

Review Article

Don't get bent out of shape - Ergonomics: good form. Good function. Good health

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ARTICLE INFO



Keywords:

Dental surgeon, dentistry, ergonomics, musculoskeletal disorders, neutral position, risk factors, static postures, work efficiency, workplace.

ABSTRACT

Since 1992 the Occupational Safety and Health Administration (OSHA) has been preparing Federal legislation concerned with ergonomic hazards in at-risk workplaces. Although multifactorial in nature, there is sufficient evidence in the scientific literature to document an association between the practice of dentistry and a variety of musculoskeletal disorders. There are preventive strategies already known and available to us. This includes many different concepts such as how dentists position themselves and their patients, how they utilize equipment, how work areas are designed and how all of these impact the health of dentists. Good working ergonomics is essential so that work capability, efficiency and high clinical level of treatment can be maintained throughout the working life of dental professionals.

Introduction

In Greek, "Ergo" means work and "Nomos" means natural law or systems. Ergonomics is an applied science associated with the study of the relationship between the worker and the workplace along with designing products and procedures for maximum efficiency and safety.

"An ounce of prevention is worth a pound of cure." That's what dental health workers spend their days telling their patients ("Brush your teeth, use dental floss"). It also applies to working conditions that can cause neck, shoulder, elbow, wrist, and lower back pain in dental health workers.

Did you know that although most dental health workers are right-handed, many have left shoulder pain? Simply holding a mirror can cause injuries that

make work uncomfortable, or even painful, requiring treatment and sometimes forcing people to stop working. It's not just holding the mirror that places a load on the shoulder, but holding the mirror while keeping your left arm elevated for many minutes at a time, several times a day.¹

Murphy DC et al (NYU College of Dentistry, USA) studied on the various Reasons for Early Retirement among Dentists and concluded as follows:²

- Musculoskeletal disorders (29.5%)
- Cardiovascular disease (21.2%)
- Neurotic symptoms (16.5%)
- Tumors (7.6%)
- Diseases of the nervous system (6.1%).

The prevalence of musculoskeletal disorders (MSD) in the dental professions has been well established, and

can have detrimental effects on the industry, including lower productivity and early retirement. A study done by Andrew Ng et al supports the increasing evidence that MSD could be developing in students, before the beginning of a professional career. The prevalence of poor posture further highlights the need to place further emphasis on ergonomic education.³

Musculoskeletal disorders

Musculoskeletal disorders (MSDs) are among the most common causes of long-term disability.⁴ Epidemiologic literature has grouped these disorders as clinically well-defined (such as tendonitis and carpal tunnel syndrome), less clinically well-defined (such as tension neck syndrome) and nonspecific (such as repetitive strain injury, cumulative trauma disorder, and overuse syndrome).⁵

Letho (1991) pointed out that female dentists suffer more neck and shoulder pain than their male counterparts, as indicated in the following table.*

	Male Dentists	Female Dentists
Neck pain	45%	67%
Shoulder pain	50%	72%

Table 1 Incidence of MSDs in male and female dentists⁶

Ergonomics

Modern ergonomics is an interdisciplinary applied science that studies the optimization possibilities of the man-machine system design by knowing the human's physical and mental possibilities and limits, his/her capacity to learn, the factors generating errors, the

work, the physiology, the human behavior as an individual and within a team, the managerial possibilities, the organizational culture (interdisciplinary study of anatomy, physiology, psychology, management), and the technical and designing possibilities (engineering, design).⁷

Good ergonomic design of the workplace is a basic requirement for improving musculoskeletal health.⁸

A poor ergonomically designed workplace may not show immediate ill health effect, because the human body has the capacity for adapting to a poorly designed workplace or structured job. However, the compounding effect of job and workplace deficiencies will surpass the body's coping mechanisms causing MSDs.^{9,10}

Advances in ergonomics continue to ease the physical challenges of the dental profession. The ultimate goal should be to prevent injuries and maintain the health of the dental surgeons by rehabilitative exercises.¹¹

Postures assumed by the dental surgeons during their professional work.

