
ERGONOMICS-THE LAW OF WORKING

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ABSTRACT

Ergonomics, the science that studies human stress and strain related to activities, has one primary objective-to prevent work related musculoskeletal disorders, or symptoms that aggravate these disorders. Repeated unnatural, deviated or inadequate working postures, forceful hand movements, inadequate equipment or workplace designs and inappropriate work patterns are likely to be the particular risk factors. The application of ergonomics to dentistry, or dento-ergonomics, can increase efficiency and prevent injury. Among the factors that need to be considered are the height and reach of staff members, the equipment being used and the distribution of tasks. By implementing the theories of ergonomics, dental care providers can prolong their interest and commitment to dentistry by making difficult or even painful tasks less stressful. The paper shows that ergonomics can have a large impact on the effectiveness of dental health care delivery systems. So we suggest the idea that the study of ergonomics should be included in the dental curriculum.

Key words: ergonomics, musculoskeletal disorders, dentistry.

Introduction

Important advances in the field of ergonomics have made in recent years. These advances have focused on improving the working environment, though preventive measures related to the dental professional have not been practiced yet. The main causative factors involved must be identified in order to create adequate preventive strategies. Musculoskeletal disorders are

characterized by presence of discomfort, disability or persistent pain joints, muscles, tendons and other soft parts, caused or aggravated by repeated movements and prolonged awkward or forced body postures. Dentists are usually included among the professionals with a higher incidences of musculoskeletal pain in the course of their professional life.[1,2]

Causes of musculoskeletal disorders

Karwaski *et al.*,[3] shown that the symptoms are a product of many risk factors including prolonged static postures, repetitive movements, and poor positioning. But Ratzen,[4] have reported that musculoskeletal pain occurrence in the dentists to the frequent assumption of static postures, which usually requires more than 50% of the body's muscles to contract to hold the body motion less, while resisting gravity. The static forces resulting from these postures have been shown to be much more tasking than dynamic forces. Repeated prolonged static postures are thought to initiate a series of events that could account for pain, injuries, or career-ending problems seen in musculoskeletal disorders.

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Lalumandir *et al.*, [5,6] reported that all dental specialties show a high occurrence of musculoskeletal pain, but with variations in frequency and locations. In this study, we found that frequency of pain varies with the number of patients treated per day in the area of hip/thigh and with the height of the dentists.

According to some studies, the frequency of stiffness remains stable with age.[7] We also found that the frequency of stiffness varies with the age in case of neck and hip/thigh, while it varies with working hours per day in case of hand, and with number of patients treated and height of the dental surgeon in case of wrist. The intensity of pain varies with the patients treated per day in case of back and with the weight of the dentist in case of neck.

Repetitive movements and prolonged awkward positions can be expected to cause muscle damage as well as ligament and joint injuries [8,9].

Yamalik[10] reported that age, gender, and perceived general health status are strongly associated with chronic complaints and seeking medical care. Back pain is more associated with sickness leaves than neck

and shoulder pain. Symptoms such as carpal tunnel syndrome (CTS), ulnar nerve entrapment, pronator syndrome, tendonitis, tenosynovitis, thoracic outlet syndrome, and rotator cuff tendonitis may occur among all dental personnel.

According to Alexopoulos *et al.*, [11] back pain is the most common complaint of the dental surgeons under study, followed by neck pain and ankle/foot pain. Most studies have shown that back pain is the most common complaint among the dental surgeons.

Ideal positions [12]

(a) For Dentist

For the optimal control the dentist should be in the balanced reference posture.

The balanced reference posture of the clinician who is prepared to perform acts of great precision with great control with the least amount of physical stress. Determination of posture is based on the reception of internal stimuli, primarily from the muscles, joints, tendons and organs that relates a person to actions and surroundings.

