



Ergonomics Solutions in Dental Practice

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Abstract

Increased modernization and immense use of technology in dental practice has exposed dentists to high risk of poor postural habits thus leading to high risk of musculoskeletal disorders like low back pain, tennis elbow and carpal tunnel syndrome etc. This review paper highlights the importance of ergonomic solutions in dental practice.

Introduction

Modernization in Dentistry has raised the levels of excellence for providing comfortable and quality approach to dental treatment. The emerging challenges in our profession demand for increase in efficiency and quality dental care. In this scenario, the human resources are more valued therefore it becomes mandatory to improve the working environment for the dental personnel. Dentists are at a high risk for exposure to numerous biological, chemical, environmental, physical, and psychological workplace hazards. These hazards include a wide spectrum of blood borne pathogens, pharmaceuticals and other

chemical agents, ergonomic hazards, noise, vibration, and workplace violence.

Ergonomics is the science of interaction between a person and his work including the anatomic, physiologic, and mechanical principles that lead to optimum and channelised use of energy. The most commonly occurring occupational hazard include Musculoskeletal Disorders (MSD) i.e. kyphosis, scoliosis, lardoses, osteoarthritis, cervical spondylitis, tendonitis ,epicondylitis and carpal tunnel syndrome etc¹.

Dental ergonomics has been defined as the adaptation of the working environment and methods to the dentist and his team, with respect

to their physical and psychological capacity, for a healthy, safe and comfortable functioning in their professional activity². Ergonomic conditions are simply the safest, most efficient and easiest way to work. In dentistry, the principle of ergonomics can be of great application for architecting the ideal working conditions and enhancing the efficiency of the dental professionals and improving the quality of dental services rendered to the patients. An ideal dental ergonomic mix requires proper selection, adjustment and accommodation and usage to utilize its benefits optimally. Some of the simplest ergonomic solutions in the workplace include proper posture, appropriate seating position, adaptive equipment and the safe lifting techniques. Therefore, it becomes essential to focus on certain work environment aspects such as design of dental chair, dental stool, arm rest, angulations, footing, proper support to forearm and shoulder, lighting condition, office setting etc. and thus improve the health and safety of clinicians³.

This paper gives an insight to the contemporary ergonomic concepts keeping in mind the increase in the incidence of musculoskeletal disorders especially of the back, neck and wrist pain amongst the practicing dentists.

The various criteria of Dental Ergonomics are:

- A. **Human Man power** – The ergonomic parameters include Posture, Vision and Comfort.
- B. **Machines** – The ergonomic parameters include dental chair and unit, dental stool hand pieces, instrument design, personal protective equipment etc.
- C. **Environment** – This involves architecting the office design, office lighting and Ventilation.

A) Human Man Power

1. Posture- It is the position or carriage of the body as whole. It involves the joints and muscles in static and dynamic relationships⁴. Until 1970's, the dental chair was designed for the patient to be

treated in the upright position with dentist standing. This posture required considerable expenditure of muscular energy to simply maintain balance in standing position. Over the years these compromised postures resulted in circulatory and musculoskeletal disorders. In an attempt to reduce the physical fatigue of standing, the dental stools were designed to practice sitting dentistry. But the wrong sitting postures can also lead to back and neck strains.

Some of the commonly encountered bad sitting postures include-

- Leaning forward into patients mouth with back sloping. This imposes great load on the anterior part of intervertebral disc and cause back pain.
- Patient seated too low with dentist lowering head and neck. This movement also strains the intervertebral discs, ligaments and muscles of neck.
- Working with neck in flexion
- Shoulders flexed and abducted
- Thumb hyper extended
- Elbows flexed greater than 90 degrees

To work in a good posture the steps to be followed are:

1. Try to maintain an erect posture, by proper chair positioning. The chair should be close to the patient so as to avoid excessive bending. Keep the feet flat on the floor (Figure -1).
2. Use chair with lumbar, thoracic and arm support. It should also have adjustable height, backrests, arm rest.
3. Don't over stress, so work close to the patients chair and the instrument tray.
4. Minimize extreme joint positions for this there should be an angle of 90 degree with our elbows, hips, knees, ankles.
5. Minimize excessive wrist movements keep wrist in neutral position
6. Avoid excessive finger movements and reduce excessive repetitive movements.

