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Dental ergonomics: A review

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Abstract--Ergonomics is much broader than preventing work-related musculoskeletal disorders. The successful application of ergonomics assures high productivity, avoidance of illnesses and injuries, and increased satisfaction among workers. Unsuccessful application, on the other hand, can lead to work-related musculoskeletal disorders (MSDs). This article sets forth broad important background information on ergonomics so that the dental practitioner can have a general awareness of ergonomic risk factors as well as some basis for understanding the ongoing dialogue about ergonomics, its diagnosis, treatment, and regulation. This article provides alternatives to be considered by the practitioner in light of the practitioner's own circumstances, experiences and goals. Dentists are often exposed to occupational health hazards such as stress, high workload, and ergonomic and mental strain. However, there are limited studies focusing on occupational health and factors associated with working conditions. The aim of this study was to identify possible gender differences and factors associated with a high workload.

Keywords--ergonomics, carpal tunnel syndrome, musculoskeletal disorders, lower back pain.

Introduction

Musculoskeletal disorders, pain, stress, and mental strain are highly prevalent in today's society, and are a major health concern among dental professionals.¹Dentists have high demands in the form of high quantitative

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demands relating to treating as many patients as possible during a working day. The physical work environment is characterized by high exposure to awkward postures, relatively high forces exerted by hand and fingers, and prolonged static loading of muscles in the neck, shoulders and upper back¹. There is also a high degree of precision and concentration combined with a time schedule and tight deadlines that must be met. Ergonomics can be defined as 'an applied science concerned with designing and arranging things people use so that the people and things interact most efficiently and safely'.²

The term work-related musculoskeletal disorders (MSDs) refer to musculoskeletal disorders to which the work environment contributes significantly or to musculoskeletal disorders that are made worse or longer lasting by work conditions or workplace risk factors². Common examples of such workplace risk factors include jobs requiring repetitive, forceful or prolonged exertions of the hands; frequent or heavy lifting, pushing or pulling, or carrying of heavy objects and prolonged awkward postures. The level of risk depends on the intensity, frequency and duration of the exposure to these conditions.²

Ergonomics looks at what kind of work is done, what tools are used and the whole working environment. The aim of ergonomics is to find the best fit between workers and their working conditions. No matter what the job is, the goal is to make sure that workers are safe, comfortable and less prone to work-related injuries. Ergonomics, therefore, is the fitting of the job to the worker by designing the work and creating a working environment to prevent work-related MSDs and other health problems.²

Content

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. The scope of ergonomics in dentistry is large: it ranges from chemistry between the dental team to lighting, noise and odor conditions and naturally to the used equipment and software. The treatment environment with the patient chair, dental unit, operating light, dynamic and hand instrumentation, cabinetry and peripheral equipment must be flexible. They need to adapt and guarantee good working postures, sufficient lighting and easy access to required instrumentation and materials for different working practices, clinical procedures and patient types.³ Dentistry poses a great challenge because the ergonomics of dental work is difficult. Ergonomics seeks to reduce cognitive and physical stress, prevent occupational diseases related to the practice of dentistry and to improve productivity, with better quality and greater comfort for both the professional and the patient.⁴ There is no uniform medical information and or sufficient understanding of the nature of MSDs. Significant difficulties in diagnosis generate an ongoing debate on many aspects of these conditions. However, various risk factors have been identified and preventive measures are now available. To achieve a realistic target of safety and health at work, prevention is clearly the best approach; hence, preventive philosophy deserves considerable attention.⁴

Types of MSDs

Musculoskeletal disorders come in a variety of forms. This article includes general information about the primary types of MSDs that dentists have to face.⁵

Back Problems

Lower Back Pain people have recurrent episodes of pain, and one-third of patients continue to have persistent, recurrent or intermittent pain after their first episode. In addition to the difficulty with healing, the degenerative process is ongoing with age, and many patients do not minimize potential risk factors. All of this can contribute to continue episodes of low back pain (LBP).⁵ Upper Back Pain While not as common as lower back pain, some individuals report extensive pain in the mid and upper back. The thoracic spine is designed for support in standing and for caging the vital organs and is quite strong. It only rarely experiences symptoms of degeneration since there is little movement and great stability.⁵

Hand and Wrist Problems

Chronic, repetitive movements of the hand and wrist, especially with the hand in 'pinch' position, seem to be the most detrimental. Other common contributing factors to hand and wrist injuries include movements in which the wrist is deviated from neutral posture into an abnormal or awkward position, working for too long period without allowing rest or alternation of hand and forearm muscles; mechanical stresses to digital nerves from sustained grasps to sharp edges on instrument handles, forceful work and extended use of vibratory instruments.⁶ Some of the common hand and wrist conditions are as follows:

- Tendinitis/tenosynovitis
- DeQuervain's disease
- Trigger finger
- Carpal Tunnel syndrome
- Guyon's syndrome.⁶

Awkward Postures

Dental personnel assume these awkward positions for the following reasons:

- To coordinate the relative positions between dentist and assistant.
- To obtain optimal view of teeth within the patient's mouth.
- To provide a comfortable position for the patient.
- To maneuver complex equipment and reach for instruments.⁶⁻⁷

Repetitive Motions

Effects of repetitive motions from performing the same work activities are increased when awkward postures and forceful exertions are involved.

