

Ergonomic Risks in Dentistry

Introduction

Ergonomics is the science of matching working conditions and human capabilities. The goal is to allow people to perform work and other activities safely and efficiently. We must match our tools, equipment, and work methods to our needs in order to perform comfortably and at our best. We must learn to recognize conditions that lead to discomfort, and implement changes to minimize or eliminate those conditions.

Dental work poses some interesting ergonomic challenges. During a normal day, dentists, hygienists, and dental assistants sit and stand, sometimes in one position (static posture) and sometimes for long periods. Dental professionals bend forward or to the side while working on patients' teeth. They may have to stay in one place for a long time rather than moving around frequently. They may need to use awkward hand and arm postures, and may frequently grip small tools and manipulate them with force.

Dental work requires considerable concentration and attention to detail. Dental professionals are concerned about patients' comfort, but probably pay little attention to their own until they begin to experience discomfort or pain. With a little attention and creativity, dental professionals can improve their comfort on the job.

Incidence of Work Related Musculoskeletal Disorders (WRMSDs) in Dental Practice

A significant incidence of carpal tunnel syndrome (CTS) and other work related musculoskeletal disorders (WRMSDs) has been recognized in dental practice (Haman et al, 2001; Michalak-Turcotte, 2000; Valachi, 2003). Positive correlations have been found between symptoms of CTS and the number of years hygienists worked, the number of days practiced per week, the number and type of procedures, and the number of heavy calculus (tartar) patients seen per day (Bramson et al, 1998). Liss et al. (1995) found that the number of heavy calculus patients per day, "clock" position around the dental chair (i.e. the angle of approach to the patient), and years in practice were significant predictors of CTS. Days worked per week (but not heavy calculus patients), time with the trunk rotated, and years of practice were significant predictors of reported shoulder trouble. Liss found that risk of experiencing wrist/hand symptoms increases sharply after 1 year of practice.

Implementation of ergonomic solutions can be a challenge. Droeze and Jonsson (2005) concluded that, even in a highly motivated group, recommendations to reduce musculoskeletal disorders will often be only partially

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implemented. When implemented however, investigators have reported the effectiveness of various solutions. For example, Dong (2005) demonstrated benefits of using finger rests to stabilize the instrument while performing dental scaling or other types of dental work. In particular, using finger rests was shown to play an important role in reducing the muscle load of the hand. Other ergonomic controls (possible solutions) are listed later in this paper.

Contributing Factors

Other contributing factors have been identified. For example, it has been reported that dental hygienists who use slow speed hand pieces and sickle scalers report more paresthesia (numbness) than those who do not. While awareness of these problems has increased, specific risk factors for hand position and instrument use have not been well documented.

Symptoms

Typically, symptoms range from mild discomfort in one or more body parts (e.g., neck or wrist) to severe generalized pain. Dental hygienists most commonly report pain in the shoulder and neck, hand and wrist, and lower back, respectively. They also generally report experiencing symptoms more frequently in the dominant hand rather than the non-dominant hand or in both hands simultaneously.

Job Functions

An ergonomic assessment begins with an understanding of job functions. Dentists, hygienists, and assistants gather and interpret medical history information; inspect intra- and extraoral structures; examine teeth and periodontal structures; remove calculus (tartar), stain and plaque; expose and process radiographs; perform fluoride treatments; and conduct oral hygiene and educational sessions. These and others tasks may be performed in various combinations. The dentist may determine work pace and patient scheduling. According to Atwood and Michalak (1992), on the average, a dental hygienist may examine and treat 8-12 patients a day, averaging 45 minutes per appointment. Dental hygienists use specifically designed instruments to perform procedures such as probing, exploring, scaling, root planing, and polishing. Hygienists may alternate among standing, sitting, and partial standing positions, although sit-down dentistry is the basic method taught in the educational setting.

Critical Demands

Upon closer examination, the significant physical demands of dentistry become apparent. Critical demands of the job include prolonged sitting or standing for up to 45 minutes,

with any or all of the following awkward postures of various body parts:

- the head, neck and shoulders positioned in static flexion (bending forward);
- frequent twisting and forward flexion at the waist;
- repetitive forearm *supination* (forearm position with the palm facing upward) and *pronation* (forearm position with the palm facing downward), possibly in combination with wrist *extension* (bending back away from the palm);
- repetitive wrist *flexion* (bending forward in the direction of the palm) and extension up to 90 degrees, combined with radial (toward the thumb side of the hand) and ulnar (toward the little finger side) *deviation* to 10-15 degrees; and/or
- a sustained modified pen grasp with varying force requirements (estimated at 1.5-8 pounds of pinch force, depending on the procedure) (Atwood and Michalak, 1992).

Instruments

Dentists, assistants, and hygienists use a variety of specialized instruments. There is some variability in the size and shape of tools and handles. Some manufacturers make separate handles to which scaling and other “tips” are added (purchased separately). Instrument handles are designed with three basic shapes: hexagonal, round, and octagonal. Instrument sizes range from 3/16” to 1/2” to 1/3” in diameter. Instrument handle serrations vary from smooth to waffle-iron (grid-like pattern) serrations.

