Review Article

Ergonomics – Work Smart, Be Safe!!

Abhishek K.N, Jithesh Jain, Sneha C. Khanapure, Shilpa M

Department of Public Health Dentistry, Coorg Institute of Dental Sciences Maggula, Virajpet, Karnataka, India.

Corresponding author

Dr. Abhishek K.N

Department of Public Health Dentistry,

Coorg Institute of Dental Sciences,

Maggula, Virajpet – 571218, Coorg,

Karnataka, India

Phone number: +91 – 9481926600

E-mail: dr.abhishek.kn@gmail.com

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Abstract: Musculoskeletal disorders (MSD's) have become increasingly common worldwide during the past decades. Work-related MSD's are of serious concern to many organizations, including industry, insurance and healthcare. MSD's including pain, weakness, parasthesia are reported to be associated with a wide range of occupation. Dentistry is a profession that generally produces muscular pain. Dental students are trained to excel theoretically, but there seems to be a disconnect between what is learned and what is applied in the clinics. In the real world, when dealing with patients, problem-solving skills and practical knowledge are necessary. Dental practice characterized by high visual demands, which results in adoption of fixed postures. Repeated unnatural, deviated or inadequate working postures, forceful hand movements, inadequate equipment or workplace designs, and inappropriate work pattern are likely to be the particular risk factors for MSD's among dental professionals. Occasional pains from irregular stances or positions are to be expected, while they are performing static work. However, when the pain becomes a regular occurrence, cumulative damage could arise, leading to debilitating injuries. Dental students are prone to development of musculoskeletal pain due to lack of awareness regarding correct posture, prolonged static postures, inadequate operating stools and lack of exercises. So the present article focuses on undergraduate dental students who have not yet been fully familiarised with Ergonomics.

Keywords: Dental students**,** Musculoskeletal disorders, Ergonomics, Posture

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Introduction:

Many studies in the past have focussed on the prevalence of musculoskeletal disorders among dentists. The present article focuses on ergonomically orienting the young budding dental aspirants, newly joining the field of dentistry, and the undergraduate dental students who have not yet been fully familiarised with this topic. It is often a common sight in the pre-clinical sections, of dental students assuming different awkward positions when performing their tasks on the phantom jaws. If not intercepted properly at this stage, they carry the same improper positional behaviours into the clinical sections, while carrying out clinical tasks on the patients.

In India, dental curriculum is spread over a period of 5 years of undergraduate dental training, which includes one year of

compulsory internship.[1] The first two years are pre-clinical years, and the third and fourth years are clinical years. Students in the clinical years (mostly the third and fourth years) are divided into small groups and are required to complete rotations in various clinical departments. They will typically spend a fixed period of time at each rotation (usually one month) to hone their clinical skills before moving on to other departments.[1]

Work-related musculoskeletal disorders (WMSDs) are one of the main occupational health hazards affecting dental practitioners and dental students. WMSD is a major concern for dental students during their training years.[2]

The World Health Organization (WHO) defines MSD as "a disorder of the muscles, tendons, joints, intervertebral discs, peripheral nerves and vascular system, not directly resulting from an acute or instantaneous event but installing gradually and chronically."

MSDs Classification[3]

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.

In a study by Madaan V and Chaudhary A, 81% of dental students were found to have musculoskeletal pain. Maximum pain was observed in the hand, followed by wrist and lower back.[4]

According to a study by de Carvalho et al, dental students at two Brazilian dental schools were found to have an increased risk of developing musculoskeletal disorders, and the need for educational programs to be implemented in dental school was highlighted. 52 percent students answered that they had felt pain in more than one body region; 4 percent, 5 percent, and 7 percent reported pain in the cervical, dorsal, and lumbar regions, respectively.[5]

In a study by Khan and Chew, ninety three percent of the clinical year students reported symptoms of WMSD in one or more body regions. Neck and lower back were more injury prone areas and were at increased risk of developing musculoskeletal disorders. A majority, i.e. 92% reported minimum participation in workshops related to ergonomics in dentistry and 77% were unfamiliar with treatment and remedies available in the case of WMSD.[2] Among dentists of South Canara district of Karnataka, around 93.87% had prevalence of atleast one musculoskeletal symptom over the past 12 months. Also, 39.13% practitioners attributed MSDs to cause limitations at work.[6]

Risk Factors:

Although the causes of any particular case of a MSD are exceedingly difficult to identify with complete accuracy, certain risk factors are typically discussed in the field of ergonomic studies. The primary occupational risk factors for MSDs discussed in the literature [7,8,9,10,11] include:

- Repetition
- Force
- Mechanical stresses
- Posture
- Vibration
- Cold temperature
- Extrinsic stress

Mechanisms Leading to Musculoskeletal Disorders[12]

What is Ergonomics?

Ergonomics is an applied science concerned with designing products and procedures for maximum efficiency and safety. In Greek, "Ergo," means work and, "Nomos," means natural laws or systems.[13]

The International Ergonomics Association (IEA, 2003) defines ergonomics (human factors) as the scientific discipline concerned with the understanding of the 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. Ergonomics discipline promotes a holistic, human-centered approach to work systems design that considers physical, cognitive, social, organizational, environmental, and other relevant factors.[14]

When applied to dentistry, ergonomics seeks to reduce cognitive and physical stress, prevent occupational diseases related to the practice of dentistry, and improve productivity, with better quality and greater comfort for both the professional and the patient.[15] According to American Dental Association's Ergonomics for Dental Students (2011)[16], Ergonomics, therefore, is an applied science concerned with designing products and procedures for maximum efficiency and safety. Ergonomics modifies tools and tasks to meet the needs of people, rather than forcing people to accommodate the task or tool.

