Review

THE IDEAL POSTURE IN DENTISTRY: ERGONOMIC ASSET OR LIABILITY? A MINI-REVIEW

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ABSTRACT

Proper ergonomics can prevent musculoskeletal disorders (MSDs) among dental practitioners. Static and awkward postures contribute significantly to the onset of MSDs, affecting various parts of the body. This review emphasizes the importance of dynamic posture over a static one. Any prolonged contraction of the muscular tissue leads to a restriction of capillaries and a reduced intake of nutrients, lactate accumulation within the tissues with subsequent pain, muscle imbalance, and activation of adaptive systems, which significantly impact the spine, neck, shoulders, and wrist health. A general overview of the main MSDs was also provided along with preventive strategies to increase the awareness on such a topical issue among clinicians.

KEYWORDS: *ergonomics, musculoskeletal disorders, injury, static posture, dynamic posture, wrist pain, back pain, neck pain, shoulder pain, preventive strategies*

INTRODUCTION

Ergonomics is the scientific discipline that examines the interaction between the components of a system and the functions for which they are designed. The aim of this science is to improve the safety and efficiency of individual procedures, transform them into practical routines, and prevent musculoskeletal disorders (MSDs).

Dental practitioners tend to assume a static forced posture to deliver quality dental treatment. Postural changes profoundly impact the musculoskeletal system, with implications for muscles, nerves, ligaments, tendons, joints, and even vertebral disks (1). Since cumulative trauma can bring occupational illness and even long-term disability, maintaining a balanced posture is fundamental during day-to-day clinical practice.

MSDs have a detrimental effect on the quality of life and represent an evergreen challenge in the healthcare system (2, 3). Several studies reported high incidences of musculoskeletal pain/discomfort in the dental population (4, 5), and MSDs were described by Hill et al. as one of the most common reasons for early retirement (6) and lost/reduced wages.

Proper posture provides more concentration, attention, and working energy, reducing pain, stress, and muscular tension and a lower risk for therapeutical errors (7). Even though the equipment has improved considerably, clinicians still work with incorrect postures derived from bad habits (7). A frequent need to bend and twist the neck and upper back

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to better visualize the oral cavity remains, especially if a direct vision is adopted (8). Moreover, the presence of the dental assistant is another fundamental issue that can influence the operator's position.

It is important for the clinician to achieve a vast knowledge of ergonomics and develop a self-perception of the body to change improper, detrimental postures, avoiding the onset of MSDs. This review delves into this issue to describe preventive strategies to avoid some of the most reported MSDs.

MATERIAL AND METHODS

Search strategy

By conducting an electronic search on the MEDLINE bibliographic database (PubMed), 185 articles with a time span from 1982 to 2024 were selected using the following algorithm: "Dentist*" AND ("Musculoskeletal disorder" OR "MSD" OR “MSDs”) AND "Ergonom". Sixteen articles were chosen as the primary sources of data. The references were also scanned to identify other potentially eligible studies.

DISCUSSION

The development of MSDs involves multifactorial risk factors (9), and the dental profession is highly related to an increased prevalence of MSDs (10). Various studies have reported a high incidence of MSDs among dentists, from 46 to 93% (11). Static and awkward postures, improper clinician or patient position, poorly designed instruments, and improper techniques represent many of the most reported risk factors (12).

Investigating the influence of gender, Hosseini et al. (13) and al-Mohrej et al. (14) reported a higher risk for female dentists with significantly higher ORs. However, contradicting results were published by Batham et al. (15). The health status of the clinician was also considered by Pejčić et al. (16); the presence of chronic diseases (e.g., cardiovascular disease and diabetes), allergies, pre-existing MSD, varicose veins, headache, hand weakness, and sleeping disorders were highly correlated to the onset of musculoskeletal pain.

Even if studies showed a direct correlation between older age and MSDs (14-17), some reported a mild trend in dentists with more experience. This outcome can be easily attributed to an increased awareness and the adoption of preventive measures by older, experienced dentists (18). In addition, a high BMI (19) or reduced physical activity (14) were reported as being other critical factors potentially involved in the onset of MSDs.

Wrist pain

Carpal Tunnel Syndrome (CTS) represents the most common entrapment neuropathy, affecting around 3-6% of the adult population (20). It has generally been reported as one of the leading causes of wrist pain. The diagnosis is based on clinical signs and the detection of median nerve dysfunction through nerve conduction studies (21).

Among the dental healthcare personnel, this percentage was reported to be higher; a systematic review conducted by Chenna et al. (22) showed that one out of seven clinicians may be affected by the syndrome.