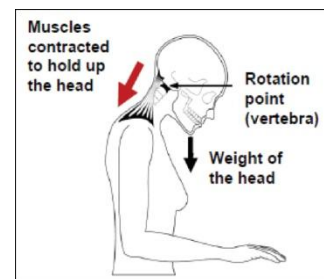


Figure 1: The muscles of the neck and upper back are under pressure to support the weight of the head and keep it from falling down

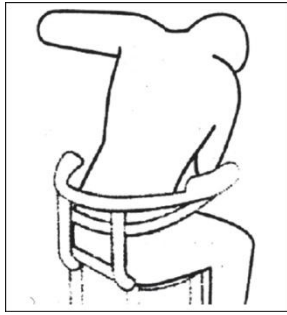


Figure 2: Typical position used by many dental surgeons with flexed and twisted neck and torso

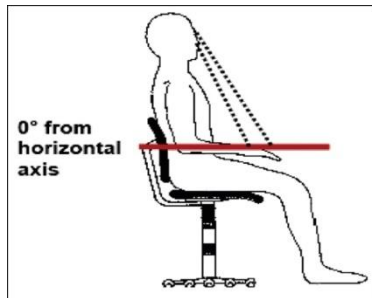


Figure 3: Neutral seated position

In a neutral-seated position as shown in fig.3 , the torso is leaning back slightly between 100° and 110° (90° is vertical), the buttocks, thighs, and legs are supported and the back of the knee is free. The operative field (the patient's mouth) to be placed at the same height as the practitioner's elbow is held close to the body. This shows that the arms are at 0° from the horizontal axis or 90° to the shoulder.

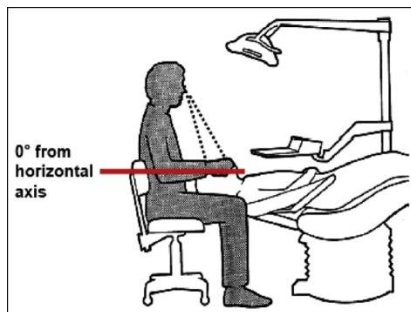


Figure 4: Theoretical "ideal position": Shoulders in line with the ears and arms at nearly 90° . The patient's mouth is positioned at elbow level, forearm angle at 0° from the horizontal axis. The eye-task distance is too great.

Therefore, an inability to see is what makes a dental surgeon bend his/her neck and back to be able to see and perform quality work in his/her patient's mouth. Extremely, bent-over positions are frequently observed as illustrated in fig. Dental surgeons, therefore, have a great deal of difficulty maintaining a straight back and neck position when their arms are held at 0° from the horizontal axis.

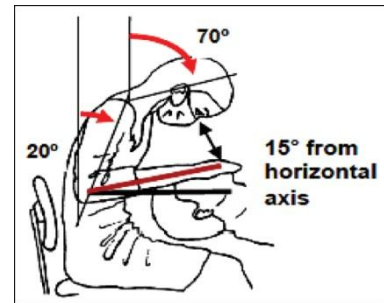


Figure 5 : Neck flexion (70°) and back flexion (20°) when forearms are at 15° from the horizontal axis. These are common positions when the patient is positioned low

Two examples of sequences [Figure 5] [Figure 6] [Figure 7] [Figure 8] are given comparing neck and back positions resulting from the angles of the forearms in relation to the horizontal axis. By raising the level of the patient's mouth and holding dental surgeon's arms up, the dental surgeon can straighten both neck and back as illustrated in [Figure 6] and [Figure 8].

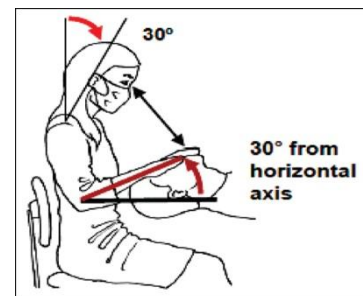


Figure 6 : Neck position is reduced (30°) when raising the height of the patient's head. There is less need to

bend over to see into the oral cavity. Forearms are at 30° from the horizontal axis

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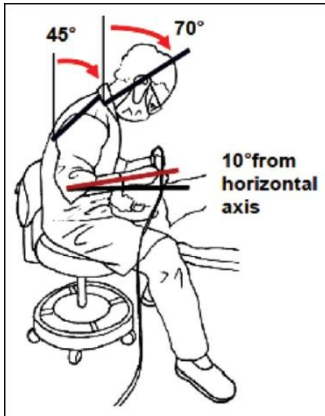


