

REVIEW ARTICLE

DENTAL ERGONOMICS: A REVIEW

ABSTRACT

One of the most prevalent types of work-related injuries are musculoskeletal disorders. Work-related musculoskeletal disorders (WRMDs) result in persistent pain, loss of functional capacity and work disability, but their initial diagnosis is difficult because they are mainly based on complaints of pain and other symptoms. These disorders are very common in the profession of dentistry. Dentists and dental students often assume awkward physical positions while providing treatment to (a) get a better view of the intraoral cavity; (b) provide a more comfortable position for the patient; and/or (c) operate equipment and reach for instruments and supplies. Also, the disorders are preventable by following simple procedures and taking precautions while working. The field of ergonomics specifically deals with making workplaces more comfortable to work in and thereby reducing WRMDs. This update provides an overview of the application of ergonomical guidelines in the profession of dentistry.

KEY WORDS: Work-related musculoskeletal disorders, dentistry, ergonomics

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INTRODUCTION AND BACKGROUND

Dentistry is a profession in that its clinical performance is restricted to an area covering only a few tens of millimeters (the mouth), and that it requires repeated, precise force applications. These situations demand a fixed posture that can create occupational hazards in both dentists and dental students.^[1] Dental professionals are prone to musculoskeletal disorders (MSD) and occupational health problems due to the extreme static body postures and use of repetitive hand and wrist movements.^[2] The prevalence of musculoskeletal disorders amongst dental professionals in various countries like Greece and Poland are as high as 62% and 92% respectively.^[3,4]

In Greek, "Ergo," means work and, "Nomos," means natural laws or systems. Ergonomics is defined as a set of multidisciplinary knowledge applied to the organization of labor activities and elements that make up a job. The goal of ergonomics is to establish a safe, healthy and comfortable working environment, thereby preventing health problems and improving productivity. The data from professionals in the public dental clinics, who answered the multidimensional analytical work questionnaire suggests that they lack postural awareness can contribute to the maintenance of painful conditions and also the low commitment to self-care can perpetuate the state of musculoskeletal discomfort/pain, justifying the application of the ergonomics concepts in the workplace and systematic guidance to professionals to adopt a healthy lifestyle.^[5]

Applying ergonomics to the practice of dentistry not only could provide safety benefits but a practice might also improve performance objectives through greater productivity. One of the main goals of ergonomics in dentistry is to minimize the amount of physical and mental stress that sometimes occurs day to day in a dental practice

SEARCH STRATEGY^[6]

A protocol was established and studies were sourced from four electronic databases. Screening and quality assessment was conducted by two authors. The databases including Pubmed, Google Scholar, EBSCO and SCOPUS were considered from

inception of data base to February 2013. In addition, we hand searched World Wide Web, bibliographies of all included studies and Library of the institution for additional information.

Inclusion criteria:

Studies published with following keywords were included in the study; dental ergonomics, Musculoskeletal Disorders, dental health professionals, lower back pain, Magnification & treatment of Musculoskeletal disorders. Above mentioned keywords with various combinations using the Boolean operators were searched to get the desired literature.^[7]

DISCUSSION

Various authors have defined stages of Musculoskeletal disorders to describe the severity of the disease:

Stages, according to Oliveira^[8]

- I. Fatigue, discomfort, localized pain without irradiation, which gets worse with work and better with rest.
- II. Persistent and more intense pain, associated with paresthesia and burning feeling. It gets worse with work and home activities and causes reduction in productivity.
- III. Persistent, strong, and irradiated pain, which gets some relief at rest, associated to a decrease in muscular strength and movement control, edema, and paresthesia. There is reduction of productivity or incapacity for work.
- IV. Strong and continual pain, with intense suffering and irradiation to all members. It causes incapacity for any work.

Stages, according to Browne et al.^[9]

- I. Pain at work, ceasing at night, without sleep disturbance.
- II. Pain during work that persists at night and causes sleep disturbance.
- III. Pain even at rest, with sleep disturbance.