CTS is derived from an increased pressure on the median nerve by the thickening of irritated tendons. Numbness, pain, and tingling in the distribution of the median nerve (e.g., thumb, index finger, middle finger, and half of the ring finger) (23) are the main symptoms reported (24). Since the discomfort and symptoms gradually subside, they may be ignored initially. Repetitive movements, the generation of high forces, mechanical stresses, and vibrational exposure are thought to be the main risk factors related to the genesis of such a condition (25).

Back pain

Low back pain is reported as being the leading cause of occupational disability in dentistry (26). A poor postural alignment can accelerate the wear of spine-supporting structures (muscles, ligament, disks, and vertebrae), leading to trauma accumulation and muscle imbalance with chronic pain. Maintaining a proper sitting position reduces the static muscle workload necessary to support the foot, knee, hip, and spine joints. In addition, it’s important to highlight that even if a proper sitting posture is maintained, over time, due to fatigue, there is a tendency to assume a slumped posture.

Sitting in a prolonged slumped posture was observed to impair the functionality of transversus abdominis and oblique abdominal muscles, which play a pivotal role in stabilizing the spine and postural control during the seated posture (27). Flexion of the knee to the hip to about 90 degrees is often observed in a conventional sitting position. Over 60 degrees from a hypothetical vertical gravity line, the passive tension of the hamstrings increases. The direct result of such a position is a posterior pelvic tilt (Fig. 1). The pelvis rotates backward, determining a kyphosis of the lumbar spine with increased muscle strain pressure on spine ligaments, muscles, and internal organs.

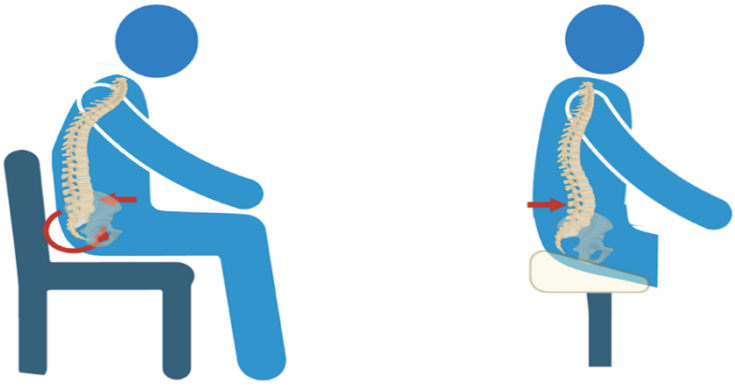

Fig. 1. *Slumped/conventional vs. ergonomic posture. When a person is seated with a forward-sloping seat, the tension in the hamstring muscles is relieved, and the pelvis is pulled forward, maintaining the lordosis of the lumbar spine. In a slumped/ conventional posture, the increased passive tension of the hamstrings pulls the pelvis backward (posterior pelvic tilt), generating a flattening/kyphosis of the lumbar spine.*

Using a forward-sloping seat with hips at 60 degrees from the vertical line, the tension is relieved, and the pelvis is moved afterward (28), preserving the physiological curves of the spine. Furthermore, interesting results were recorded when lumbar support was considered.

Andersson et al. (29), studying the effects of unsupported and supported sitting, reported an optimal reduction in both the myoelectric activity and disk pressure when the back was supported. An unsupported sitting position, accompanied by forward flexion and rotation, is related to increased pressure in the lumbar spinal disks (30). Bulging or herniation is a direct consequence of this scenario, with a serious involvement of the spinal cord or peripheral nerves and subsequent low back, hip, or leg pain (31) (Fig. 2).

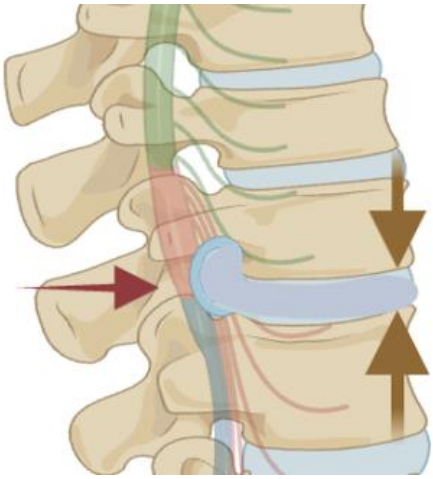

Fig. 2. *Flattening of the spinal lordosis can result in the dislocation of the annulus fibrosus with disk bulge or herniation. As only the outer layer of the annulus fibrosus is innervated, degeneration of almost the totality of the disk is generally encountered when pain is reported.*

Lake (32) showed, in a population of Canadian dentists, how a forward trunk inclination, ranging from 19 to 54 degrees prolonged for 2/3 of each treatment hour, can lead to massive pressure on vertebral disks compared to standing position.

