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RESEARCH ARTICLE

REVEALING THE SECRECTS OF ERGONOMICS IN DENTISTRY

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ABSTRACT

Dental professionals commonly experience musculoskeletal pain during the course of their careers. The prevalence of work-related musculoskeletal complaints in dentists is high and the past two decades have witnessed a sharp rise in the incidence of various disorders. The most effected regions have been back and neck. This article provides a brief review of literature on musculoskeletal disorders in clinical dentistry and various strategies of their prevention with a special emphasis on the neutral position for the clinicians and dental operators with an aim that it should help the dental operators to prevent these injuries and to work effectively and efficiently.

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INTRODUCTION

In the dental profession, dental professionals spend their work days in an awkward, static position performing extremely precise procedures. A work-related musculoskeletal disorder is an injury affecting the musculoskeletal, peripheral nervous and neurovascular systems, that is caused or aggravated by prolonged repetitive forceful or awkward movements, poor posture, ill fitting chairs and equipments, or a fast paced workload (Silverstein et al., 1997). Work-related musculoskeletal disorders are a common complaint of practicing dentists and dental hygienists (Jacobsen**, 1995;** Jacobsen, 1996; Moen, 1996; Reitemeier, 1996; Rundcrantz et al., 1990; Rundcrantz et al., 1991; Silverstein, 1986). The human body is not designed to maintain the same body position or engage in fine hand movements hour after hour, day after day. BA Silverstein, in an article defined a repetitive task as s task that involves the same fundamental movement for more than 50% of the work cycle (Saunders, 1995).

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The natural spinal curves: In standing postures, the spine has four natural curves when viewed from the side: cervical lordosis, thoracic kyphosis, lumbar lordosis and sacral kyphosis (Figure 1) (Norkin, 1992). The curves are interdependent; a change in one curve will result in a change in the curve above or below it (Hertling, 1996). Since the sacral curve is composed of five fused vertebrae, its movement is extremely limited. However, the remaining curves—especially the lumbar and cervical curves—are more mobile and can be influenced more easily. When the curves of the spine are present and balanced against the center of gravity, the spine is supported mostly by the bony structures of the vertebrae resting on top of one another. When these curves become either exaggerated or flattened, the spine increasingly depends on muscles, ligaments and soft tissue to maintain erect. When sitting unsupported—a frequent posture in dentistry—the lumbar lordosis flattens (Figure 2). The bony infrastructure provides little support to the spine, which now is hanging on the muscles, ligaments and connective tissue at the back of the spine, causing tension in these structures. Ischemia can ensue, leading to low back strain and trigger points. This flattening of the lumbar curve also causes the nucleus in the spinal disk to migrate posteriorly toward the spinal cord.

Over time, the posterior wall of the disk becomes weak, and disk herniation can occur. Therefore, operators need to know about strategies they can use to maintain the essential lumbar lordosis whenever possible. Maintaining the cervical lordosis in the proper position is equally important. Forward-head postures are common among dentists, due to years of poor posture involving holding the neck and head in an unbalanced forward position to gain better visibility during treatment (Figure 2). In this posture, the vertebrae no longer can support the spine properly, and the muscles of the cervical and upper thoracic spine must contract constantly to support the weight of the head in the forward posture (Cailliet, 1991). This can result in a pain pattern, which often is referred to as tension neck syndrome. This syndrome can cause headaches and chronic pain in the neck, shoulders and interscapular muscles, and it occasionally can radiate pain into the arms. Sustained contraction of cervical muscles also causes weakening of the spinal disks, with possible disk degeneration or herniation (Valachi, 2003). Therefore, frequent relaxing and stretching of the neck muscles, strengthening of the deep postural cervical muscles and preservation of the cervical lordosis in proper posture (ear over the shoulder) with all activities, including sleeping and driving, is essential for optimal musculoskeletal health of the neck. A forward-head posture also can lead to muscle imbalances (Karwowski, ?), contributing to a rounded shoulder posture. This posture can predispose the operator to impingement of the supraspinous tendon in the shoulder (rotator cuff impingement) when reaching for items. Additionally, static posture of the arms in an elevated or abducted state of more than 30 degrees impedes the blood flow to the supraspinous muscle and tendon (Hagberg, 1996; Gehrig, 2007). Prolonged arm abduction also can lead to trapezius myalgia—chronic pain and trigger points in the upper trapezius muscle. To effectively prevent injuries in dentistry, prevention strategies and ergonomic techniques must address these postural and positioning difficulties, as well as subsequent detrimental physiological changes: muscle imbalances, stiff joints, muscle necrosis and spinal disk degeneration.