7. Switch over to alternate work positions between sitting and standing, this allows each side of the body to share the stress and minimizes sustained effort. Brief but frequent rest pauses can minimize fatigue and enhance productivity.
8. Consider horizontal position of the patient, it allows to sit above the patient's head and thus providing a good ergonomic posture (Figure -2)

These individually determined operating conditions maintains the alignment of the vertebra and hence the health of the dentist neck and back during his or her career. The position that sitting subjects reported feeling most physically comfortable while pantomiming precise operation with their fingers was on average 103.2cm from the floor for men and 96.2 cm for women. This location is termed as "zero point" for the mouth of patient⁵.

Position of Assistant - The ideal assistant sitting position is 8-10 inches higher than the dentist. They should have adjustable stools for better access. The work units should be closely placed, not more than 20 cm from patient head⁶.

2. Vision- To improve the quality of dental care and reduced eye fatigue vision enhancement in the dental clinics is essential (Figure-3).

To enhance vision during dental procedures:

- i. The environment should be well lighted.
- ii. Overhead light switch readily accessible
- iii. Hand mirrors can be used to provide light intraorally
- iv. Optimum distance for precision work should range between 25-40 cms
- v. Additional aids can be utilized for magnification and illumination e.g. Prismatic telescopes, Galiban TTL system and from illuminators.
- vi. Repeated shifting of vision from bright illuminated operative field at close range to a darker area outside of the oral cavity located at greater distance forces the eyes of the operator to accommodate for these

lighting and distance changes which lead to eye fatigue and subsequent headache. So a mobile cabinet with a movable tops helps the dentist to prevent eye problems.

Magnification: the complete visualization of oral cavity is difficult and poses many barriers therefore the use of magnification lenses make the procedure ergonomically sound. When selecting magnification systems consider the following points- working distance, Depth of field, Declination angle, Convergence angle and Magnification factor. The various type of magnification available nowadays are⁷-

- I. **Procedure scopes** is the latest magnification device and allows the upright posture as the images are viewed on the LCD
- II. **Surgical operating microscopes** indirect view of oral cavity can be achieved by optics in the scope which bends the path of image to 90 degrees
- III. **Loupes (telescopes)** – they are the most popular type of magnification in dentistry.

3. Comfort- Both dentist and the patient must be comfortable while working. Permanently place equipment used in every clinical procedure within comfortable reach (within 20 inches of the front of the body). For the patient, comfortable waiting rooms with good lighting and seating arrangements should be there. Ergonomic working positions improve comfort level by reducing fatigue and thus enhances the clinical efficiency and performance of the operator.

B) Machines

Dental Unit- It should be of Transthroax style, with adjustable horizontal and vertical access. The headpieces and other dental unit accessories should be within 21 inch radius of the operator and assistant³. The dental unit tubings should be smooth, tangle free and designed to contain multiple high tech devices (Figure-4).



Fig 01



Fig 02

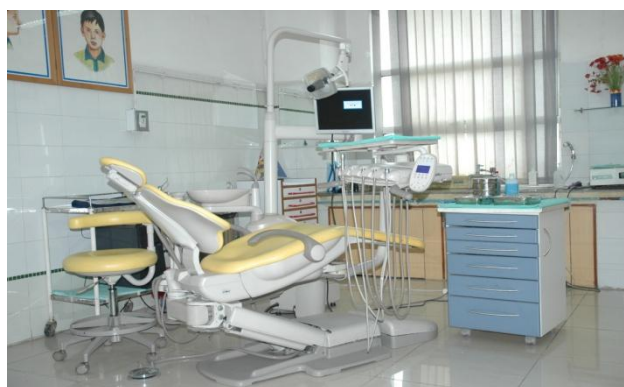


Fig 03



Fig 04

Dental Stools- Ergonomics seating is available in various styles to suit every dental personnel. It is designed for ergonomics posturing, comfort, reduces and prevents back/neck pain. The dental stools should have stable base with four or five casters, adjustable armrests, with well padded flat or contoured seats, adjustable height, angle and distance from body. The flat dental stools seat enables thighs to be parallel to the floor and allows for lumbar back support 8 inches above the seat.