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.[13]

The historic change in dental workers from standing posture to typically seated posture has not reduced the rate of MSD, but that the part of body affected has moved from the back to the neck, shoulders, and arms largely due to static postures combined with forceful, repetitive movements.[15]

Dentists today work in the sitting position treating the patient in the supine position. When operators sit, pain occurs not only in their backs, but also their necks, shoulders and arms**.**[17,12]

The key to preventing work-related musculoskeletal disorders is Ergonomics. It is the science of fitting the work environment to the worker. Stress is cumulative, so ergonomic principles are also important outside the clinical environment. By making adjustments as

necessary to your work, we can reduce the likelihood of MSDs in dental students i.e. in turns future dental practitioners. To conclude we would like to suggest some guidelines on how to be in day today life and how to work[16,18]

1. Student/clinician should be properly seated in neutral posture (Figure 1 and 3) i.e.

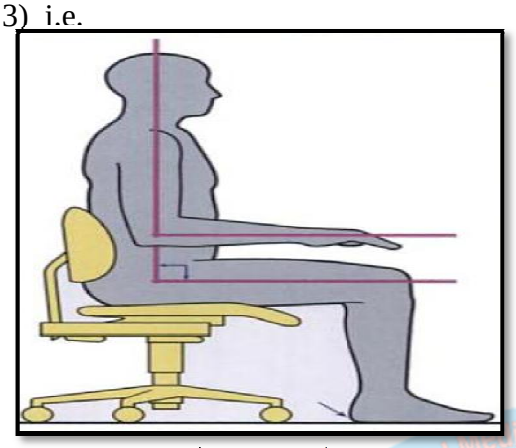

Figure 1: The Neutral posture

a) Feet should rest flat on floor
b) Angle between spine and the thighs should be 90 to 110 degrees
c) Upper arms should be close to body and shoulders should be maintained in a horizontal line (Figure 4 and 5)
d) Elbow / forearm angle is close to 90º
e) Wrists should be in line with the fore-arm with no more than 20-30º extension

2. Patient should be seated such that oral cavity is at a height equal to the height of seated clinician's heart.
3. For Maxillary arch head positions should be such that chin should be up and for mandibular chin should be down.
4. Turn head of the patient towards left/right depending upon the quadrants.
5. Place instruments, materials and medications within easy reach that is "comfortable distance" (i.e. within the reach of fully extended arm /22–26 inches).
6. Use light weight instrument with hollow or resin and Round, textured handles.
7. Color-coded instruments should be used as it makes instrument identification easier reducing eye strain.
8. For optimal illumination the light-line must be as close to the sight-line as possible, this will help to maintain proper posture.
9. Dental chair should be constructed of rigid cast frame with proper lumbar support that will not distort with time and use.(**Figure 2 and 3**)

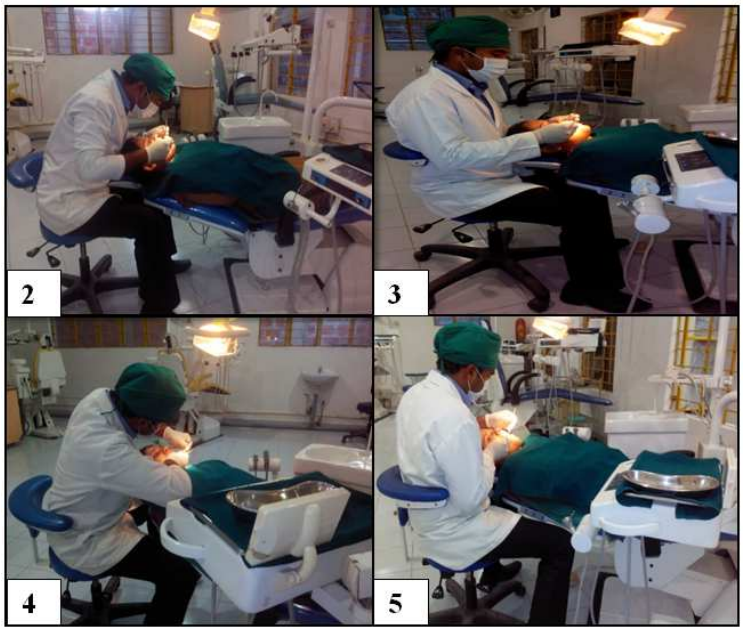

Figure: 2) Incorrect back and neck posture; **3)** Correct back and neck posture; **4)** Incorrect shoulder and arm posture; **5)** Correct shoulder and arm posture

10. Schedule patients so that clinician will work alternate for long on difficult cases and for short on easier cases.
11. Take breaks in between patients, pausing briefly and frequently can minimize muscle fatigue and the risk of MSDs.
12. Perform variety of exercises and stretches which will help to maintain normal muscle and joint function.

Recommendations:

1. Ergonomic practices must be made mandatory in the dental curriculum right from the preclinical setting up to the clinical tasks of the undergraduate dental students.
2. Unnecessary twisting, placing instruments far from reach, and awkward positions must be strictly discouraged among the students.
3. Students should be made familiar with use of magnification aids.
4. Working with assistants' i.e four handed dentistry must be promoted in the clinics.
5. Ergonomically designed instruments must be utilized, particularly dental instruments with larger handles. This will reduce pain and fatigue during cavity preparation, scaling, etc.
6. Chairs that provide adequate adjustability must be used.
7. Proper methods of using the lighting must be monitored among the students.
8. Ergonomics awareness training must be conducted among the dental students.

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