Musculoskeletal disorders seen in dental health care providers

Carpal Tunnel Syndrome: It is a painful disorder of the wrist and hand caused by compression of the median nerve within nerve the carpal tunnel of the wrist As the nerve fibers of the median nerve originate in the spinal cord in the neck, therefore poor posture can cause symptoms of CTs. It is characterized by numbness, pain, tingling in the thumb, index and middle fingers (Finsen, 1997).

Pronator Syndrome: It is a painful disorder of the wrist and hand caused by compression of the median nerve between the two heads of pronator teres muscle. Symptoms are similar to carpal tunnel syndrome (Finsen, 1997).

Ulnar Nerve Entrapment: It is a painful disorder of the lower arm and wrist caused by compression of the ulnar nerve of the arm as it passes through the wrist. It is characterized by numbess, tingling and/or loss o strength in the lower arm or wrist (Finsen, 1997).

Rotator Cuff Tendinitis: It is a painful inflammation of the muscle tendons in the shoulder region. It is caused by holding the elbow above waist level and holding the upper arm away

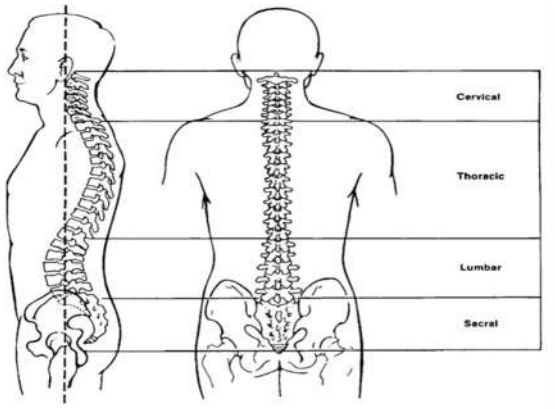

Figure 1. The four primary curves of the spine: cervical lordosis, thoracic kyphosis, lumbar lordosis and sacral kyphosis. Adapted with permission of the publisher from Saunders and Saunders

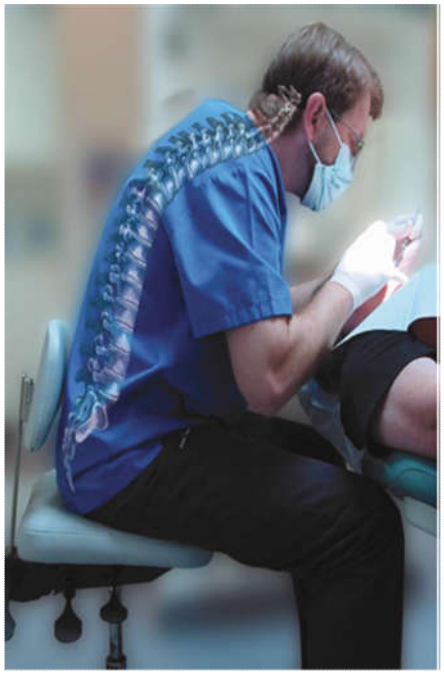

Figure 2. The effects of poor posture on the curves of the spine: flattened lumbar lordosis and a forward-head position

Figure 3. Examples of chair side directional stretches. A. Neck and shoulder combination. With the elbow at shoulder height and at a 90-degree angle, gently pull the arm across the front of body with opposite arm. Look over the shoulder being stretched and hold for two to four breathing cycles. Repeat. B. The untwister. With the knees wider than shoulder width, bend to the left side, resting the full body weight through the left elbow on the left knee. Stretch the right arm overhead and look toward the ceiling. Hold for two to four breathing cycles. Repeat. C. Upper trapezius stretch. Anchor the right hand behind the seat of the chair. Gently bring the left ear toward the left armpit. Hold for two to four breathing cycles. Repeat. D. Downward squeeze. Assume a neutral head posture (ears over the shoulders) and do not let the head move forward throughout the exercise. Lift the chest upward, position the arms at the sides with fingers pointing upward and palms facing forward. Roll the shoulders back and down, squeezing the shoulder blades downward and together. Hold for one long breath cycle. Repeat five times.

