, stress, and loss of productivity. Four-handed dentistry is ergonomically the most favorable way to provide dental services since it minimizes undesirable movements of the operating team and expedites the progress of most dental procedures. Available research supports the idea that ergonomic hazards 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 [5].

Dental mirror

To maintain preferred body conditions the mirror to handle angle is set at 45° and is held in a vertical manner and at the end of its handle. The mirror handle is made lighter, has a smaller diameter for finite rotational movement, and has slight ribbing parallel with the long axis of the handle to aid in rotary movements for viewing; it is held in a pendulum fashion to allow for access by the assistant. A No. 1sized mirror is preferable as its reflected image includes one-half of a tooth on either side of the one being treated. The mirror surface-to-handle angle and smaller mirror size enables a more systematic way of integrating operating views with finger positions and movements during tooth preparations [6].

Dental chair requirements[6].

1) Sitting with an angle of 110° or a little higher between lower and upper legs.

- 2) The seat is divided in 2 parts:
 - A horizontal part at the rear for supporting the buttocks with a minimal length of 15 cm
 - An oblique front part declining 20° for an equal support of the thighs
 - Movable front part, an angle of more than 110° between lower and upper legs
- 3) The maximum depth of the seat shall be 40 cm and the width 40 with a maximum of 43 cm.
- 4) A lumbar or pelvic support of 10 to 12 cm high that is adjustable vertically from 17-22 cm and for very tall dentists to 24 cm.
- 5) The pelvic support can rotate around a horizontal axis with an angle of 25° upwards and downwards.
- 6) The upholstery of the seat has to be sufficiently hard with a roughened surface. It has to be firm, depressing only slightly.
- 7) Support has to be given up to a point just before the elbow to maintain the agility of the underarm and hands.
- 8) Width of 10-12 cm and it being not too long.

Positioning instruments for the dental assistant[6].

- 1. 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.
- 2. Minimum working height of 78 cm and a maximum working height of 116.2 = 116 cm, for use in a sitting and standing position.
- 3. When these instruments are also used by the dentist the reach must fulfill the requirement of being at a distance of 30-40 cm

Positioning hand instruments for the dentist[6].

- 1. Tray for hand instruments to be at a distance of 20 to maximally 25 cm of the body of the dentist
- 2. Minimum working height of 78 cm and a maximum working height of 107 cm for the sitting dentist.
- ^{3.} The distance from the underside of the instrument console to the tray has to be about 9-10 cm.
- 4. The tray holder attached to the unit via firstly, a horizontal arm with a swivel coupling that is placed directly below the console.

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/cm2-20 cd/cm2 occur 8 cm above the illuminance maximum in six operating lights. Luminances of more than 20 cd/cm2 cause squinting and running eyes. A light fitting with more than 200 cd/cm2 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 [7].

Musculoskeletal disorders

The World Health Organization defines an 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). These disorders are considered to be work-related when the work environment and the performance of work contribute significantly, but are only one of a number of factors contributing to the causation of a multifactorial disease."[8].

Prevalence of MSD'S

The 12-month period prevalence of lower back pain among Queensland dentists (53.7%), was similar with that reported in many other countries, such as Denmark, Israel, and the United States. MSD rate reported by Saudi Arabian counterparts were (73.5%). The 12-month period prevalence of neck-related pain among Queensland dentists (57.5%) was similar to that reported by dentists in many other countries, such as Denmark (65%) and Saudi Arabia (65%), but higher than a survey of Israeli dentists (38.3%). 12-month period prevalence of shoulder pain (53.3%) was as prevalent among Queensland dentists as lower back or neck pain. This finding is similar to an investigation of dental workers in the United States military (53%), as well as another study of Danish dentists (65%). Study from Sweden found that dentists were exposed to a high load on the trapezius muscles bilaterally, as well as prolonged forward bending of the head [9].

MSDs classification[10].

- 1. Nerve Entrapment Disorders: carpal tunnel syndrome, ulnar neuropathy.
- 2. Occupational Disorders of the Neck and Brachial Plexus: tension neck syndrome, cervical spondylosis, cervical disc disease, brachial plexus compression.
- 3. **Shoulder disorders:** trapezius myalgia, rotator cuff tendonitis, rotator cuff tears, and adhesive capsulitis.
- 4. **Tendonitis of the Elbow, Forearm and Wrist:** deQuervain's disease, tendonitis, tenosynovitis,epicondylitis
- 5. Hand-Arm Vibration Syndrome: Raynaud's disease.
- 6. Low Back Disorders: chronic low back pain.

The sitting postures

The correct working postures in the Dental surgery are the sitting postures that conform to the following requirements[10].

- Symmetrical postures
- All horizontal axes should be parallel
- Legs should be slightly apart (a 30°-45° angle)
- Shank should be perpendicular on the floor
- Upper part of the body should be perpendicular on the chair forward movements should be made without curving the spine
- Head could bend 20°-25°
- Arms should be close to the body
- Forearms should be nearly horizontal (max. 25% raised)
- Shank / thigh should be at 115°
- Soles should be on the floor

Mechanisms leading to musculoskeletal disorders (MSDs) in dentistry

1. **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 [11].

- Muscle Imbalances: During treatment, operators 2 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 ischemic and become painful, exerting asymmetrical forces that can cause misalignment of the spinal column and decreased range of motion [11].
- ^{3.} **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 [11].
- 4. **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 [11].
- 5. **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 [11].

Prevention of MSDs

Ergonomics problems in dentistry can be reduced by implementing various strategies. Dentists should also perform specific exercises for the trunk and shoulder girdle to enhance the health and integrity of the spinal column, stretching exercises for the hands and head and neck, maintain good working posture, optimize the function of the arms and hands and prevent injuries [5].

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.

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