Instrument Design- Proper design of the instrument reduces the force of exertion and maintains hand/wrist in neutral position. Before selecting an instrument one should consider overall shape/size, weight, balance, maneuverability, ease of operation, ease of maintenance. The instruments with hollow or resin handles, round textured/grooves, or compressible handles should be preferred. Color-coding also makes the instrument identification easier and thus increases the efficacy. Lightweight, balanced handpieces with sufficient power have an ergonomic advantage and therefore should be a dentist's first choice.

Personal Protective Equipment- Gloves should be of proper size, and should fit hands and fingers snugly. The Ambidextrous gloves (i.e., non-hand specific) exert more force than fitted gloves across palmer region of hand and this may exacerbate symptoms of carpal tunnel syndrome. Therefore Hand-specific (i.e., right vs left) is recommended. Lightweight, clean, well-fitted glasses should be used. The magnifying lenses and head lamps are to be encouraged. Face mask and N 95 respirators should be used to prevent the spread of infections from one another (Figure-5).

C) Environment

Office Design- The most important objective for the successful design of the operator is to have clear and concise setup. The workstation is composed of dentists/ dental hygienists chair, the patients chair, the delivery systems and the cleaning area. The treatment room should not be overstuffed with low use frequency equipment. It

should be such that the frequently used equipment is closest to the point of use. While performing intraoral tasks randomly positioned devices, e.g. operating lights and handpiece holders usually compromises operator's attention. The design should be adjusted to the dentist's dimensions so that it does not cause excessive strain with the repetitive movements throughout the day. The operatory should be adaptable to right and left handed operators. Rear support cabinets or mobile carts should be there for the assistant to facilitate easy access to instruments and materials⁸.

Office Lighting- A good Ambient and Operating light should be used to improve efficiency of dental procedures. The Fibreoptic light should be used to produce shadow free illumination. To prevent glare, an optimum light level of about 1000- 2000 candle powers should be used. The ceilings should be covered with light diffusing materials. The patients should be given tinted plastic glasses to wear during dental procedures in order to prevent eye fatigue.

Motion Economy- It is the manner in which human energy can be conserved while performing a task. It involves- Avoiding unnecessary twisting and turning to access equipment, placing instrument within 21 inch radius of operator and use of 4 handed dentistry.

Four Handed Dentistry- Many dentists work in a strenuous manner i.e. while performing a task they have to look away and reach out and hence breaking their concentration levels. To avoid this use of an assistant is advocated which decreases the strain and allows you to give more attention to task in hand and reduces time needed for each performance. Therefore, Four Handed Dentistry is ergonomically the most favorable way to provide dental services since it minimizes undesirable movement of the operating team and expatiate the progress of the dental procedures⁹.

Ventilation - Proper ventilation should be maintained in an office setup and laboratories. This helps in release of harmful vapours and toxic products used in dentistry. A new hazard information issued by the Occupational Safety and

Health Administration known as Chronic Beryllium Disease (CBD) which is caused by chronic beryllium exposure in dental laboratories. Therefore appropriate ventilation should be maintained in ergonomically settled dental office.

Conclusion

In developed countries ergonomic standards have been progressively developed for providing better working conditions to the dentists. Further continuous research and development activities are needed for creating ergonomically safe equipment with a long term vision of preventing the occupational hazards of the employees and students. In contrast ergonomically safe dentistry is yet to make its impact in the developing countries. This is essentially due to lack of awareness amongst the dental professionals. Since the dentistry itself is in the infancy stage, low priority is given by individual and government. With changing economic conditions, attitude of dental workers and patients is bound to change and each one would like to have a hazard free profession and service respectively.

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