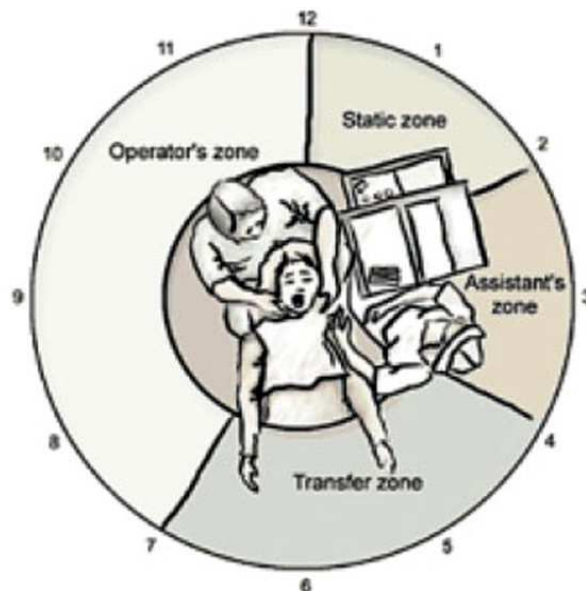


Fig 1: position for right handed dentist

Characteristics of balanced reference posture

1. Head- In the least strained position vertically and horizontally.
2. Shoulders- Loose hanging free vertically.

3. Upper arms- Loose hanging free vertically.
4. Lower arms- In the least strained position vertically and horizontally; in line with the palms.
5. Wrists- Neither flexed nor extended.
6. Hands- Near the level of the apex of the heart; palms vertical; fingers relaxed and flexed; index finger near the median plane.
7. Back- Straight and erect.
8. Buttocks- Weight distributed evenly.
9. Thighs- Clear and free of distracting contracts; separated and unstrained; front of the thighs slopping downwards from trunk to knees.
10. Legs- Clear and free of distracting contracts.
11. Feet- Clear and free of distracting contracts.

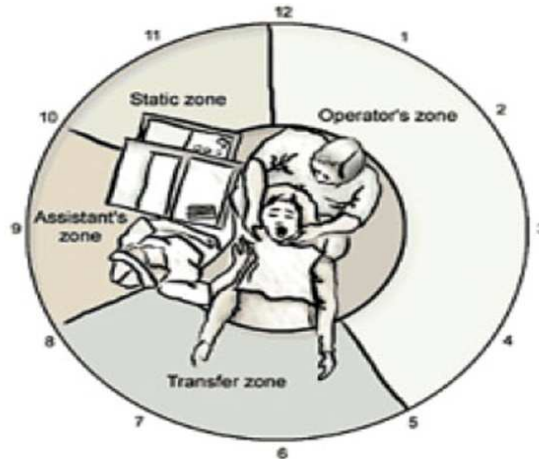


Fig 2: position for left handed dentist

(b) For assistant

Four-handed dentistry reduces stress and strain on the dental team. The dentist may use assistant where the dentist exchanges instruments with the assistant, which evacuates the mouth, and the assistant prepares dental materials. However, true four handed dentistry is the methodology of a team comprised of highly skilled clinical practitioners working together in an

ergonomically designed environment to improve productivity of the dental team, improve the quality of care for dental patient, while protecting the physical well-being of the operating team. True four-handed dentistry is not simply transferring instruments from one person to another nor is it “hurry-up” dentistry. True four-handed dentistry is the way to work smarter, not harder.



Fig 3: Four handed dentistry

(c) For Patient

If the clinician is to maintain a balanced posture, the patient must be placed in the supine position, parallel to the floor. The top of the patients head should be at the upper age of the head rest. Most dental chairs can

be positioned so that the patient is well supported and reasonably comfortable. Once the patient in the supine position, the height of the patients chair should be set so that the patient's mouth is at the height of the clinicians optimal control point, approximately at the clinician's heart level.



Fig 4: Position for patient

Positioning Variables

1. Clinician – The clinician can move around the patients head to access various areas of the oral cavity.
2. Patient head tilt- The patients head can be tilted in the anterior or posterior plane for better access.
3. Patient head rotation-Patient can also rotate the head to right or left for better access.
4. Intraoral opening-The amount of intraoral opening or width of opening is another variable for accessibility. For access to most areas of oral cavity, maximum opening is desirable, but for accessing the buccal surfaces of the posterior teeth, the task will be easier if the patient closes the mouth slightly.
5. Patient support height-The patients support height should be adjusted according to the optimum control point.

(D) Equipment Placement

Clinician should be aware of the impact of equipment placement on posture and control and, whenever possible should maintain ideal placement.

1. Instrument tray position

The tray should be placed on the dominant side of the clinician beside the patients head in order to minimize unnecessary by the clinician when reaching for the instrument tray.

2. Instrument placement

Instrument should be placed on the tray horizontally and in the logical order of ease of pickup. This will prevent constant distortion of the clinician wrist and confused searching when reaching for instruments.

3. Light position

The light should be placed directly above the patients oral cavity within the reach of the clinician. It should be placed high enough that the clinician and the patient will not inadvertently hit their heads on the light.

4. Handpiece or chair foot control

Any handpiece and chair foot control should be placed just out of the normal range of foot movement. This will prevent inadvertent activation of the handpiece, yet it will allow for intentional activation with the minimum of strain on the clinician.