Figure 4. Neutral Position and Magnification systems

from the body. It is characterized by severe pain and impaired function of the shoulder joint.

Periodic breaks and stretching: Studies suggest that the increase in operator pain may be due to longer work periods without breaks, due in part to the use of fourhanded dentistry techniques (Marshall, 1997; Rundcrantz, 1990). Having operators take frequent breaks (Hedman, 1997) and reverse their positions is integral in an effective injury prevention program. Frequent stretching breaks address the detrimental physiological changes that can develop while working in optimal or awkward PSPs: ischemia, trigger points, muscle imbalances, joint hypomobility, nerve compression and disk degeneration. Furthermore, stretching

- Increases blood flow to muscles;
- Increases production of joint synovial fluid;
- Reduces formation of trigger points;
- Maintains normal joint range of motion;
- Increases nutrient supply to vertebral disks;

Concept of neutral position for the clinican: Research indicates that over 80% of dental hygienists complain of pain in the upper body and back. This musculoskeletal pain is often the direct result of the body positioning and movements made by dental hygienists in their daily work. Neutral position is the ideal positioning of the body while performing work activities and is associated with decreased risk of musculoskeletal injury. It is generally believed that the more a joint deviates from neutral position, the greater the risk of injury (Finsen, 1997).

Neutral seated position: Forearms parallel to the floor, weight evenly balanced, hip angle of 90°, seat height positioned low enough so that you are able to rest the heels of your feet on the floor, the goal of neutral back position is to lean forward slightly from the waist or hips and trunk flexion of 0 to 20°. Over flexion of the spine should be avoided (Fig 4)

Postural awareness techniques

Maintaining the low back curve: When sitting maintaining low back curve can reduce or prevent low back pain.[2122] The best way to achieve low back curve is by tilting seat angle slightly forward 5 to 15° to increase the low back curve.[23] It increases hip angle to greater than 90° , which may allow for closer positioning to the patient. A saddle – style operator stool should be taken in consideration as it promotes the natural low back curve by increasing hip angle to approximately 130°. Proper adjustment of chair to distribute the body weight evenly is required. The forward edge of the chair should not compress operator's thighs. Use lumber support of the chair to support your back.

Use magnification systems: Use of magnification systems have been associated with decreased neck and low back pain as they allow operators to maintain healthier postures [24] (Fig4). Declination angle of the scopes should allow the operator to maintain less than 20° of neck flexion. Working in postures with greater than 20° of neck flexion have been associated with increased neck pain.[25] One should try various telescopic models to determine which unit suits best to the operator.

Avoid static postures: As human body is made for movement and ever changing postures, the concept of a single correct work posture may be physiologically invalid[26]. Some dental schools and educational programs stress the importance of using one 'home position while working' while it is important to use ergonomically correct positions and postures, some studies suggest that several home positions may be better than one[27]. Static postures can increase susceptibility to injury (Silverstein, 1997). Operators should vary their work positions as often as possible to shift workload from one group of muscles to another (Ratzon et al., 2008). Alternate between standing and sitting is also an effective alternative. One study revealed that dentist who worked solely in a seated position had more severe low back pain than did those who alternate between standing and sitting (Ratzon et al., 2000).

Conclusion

Work –related pain is common among dental professionals. But available research supports the idea that musculoskeletal problems can be managed effectively using a multifaceted approach that includes preventive strategies, proper selection and use of positioning techniques and frequent breaks with

stretching and postural strengthening techniques, by using magnification systems. It is important that dentistry incorporate these strategies in to practice to facilitate balanced musculoskeletal health.

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