Figure 7 : Neck flexion (70°) and upper back flexion (45°) when the patient is positioned low. The forearms are at 10° from horizontal. Leg movements are limited by the back of the patient's chair

Neck flexion (70°) and upper back flexion (45°) when the patient is positioned low. The forearms are at 10° from horizontal. Leg movements are limited by the back of the patient's chair.¹²

DISCUSSION

Solutions to prevent or reduce shoulder, neck, upper and lower back pain¹³

Early Treatment of MSDs

- Early symptoms in the wrist and hand respond to conservative medical management that includes rest, icing, nonsteroidal anti-inflammatory drugs and splints. Early intervention could be important in order to achieve a better result at less cost and inconvenience.¹⁴

Posture

- Always try to maintain an erect posture
- Use an adjustable chair with lumbar, thoracic and arm support
- Work close to your body
- Minimize excessive wrist movements
- Avoid excessive finger movements
- Alternate work positions between sitting, standing and side of patient
- Adjust the height of your chair and the patient's chair to a comfortable level
- Consider horizontal patient positioning
- Check the placement of the adjustable light.

Patient Positioning

- Supine positioning of the patient in the chair is usually the most effective way to help to maintain neutral posture. The chair should be raised so the operator's thighs can freely turn beneath the patient's chair. Clearance around the patient's head should at least allow unimpeded operator access from the 7 to 12:30 o'clock position, for right-handed operators.
- For most intraoral access sites, the maxillary plane should be extended 7° beyond the vertical. For treating the maxillary second and third molars, the maxillary plane should be 25° beyond the vertical. For the mandibular anterior teeth, bring the patients chin down so the maxillary plane is 8° ahead of the vertical.

Hand Instruments

- No industry standard for an 'ergonomic' instrument currently exists. 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. Handles with shallow, circumferential grooves or with knurling allow better friction with the fingers so that a secure grasp requires less force. Small diameter, hexagonal shaped instrument handles produce a mechanical stress that may cause digital nerve compression.²⁶

Automatic Instruments

- Practitioners should consider use of automatic instruments (high-speed handpiece, slow-speed handpiece, belt driven drills, lasers, ultrasonic scalers, endodontic handpieces) instead of manual hand instruments.
- Handpieces should be as light as possible and well balanced.
- Delivery Systems
- Various delivery systems have advantages and disadvantages. When working in four-handed dentistry the dentist maintains a position around the operating field with limited hand, arm and body movement, and should best confine eye focus to the working field.
- Additionally, the dental equipment and instruments should be centered on the dental assistant. From an ergonomic viewpoint, over-the-head and over-the-patient delivery systems better allow the dental assistant to access the hand-pieces for bur changes or other operations.

Lighting and Magnification

- The goal of overhead lighting is to produce even, shadow-free, color-corrected illumination that is concentrated on the operating field. Once the patient and operator are properly positioned, the light source can be left far above the heads of both the operator and assistant because the

correct position will require no adjustment during the procedure.

Gloves

- Each dental healthcare worker must have gloves of proper size and fit. Although the Influence of gloves on hand discomfort has yet to be explored, they have been cited indirectly as a potential contributor to carpal tunnel syndrome.

Supervised Exercise

- Exercise and stretching for the treatment of an MSD should be under the supervision of a physician or physical therapist. Injury could incur or a previous injury might be exacerbated by improperly performed exercises.

Proper Temperatures

- Within the work environment, low room temperatures, manipulation of cold materials or instruments and exposure to cold air exhaust can contribute to low finger temperature. There are no standards for finger temperatures, but it is recommended that hands and fingers be kept above 25° C or 77° F to avoid detrimental effects on dexterity and grip strength.

Procedures and Administration

- The appointment schedule can be used to reduce stress and strain.

CONCLUSION

Interventions or prevention strategies require an awareness of "how to fit the job to the worker and not the worker to the job." Applying ergonomics to the practice of dentistry not only could provide safety benefits, but a practice might also improve performance objectives through greater productivity. The ergonomics and healthy workplace help the dental surgeons increase their performance without putting at

risk their own health. 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.

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Source of support: Nil Conflict of Interest: None

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