

Ergonomics in Dentistry - literature review

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Abstract

With so many opinions from so many different people, professionals, and organizations, we are not always able to determine the most efficient methods for reducing back and neck pain, or even how it's caused. Is it related to static sitting, lack of movement, inappropriate magnification, or restricted joint range of motion? Could it be caused by a combination of environmental characteristics and body structure? We do, however know, that a main contributor to the health and wellbeing of our joints, one that even allows us to work more efficiently and healthily, **is the field of ergonomics.**

A quick dictionary search for the word ergonomics leads to a rough definition of "the rules of work." But ergonomics is also a very logical and creative field that is capable of helping dentists work comfortably, without experiencing back or neck pain, and with fewer signs of physical or mental burnout.

According to researchers, dentists report suffering from neck and lower back pain much more than members of the general population. Surprisingly, even among those who exercise regularly, the incidence of back and neck pain is extremely high. This may affect their body posture during treatment, working hours, sitting position, repetitive movements, and other mechanical reasons.

It is certainly possible to reduce musculoskeletal pain. The secret is in combining principles of movement and ergonomics, such as magnification, maintaining neutral trunk and neck positions, maintaining natural spinal column curvatures, stretching exercises, and more.

How can you implement all the recommendations?

The following literature review will try to represent practical conclusions and recommendations, based on research and studies from the recent years.

Introduction- Ergonomics

"Dentists are at risk for musculoskeletal problems, mainly due to poor ergonomics affecting their neck and lower back." This was the main finding of a 2018 survey conducted by the American Dental Association (ADA) on 7,475 active dentists. Two-thirds of the respondents reported that they suffered from neck pain and back pain and nearly half of them said that it was either moderate or severe in its intensity ⁽¹⁾.

This finding corresponds with one of the most interesting conclusions related to ergonomics in dentistry. It turns out that a dentist can spend up to 60,000 hours in a lifetime working in intense and distorted positions that may lead to musculoskeletal problems. However, it seems that proper ergonomics may correct the harmful postural habits that caused stress and pain in the first place.

The definition of **ergonomics** is 'an applied science concerned with designing and arranging instruments so that the people and instruments interact most efficiently and safely'. Therefore, ergonomics is a much broader field than merely preventing work-related musculoskeletal disorders. The successful application of ergonomics assures high productivity, avoidance of illnesses and injuries, and increased satisfaction among workers ⁽²⁾. Ergonomics in dentistry aims to learn about human abilities and the dentist's work environment to reduce the risk factors associated with musculoskeletal pain ⁽³⁾.

Musculoskeletal Disorders among Dentists

Musculoskeletal disorders (MSDs) are injuries and disorders affecting muscles, nerves, tendons, ligaments, joint cartilage, or spinal discs. It is the most significant work-related problem that is currently reported. The incidence of neck and back pain among dentists is higher than in the general population and may be attributed to extreme postures that may be attained during clinical work ⁽³⁾.

Various studies present similar data pertaining to the incidence and distribution of musculoskeletal pain among dentists, while the most prevalently affected site reported was the neck region (over 85%)^(4,5,6,7,8).

Risk Factors for Musculoskeletal Problems among Dentists

Dentistry ergonomics experts point to several risk factors leading to musculoskeletal problems, including maintaining a seated posture while accessing the oral cavity, bending when treating the patient, prolonged muscle contraction, and repetitive motion⁽¹⁾. A study that examined the effect of ergonomics on cervical neck pain found that the degree of neck region overload depends on the technique used by the dentist, the ergonomic conditions, and the long-lasting maintenance of a static body position⁽⁹⁾.

A comprehensive review of thousands of studies evidences that static postures are largely responsible for the etiology of musculoskeletal disorders. The awkward postures more frequently identified among dental professionals are extreme forward-head and neck flexion; trunk inclination and rotation towards one side; lifting one or both shoulders; increased curvature of the thoracic vertebral column and incorrect positioning of the lower limbs with a thigh-leg angle of less than 90°. As such, it is really important to use a modern workstation with appropriate ergonomic supports. Among existing preventive ergonomic measures, literature has widely recognized the role of physical activity and a neutral, balanced posture⁽¹⁰⁾.

The Kinematics of Static and Prolonged Neck Flexion:

A kinematic motion analysis of dentists reveals that the entire head and trunk area is tilted anteriorly while the back is twisted to the right, when treating patients⁽¹¹⁾.

Recent research found that static flexion resulted in changes in the mechanical and neuromuscular behavior of the cervical spine. These results confirm the importance of maintaining a correct head and neck position during work and improving the work environment to reduce the cervical spinal load and work-related neck pain⁽¹²⁾.