Table 1, Explains the Symptoms, Possible Causes, and Treatment Options for Common Musculoskeletal Disorders caused due to improper ergonomics in Dentistry.^[10-13]

DISORDER		SYMPTOMS	POSSIBLE CAUSES	TREATMENT OPTIONS
Hand	Carpal tunnel syndrome	Numbness, pain, tingling, clumsiness; reduced muscle/grip strength, dexterity; symptoms may be worse at night	Compressed median nerve in the wrist	Night splint; increased frequency of rest/breaks; change work patterns; use large-handled instruments; anti-inflammatory drugs, B ₆ , diuretics; steroid treatment; surgical intervention as a last resort
Hand	Carpal tunnel syndrome	Pain, numbness, tingling in 4th and 5th fingers, the side and back of the hand; reduced dexterity and grip	Compressed ulnar nerve in the elbow	Avoid extreme elbow flexion and extension; ergonomic intervention; physical therapy; surgical intervention as a last resort
Hand	De Quervain's disease	Pain around thumb with grasping, pinching, twisting; swelling of the thumb area; decreased and painful thumb motion	Swelling/thickening of the tendons at base of thumb	Thumb spica wrist splint; hand rest; physical therapy; NSAIDs*; steroid injection; surgical intervention
Hand & Arm	Tenosynovitis	Pain, stiffness, swelling at the wrist, shoulder, elbow, hand, or finger joints; painful gripping or grasping; difficulty straightening	Swelling/thickening of tendons and related structures	Worksite ergonomic interventions; NSAIDs; minimize aggravating movements; physical therapy; steroid injections, surgical intervention as a last resort
Arm	Epicondylitis	Pain or tenderness on either side of the elbow; pain increases during activities	Tearing of the tendons from overuse of the forearm muscles	Worksite ergonomic interventions; NSAIDs; physical therapy; acupuncture; steroid injections; surgical intervention as a last resort
Arm	Radial tunnel syndrome	Dull aching pain below the elbow and on outside upper forearm; may be worse at night; may include hand pain	Compressed radial nerve	Worksite ergonomic interventions; NSAIDs; steroid injections; surgical intervention as a last resort

Shoulder	Rotator cuff problems	Pain, stiffness in shoulder with backward and upward arm movements; weakness of the rotator cuff muscles	Swelling or tearing of rotator cuff soft tissue; shoulder joint bone spurs or abnormalities	Worksite ergonomic interventions; NSAIDs; steroid injections; surgical intervention as a last resort
Shoulder	Thoracic outlet syndrome	Pain in the shoulder, arm and/or hand; numbness and tingling of fingers; muscle weakness and fatigue; cold arm or hand	Compressed nerves or blood supply passing to the arms	Worksite ergonomic interventions—avoid working with hands above chest; Avoid surgery due to high rate of complications
Hand Arm Shoulder	Tendonitis	Localized and/or diffuse pain; loss of strength and motion	Irritation and inflammation of tendons	NSAIDs; minimize aggravating movements; physical therapy, massage; steroid injections; surgical intervention as a last resort
Neck Back	Myofascial pain syndrome	Pain in neck, shoulder and arm; painful "trigger points"; restricted range of motion	Overloaded neck and shoulder muscles	Mechanical, thermal, and chemical (eg, botulinum toxin) treatments to reduce pain and restore muscle function; muscle strengthening and stretching

*NSAIDs=nonsteroidal anti-inflammatory drugs, such as aspirin or ibuprofen.

Interventions for Consideration in the Dental Practice. In addition to widely recognized general interventions, consider the following interventions as well:

Exercise caution in purchasing equipment: When purchasing new equipment, dentists should consider the ergonomic ramifications of the purchase and be aware that the term "ergonomically designed" could simply be a marketing play. There are, unfortunately, no industry standards. Consequently, dentists should develop an understanding of ergonomic risk factors and the concept behind ergonomic interventions to help them make more knowledgeable decisions about instrument and equipment purchases.

Early Treatment of MSDs: Early intervention is of the utmost importance. Early symptoms in the wrist and hand respond to conservative medical management that includes rest, icing, non-steroidal anti-inflammatory drugs and splints. Early intervention could be important in order to achieve a better result at less cost and inconvenience.

Posture and stools: The posture adopted during the practice of operative dentistry has changed over the years. Originally, dentists commonly stood to provide treatment. With the introduction of four-handed dentistry in the 1960's, sitting became the preferred position. The sitting position was also an attempt to reduce the fatigue and discomfort sometimes associated with dental practice. Unfortunately, the seated

working position has not eliminated the potential for discomfort or injury in dentistry. In many cases, dental care providers adopt whatever position is necessary to access the oral cavity.^[14-17]

OPERATOR CHAIR ERGONOMIC

GUIDELINES:^[16,17]

Goal: Promote mobility and patient access;

Accommodate different body sizes

Remember- one size does not fit all!