Force requirements may increase with:

- Use of an awkward posture.

- The speeding up of movements.
- Use of small or narrow tool handles that lessen grip capacity.
- Increased slipperiness of the objects handled.
- Use of the index finger and thumb to forcefully grip an object (i.e., a pinch grip compared with gripping the object)⁶

Vibration

Exposure to local vibration occurs when a specific part of the body comes in contact with a vibrating object, such as a power hand tool.⁷

Psychosocial Factors

Identified stressors include the psychological demands of doing meticulous surgery with little or no rest or diversion and time pressures. Dentists with work-related MSDs show a significant tendency to be more dissatisfied at work and to be more burdened by anxiety, experiencing poorer psychosomatic health and feeling less confident.⁸

Workstation

Proper workstations may include the following:

- Dentist's or patient's chair height
- Lumbar, thoracic or arm support in dentist's chair
- Position of instrument table
- Adequate lighting
- Edges of work surfaces should be comfortable
- Proper ventilation
- Pleasant temperature.⁹

Hand Instruments

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.⁹When working edges are sharp, the instrument performs more of the work; when the edges are dulled, additional operator force is required to achieve the same result. Sharp instruments are important for reducing excessive force during instrumentation.¹⁰

Lighting and Magnification

The goal of overhead lighting is to produce even, shadow free, color-corrected illumination that is concentrated on the operating field. In general, the intensity ratio between task lighting (the dental operating light) and ambient room lighting should be no greater than 3 to 1.6. Furthermore, the light source should be in the

patient's mid-sagittal plane; directly above and slightly behind the patient's oral cavity, and 5° toward the head of the operator in the 12 o'clock position. 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.¹¹

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.¹²

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.¹²⁻¹³

Management

When working in four-handed dentistry the dentist maintains a position around the operating field with limited hand, arm & body movement, and should best confine eye focus to the working field. The dental equipment & instruments should be centered on the dental assistant promoting over-the head & over-the patient delivery system.¹³ Alternate between standing & sitting. Standing allows reducing the pressure in the back. However, there are times when the dentist needs to sit. When sitting, the main part of the body weight is transferred to the seat. Alternating between the two positions lets one group of muscles rest, while the workload is shifted to another group of muscles. Alternating between standing & sitting can be an effective tool in preventing injuries.¹³

A foot control can be designed with a pedal on which the foot is placed either entirely, or partly. Placing the whole foot on the pedal causes an unfavorable load which results in the unequal position of the right & left foot which in turn causes an asymmetrical, harmful strain on pelvis & vertebral column. Therefore, it is necessary to place the heel on the floor so that it can support the foot, while the front part of the shoe is placed on the pedal. Using matt surfaces. The surfaces of dental equipment & instruments have to be matt, to avoid fatiguing glittering effects on the eyes of the dentist. The colours used for dental equipment should be light for an optimal contrast to avoid more adaptation of the eyes⁴ that allow better access during procedures.¹⁴

Conclusion

The assessment of risk of MSDs and prevalence of musculoskeletal disorders among dentists revealed that prevalence and risk of such injuries were high. The analysis of personal risk factors through regression analysis indicated that female gender and exercise for less than 3 hours per week were influential upon

musculoskeletal disorders of most body parts. In addition, the results of posture analysis suggested that risk of symptoms occurrence in right side of dentists' bodies was high.¹⁴

Therefore, to minimize musculoskeletal symptoms among dentists, it is necessary to consider these risk factors and to develop ergonomic solutions through interventional programs and working conditions improvement. Dentists with low influence over work, low levels of social support and who were unsatisfied with the ergonomic conditions perceived higher levels of workload. Working conditions must be made visible early and taken seriously to avoid stress and future inconvenience. Thus, preventive actions at the workplace aimed at both the individual and organizational levels are essential to minimize poor work environments and prevent work-related ill-health.¹⁴

A dentist can spend up to 60,000 hours in a lifetime working in tense and distorted positions, with consequent musculoskeletal problems. Dentistry does not lend itself to good posture; however, it is possible with instruction and practice to correct the harmful postural habits that may be the cause of such stress and pain. Dental professionals are prone to unique muscle imbalances and require special exercise and ergonomic interventions to maintain optimal health during the course of their career. It is important to not only know what effective interventions are, but also in what sequence to implement them.¹⁴

Here are six keys to wellness to help a dentist to work more comfortably, with less fatigue and extend their career:⁷

1. First and foremost, correct the ergonomic problems in the operatory.
2. Physical therapists, neuromuscular therapist should be consulted for musculoskeletal disorders.
3. Major trigger points should be resolved before any strengthening exercise is attempted.
4. Strengthen specific stabilizing muscles (like shoulder and back).
5. Be patient, but most of all commit to a regular regimen of prevention strategies.
6. Chairside stretching is an important strategy to perform throughout the workday to prevent microtrauma and muscle imbalances.¹⁴

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