The kinematic analysis of dentists illustrates typical patterns of postures during tasks that are essential to the dental treatment of patients. The postures that place stress on the area of the cervical and thoracic spine have higher angular values during treatment compared to other dental tasks. Consistently, appropriate ergonomic design measures to optimize the dental chair and equipment, as well as integrated training in

ergonomics as part of the study of dentistry to prevent musculoskeletal harm are recommended ⁽⁸⁾ .

Ergonomic Intervention and Recommendations

Since neck flexion is the most commonly associated cause of neck pain among dentists, wearing loupes improves neck posture ⁽⁴⁾. This has been proven in several studies to date. However, not all surgical loupes available on the market satisfy the criteria for clinicians' optimal postural and visual support ⁽¹³⁾. As such, loupes should be custom-made to the dentist. It is necessary to determine the magnification level, working length, field of view, and angle of declination, to maintain proper head and neck posture ⁽¹⁾.

A recent study of 400 dentists and students found that the use of loupes was associated with lower levels of musculoskeletal disorders in the lower back, neck, shoulders, elbows, upper back, and feet ⁽¹⁴⁾.

Seeing better may lead to better treatment outcomes and less musculoskeletal effort, and magnification can help improve ergonomics and treatment outcomes ^(16,17). The loupes must be lightweight so that they remain stable on the bridge of the nose and do not ride down. Properly adjusted loupes may prevent and reduce the severity of neck and back pain. Also, it was found that dentists who wore loupes experienced better stabilization of the proximal joints like elbows and shoulders, which led to better distal function of the finger joints and wrists in the fine motor skills needed for treatment. To this end, a growing number of dental schools are embracing magnification.

Sitting in a more upright posture is better from an ergonomic standpoint, as the dentists will experience less fatigue in both the lower (back) and upper spine (neck and shoulders). It is nearly impossible to achieve a straight forward vision (as can be obtained with the operating microscope), and loupes may lessen pain severity if vision is properly adjusted ⁽¹⁸⁾. Moreover, a new study suggests that trunk posture improves while wearing loupes as forward trunk flexion was significantly reduced when wearing loupes. ⁽¹⁹⁾

"Balanced Posture" among Dentists

Posture, in ergonomics, refers to how different parts of the body are located and thus the reports are established between them to allow a special task execution. The posture described in "ISO Standard 11226 Ergonomics – Evaluations of static operating postures" is recommended for dentists and is called balanced or neutral posture. The characteristics of "balanced posture" among dentists include the following principles:

1. Symmetrical seating while equally bearing weight on the pelvis' ischial tuberosity.
2. A straight back - avoiding rounding the back into a "C" shape.
3. Forward inclination of the trunk to a maximum of 20°- a greater forward inclination leads to less tilting aside and trunk rotation.
4. Forward inclination of the head up to 20-25° from the trunk. (Preferably an angle that is less than 20 degrees).
5. Arms placed along the body, forward-oriented within 10°, with the forearms raised to 25° from the horizontal line.
6. An angle between the thighs and calves than measures 105-110°, or more.
7. A maximum separation of 45° between the thighs, preventing a rigid fixation of the hip joint.
8. The calves are oriented perpendicular to the floor or in a slightly posterior position.
9. Feet are placed on the floor and are oriented forwards in the same plane with the calves. When the feet are symmetrically positioned below the operator's hands, the posture is balanced ^(20,21).
10. A sitting posture with a slight anterior pelvic tilt and a slight lumbar lordosis reduces the incidence of low back pain most efficiently ⁽²²⁾.
11. Therapeutic exercises and a McKenzie exercise approach ^(1,9).
12. Regular rest breaks and performance of stretching exercises between working hours to reduce and prevent musculoskeletal harm in dentists, especially in their neck and shoulder regions ⁽²³⁾.
13. Deep Cervical Flexor training may improve forward head posture and decrease neck pain and disability. ⁽²⁴⁾

In Summary - The Winning Combination for Reducing Musculoskeletal Pain

Musculoskeletal pain is the main reason for early retirement among dentists. Therefore, good working ergonomics is essential to promote and maintain work capability, efficiency, and high clinical level of treatment throughout the working life of dental professionals. ⁽²⁾

Our ability to work comfortably, without any back or neck pain, is probably related to the combination of movement and ergonomics. We expect that tailored stretching exercises, strengthening deep neck muscles, magnification, and proper declination angles of the neck and trunk will allow dentists to maintain upright and neutral positions effortlessly.

Sitting in a more upright posture is better from an ergonomic standpoint, as the dentists will experience less fatigue and neck pain. Dentists should focus on how they work, how they hold instruments, and how neck and back posture could be contributing to their aches ⁽¹⁾. Therefore, magnification with loupes possessing an excellent declination angle is a must for all dental practitioners. ⁽¹⁸⁾

Physiotherapy is within reach, exercises can be practiced easily, and the technology already exists. It is important to choose the best combination for everyone, and most importantly, it is easier to prevent musculoskeletal pain than treat it after it has already begun to take root.

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