It was observed that clinicians spent from 78 % to 100% in a seated position during dental treatments(33-36). Interestingly, Ratzon et al. (37) reported more severe lower back pain from dentists who work solely in a sitting position. In general, any prolonged static posture has been shown to increase MSDs (38). Static muscle activity involves a

prolonged contraction of the muscular tissue, a capillary restriction, a reduced nutrient intake, and lactate accumulation within the tissues. This position can only be maintained for a short time until pain and injury occur.

Neck and shoulder pain

While hand injury arises more frequently from repetitive motions and improper exertion of force, neck and shoulder problems are derived from maintaining a static and awkward posture (39).

A significant part of the shoulder's functionality depends on the rotator cuff. This structure comprises important muscles (supraspinatus, infraspinatus, teres minor, and subscapularis) and tendons, which stabilize the shoulder, providing a wide range of motions. Pain and loss of active range of motion with overhead activity are among the most reported symptoms(40) when rotator cuff tendinitis or shoulder impingement occurs. An ergonomic study conducted by Rucker et al. reported that 66% of dentists raise the dominant elbow approximately 45 degrees for most of their work (41).

A prolonged arm abduction and forward flexion of more than 30 degrees is thought to be an essential risk factor for the onset of injury to the rotator cuff since they lead to the compression of the supraspinatus tendon under the coracoacromial arch (rotator cuff impingement) (42). In addition, a sustained awkward posture involves a forward bending and rotation of the head, neck, and trunk to one side, generating a shortening and strengthening of muscles involved in the movement. These muscles may become ischemic, developing trigger points, pain, or asymmetrical forces, which can misalign the spinal column. A forward-head-and-rounded-shoulder posture is often the result of such poor ergonomics.

In this scenario, the anterior mover muscles (such as the scalene, sternocleidomastoid, and pectoralis muscles) become short and tight due to the forward head posture. Meanwhile, the stabilizer muscles of the shoulder blades (including the middle and lower trapezius, rhomboid, and serratus anterior muscles) become weak and elongated.

An American observational study highlighted how, most of the time (86%), dental operators usually assume trunk and cervical flexion with angles ranging from 30 to 60 degrees (33). Assuming these positions, the forward movement of the head and the trunk is accompanied by a more significant effort by the neck and lumbar muscles (43, 44), leading to MSDs.

Protective muscle contraction and substitution reinforce the imbalance cycle, generating joint hypomobility, nerve compression, and even spinal disk degeneration/ herniation (31). Pain, stiffness, and muscle spasms in the cervical musculature may follow the condition. Trapezius myalgia, tension neck syndrome (45), or thoracic outlet syndrome (39) are some of the other MSDs related to the prolonged maintenance of such postures.

Preventive strategies

For CTS, keeping a neutral position with the forearms and wrist in a straight line is an effective preventive measure, as well as frequent stretching and breaks.

While seated, the clinician should maintain the lumbar lordosis to prevent low back pain (46-48). A slight anterior tilt of the seated angle, from 5 to 15 degrees, is recommended to reduce the massive passive tension of the hamstrings and the flattening of the lumbar spine. A saddle operator stool can also be a useful tool to maintain the spine's natural position. The lumbar support of the chair should be used as much as possible and should be moved forward until it reaches the lumbar lordosis of the back. In addition, the use of a magnification system is also highly recommended.

A significant decrease in neck flexion is one of the most important advantages of using loops or microscopes (49), as they oblige the operator to maintain an optimal working distance, which allows the proper positioning of elbows and shoulders, avoiding the onset of a forward-head position. It is also important to highlight that the permanence in static postures for a prolonged time during the treatment plays a fundamental role in determining MSDs. Rather than achieving an ideal posture, the literature promotes the concept of dynamic posture. Alternating between standing and sitting may be an effective strategy to prevent injuries (50).

Positioning the patient too high is a common mistake reported by clinicians and forces the operator to a detrimental abduction of the shoulders. The height of the patient should be selected to have a position of forearms parallel to the ground, with the working area at elbow level or slightly higher. Generally, a semi-supine and a supine position should be preferred for mandibular and maxillary procedures, as well as a "chin down" or "chin up" inclination of the patient's head. In addition, clinicians should consider periodic breaks and stretching.

Stretching exercise programs, especially for the side in the reverse direction of awkward prolonged static postures, can prevent muscle imbalances (50) and should be integrated into a daily routine (51).

CONCLUSIONS

Despite the increasing related issues with MSDs and their effects, ergonomics in dentistry remains under-reported. The clinician should be aware of the patient's posture during the treatment, and periodic checks of the patient's spatial position are mandatory to preserve the general well-being of the spine, shoulder, neck, and wrist. As a prolonged static posture can be detrimental to all these structures, dynamic posture with breaks, stretching, and even a change to a standing posture should be considered along with magnification.

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