The condition of the tool will influence its effectiveness and its ease of use, so tool maintenance is a critical factor. Hygienists agree, for example, that sharp instruments require less pressure during scaling. However, they admit that they don’t take, or don’t always have, the time between patients to sharpen their tools.

The dentist should check with suppliers to find the best available tools. Informing suppliers and manufacturers of the need for different size and shape tools (and handles) is an important step in improving the availability of comfortable and effective tools.

Instrument Delivery

Instrument delivery, or the direction from which the patient is approached, is identified as front, rear, and side. Most dental personnel prefer side delivery, although the choice may be at least in part dependent on the particular procedure. The angle of approach to the patient will certainly influence posture.

Ergonomic Risk Factors

Dental work involves ergonomic risk factors associated with musculoskeletal disorders. The most commonly observed risk factors include:

- static, awkward postures of the neck and back;
- repetitive wrist and forearm motions combined with forceful, sustained pinches;
- use of the wrist or hand in awkward positions;
- mechanical stresses to nerves in the fingers (introduced through sustained grasps or serrated handles and contact of the instrument handle with the radial aspect index finger); and
- vibration (introduced through use of the slow speed handpiece).

Added to these physical stressors are the demands of working with patients undergoing difficult procedures, assisting fearful or difficult patients, and keeping up with a hectic pace.

Side delivery requires twisting at the torso and internal rotation, abduction (arm away from body) and extension of the arm in order to reach instruments. Front delivery may require asymmetrical postures of the trunk and upper extremities as well as shoulder flexion and elbow extension (reaching). Rear delivery is likely to require shoulder flexion and abduction, some rotation of the upper extremity, and back flexion. Limited space for the legs during front and side approaches may also contribute to a variety of awkward postures.

Characteristics of dental work meet criteria that have been determined to be associated with musculoskeletal disorders. The work is highly repetitive. Extremes of wrist flexion and extension are used in combination with forceful pinch. The index and third fingers are primary executors of motion in the modified pen grasp, and there is little rest during patient examination and scaling. Scaling, root planing, and ultrasonic instrument scaling were found by Rice et al. (1996) to initiate or aggravate upper extremity symptoms.

In addition, hygienists have little control over the volume and pace of their work. Feelings of control, or lack of control, over one's daily work routine have been associated with both the occurrence of hand symptoms and sick leave believed to be taken as a result of work requirements (Rice et al., 1996).

Summary

The existence of ergonomic risk factors and the occurrence of musculoskeletal disorders in dental practices take a human toll, affect productivity, and increase absenteeism and

inefficiency by slowing dental staff down. While it may be impossible to completely eliminate all ergonomic exposures in dentistry, the detrimental effects of these hazards can be minimized through *engineering controls* such as workstation design/adjustment, and through *administrative controls* such as creative scheduling and rest breaks. The variety of tasks performed by dental staff provides the opportunity for “musculoskeletal relief” offered by alternating task assignments. Staff members who are trained in ergonomic awareness will be able to recognize early signs of discomfort or musculoskeletal disorders. Training will also increase awareness of ergonomic risk factors and body mechanics, and help them develop possible solutions to ergonomic concerns. Early reporting of symptoms gives the employer the opportunity to respond quickly, address concerns, and to head-off or alleviate potential MSD problems.

Possible Solutions

Ergonomics problems in dentistry can be reduced by implementing these controls:

General:

- Adjust position relative to patient (sometimes referred to as instrument delivery position: front, side, rear)
- Change instrument delivery position
- Alternate scaling and polishing (rather than scaling all the teeth before polishing)
- Stretch and exercise between patients; pace work, and alternate work tasks
- Alternate instruments
- Use proper instrumentation techniques:
 - avoid thumb hyperextension
 - avoid excessive finger movement
 - keep wrist in neutral during forearm rotation
- Wear properly fitting gloves
- Gradually increase work tolerance (start at part-time employment and go to full-time employment gradually)
- Be aware of body signals (e.g., fatigue, discomfort or pain)

Tools

- Select balanced instruments
- Match instrument size and weight to hygienists (select diameter and handles according to hand sizes, increase tool diameter)
- Keep instruments sharp to require less pressure and time (for example, in scaling)
- Alternate instruments
- Dampen vibration components
- Increase surface friction and eliminate sharp ridges

Posture

- Adjust approach to patient to minimize reaching and twisting or forward bending at the waist
- Stretch hand, neck, shoulders, and back between patients
- Alternate work positions and/or work tasks
- Use adjustable chairs (patient and staff chairs) and other work surfaces
- Use indirect vision (e.g., Mirrors) to eliminate awkward positions
- Keep tools conveniently accessible

Work Design (Administrative Controls)

- Rotate tasks
- Use selective polishing to reduce use of the handpiece
- Alternate heavy and light calculus patients (scheduling)
- Schedule adequate time for each patient
- Add buffer times to schedule for relaxation and stretching
- Offer relaxation tapes to patients
- Give and get feedback to and from coworkers about posture

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