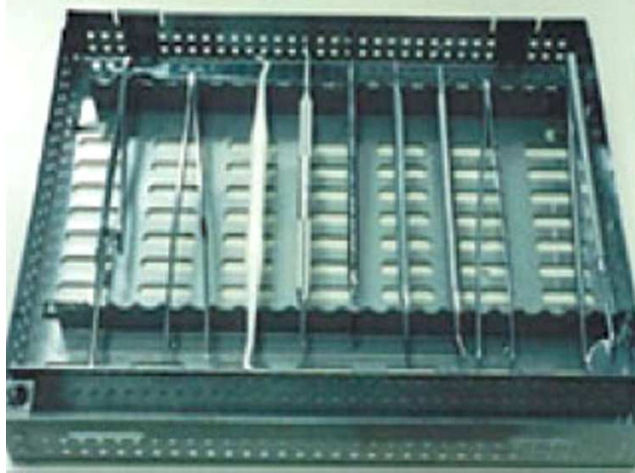


Fig 5: Instrument position



Fig 6: Trolley position

Preventive measures

1. The ergonomics factors to be taken into account could be summarized as support of limbs, the use of instruments with large handles, and working with a mechanically adjustable chair presenting an adjustable back rest.[13]
2. The use of indirect vision and correct patient positioning in the dental chair to avoid awkward or forced neck postures are also important.
3. Proper lighting and use of systems such as magnifiers and microscopes also helped to reduce fatigue and increase productivity.
4. Daily work planning should allow a break for the alternating muscle groups in order to maintain productive work. The applied occupational and

environmental hygiene guidelines recommend atleast six min of rest every hour for professionals to perform repetitive movements.[14] Three types of breaks which are recommended for dentists are.

- I. Frequent gaps and shaking exercise (relaxing of the arms, shaking and dropping them for periods of fifteen seconds).
- II. Breaks between successive patients (dentist should perform movements opposite to those done during work, for 2-3 mins).
- III. Breaks to allow recovery (periods of 10-15 mins every 2-3 hours).

5. The key role of exercise should be taken into account. Exercise will improve muscular strength, flexibility, stamina, tendon strength, co ordination of movements, decreases the risk of overburdening, and degenerative changes in locomotor organs. Exercises should be given individually and referred to the physiotherapist as possible.

Epidemological studies

1. The study by Marshall *et al.*, [15] describes the prevalence and distribution of symptoms of musculoskeletal disorders among dentist in New South Wales, Australia and shows that 82% of respondents reported experiencing one or more musculoskeletal symptoms during the previous month. 64% of respondents reported suffering pain and 58% headaches. The most severe symptoms reported were pain 39% and headaches 25%.
2. Akesson *et al.*, [16] studied 268 dental staff members and 111 referents. Female dentist and female dental hygienist show higher prevalence of symptoms of the neck, shoulder and hand or wrist during the previous 12 months. Both dental groups also had higher frequencies of a combination of symptoms in these regions of the body as well as a longer duration of the symptom in the neck and the shoulder during the previous 12 month period. Male dentist had higher frequencies of neck and shoulder symptoms compared with the referents.
3. Franczek *et al.*, states that the frequency of prevalence of painful disorders of the back, together with metatarsals and wrists among respondent dentist was significantly greater among the group of dentists with long year in practice.
4. In 1987 and 1990, Rundkrantz *et al.*, [17] also studied the occurrence of Pain and disorders among dentists. The prevalence of pain and discomfort has increased with work time, with the exception of pain of the lower back and headache. Of the 311 dentists studied, 262 had symptoms in 1987 and in 1990. In 1987, 49 dentists were free of any symptoms, while in 1990, 24 were without any symptoms at the follow up study.

Relationship between length of time at work without the break and the number of disorders

experienced was also analysed but no significant difference was found. However significantly more dentists cervico-brachial symptoms were aware of an utilised naturally occurring breaks in their work than dentist in pain and discomfort.

64.6% respondent replied in the affirmative to treatment taken. 27.75% utilised two types of treatment, 24.86% utilised three, 20.81% -one type of treatment, 17.92%-four and 8.67% used five types of treatment. A highly significant relationship was found between years in practice and treatment taken which is connected with relationship between years in practice and disorders noted. The majority used physiotherapy -77.5%, pharmacological treatment 67.1%, x-ray film of the back-60.1% and neurological consultations -41%, 20.2% of respondents used other types of treatment. Eg. Interchangeable sanatorium treatment, rehabilitation, massage, gymnastics, manual therapy and alternative medicine. [18]

Conclusion

Knowledge about the scope of ergonomics and prophylactic measures during working should be imparted in the graduation studies and various forms of training. The dental clinic should be designed so as to ensure a better work with healthy and long lasting career. Lastly, the preventive role of physical exercise is also a key element and should also be considered. Personalised rehabilitation exercise, stretching and regular aerobic activity should be done.

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