Look for:

3. Hands-free seat height adjustment
4. Adjustable foot rests
5. Adjustable, wrap-around body support
6. Seamless upholstery
7. Hydraulic controls
8. Cylinder height
9. Adjustable backrest
10. Tilting seat pan
11. Textured seat material
12. Correct wheel type
13. Armrests (optional)

PATIENT POSITIONING

Patient chair ergonomic guidelines

Goal: Promote patient comfort; maximize patient access

Look for:

1. Stability
2. Pivoting or drop-down arm rests (for patient ingress/egress)
3. Supplemental wrist/forearm support (for operator)
4. Articulating head rests
5. Hands-free operation
6. Small, thin headrest: Allows for greater leg room
7. Narrow upper back: Allows closer positioning
8. Swivel feature: Allows chair to rotate in the operatory
9. Sling or low profile arm rests: Helps the dentist to work in 8:00-10:00 positions without hitting their knees on a fixed metal arm rest.
10. Large knobs: Should be absent. They hit the edge of operator chair, preventing close posi-

tioning.

11. Adjustable chair height

HAND INSTRUMENTS

Various features of dental instruments may have an effect on ergonomic issues. These include:

- v Size and shape of the entire instrument
 - v Diameter of the instrument handle
 - v Surface configuration where the instrument contacts the fingers
 - v Weight of the instrument including attachments
 - v Balance and alignment of the instrument
 - v Maneuverability of the instrument in space
 - v How well the moving parts can be manipulated
- Maintenance of the cutting edge

1. 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.
2. Handles with shallow, circumferential grooves or with knurling (texturing) allow better friction with the fingers so that a secure grasp requires less force.
3. Small diameter, hexagonal shaped instrument handles produce a mechanical stress that may cause digital nerve compression. Resistance from retractable or coiled hoses on dental units could result in extra mechanical stress to maintain a precision grip.
4. Unbalanced instruments, such as slow speed motors, feel heavier at one end causing the operator to compensate in their grip by increasing the mechanical stress to the fingers and hand.
5. When instruments are wet and slippery or handles have smooth round surfaces force is increased to maintain a secure grip on the instrument. Force can also be affected by posture.

LIGHTING AND MAGNIFICATION:

The goal of overhead lighting is to produce even, shadow-free, color-corrected illumination that is concentrated on the operating field. Magnification

helps in maintaining proper ergonomic posture while working on patients. Eg:- Loupes, Microscope.

FOUR-HANDED DENTISTRY:

Dental assistants create a more efficient environment for the operator by eliminating unnecessary motion; decreasing twisting and turning movement; decreasing long reaches and unbalanced posture

Dental practitioners teach clients to take care of their teeth and gums, but they must also recognize the importance of protecting their health. The risk of musculoskeletal injury can be significantly reduced through the maintenance of strong muscles, especially the core muscles, good flexibility, and a healthy weight. Aerobic exercise is important and will assist with weight, as well as with stress reduction. Additionally, eating properly and getting sufficient sleep lessens the risk for injury. Musculoskeletal disorders can occur even when practitioners adhere to healthy principles; however, the recovery time is significantly reduced when practitioners are healthy at the onset of injury.^[18]

GENERAL RECOMMENDATIONS^[19]

- 1 When sitting for prolonged periods you must sit correctly with the low back in moderate lordosis. Whenever the seat has back rest you must use a lumbar roll to support the low back.
- 2 When sitting for prolonged periods, regular interruption of the sitting posture is essential to prevent the onset of pain. This can be achieved by standing upright, bending backward five or six times and walking about for few minutes.
- 3 When working in a stooped position, regular interruption of the bent posture is essential to prevent the onset or pain, this can be achieved by upright and bending backward five or six times.
- 4 When lifting, you should apply the correct lifting technique. In addition, you should stand upright and bend backwards five or six times immediately before and after each heavy single lift and also at regular intervals repeated lifting.
- 5 After vigorous activity you should restore and accentuate the lordosis by standing upright and

bending backward five or six times. When you sit down to rest, you should maintain the lordosis and use a lumbar roll to avoid slouching.

- 6 When standing for prolonged periods, you must stand correctly. Stand tall. Do not allow your back to sag into extreme lordosis.

SPECIFIC RECOMMENDATIONS:^[19]

- 1 Patient chair should be placed at mid-sternal level.
- 2 Sitting position can be more appropriate for dental practice provided that minimizes the time period
- 3 The relationship between the knee to the patient chair should be at 90°.
- 4 Inclination angle should be minimized.
- 5 Using back support during treatment.

CONCLUSION

By practising with correct postures the working capacity and productivity of dental professionals can be enhanced and thus can make a considerable difference to earning and quality of dental practice.

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