Ergonomics in Dentistry and the Prevention of Musculoskeletal Disorders in Dentists
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Abstract
Recently, “Ergonomics” has become a popular term. The term has been used with most professions, but increasingly in the dental profession. It is a discipline that studies workers and their relationship to their occupational environment. 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. The scope of ergonomics in dentistry is large.

INTRODUCTION
In Greek, “Ergo,” means work and, “Nomos,” means natural laws or systems. Ergonomics, therefore, is an applied science concerned with designing products and procedures for maximum efficiency and safety. It is also a study of the relationship among the personnel, equipment and environment in the work area. Proper ergonomic design is necessary to prevent repetitive strain injuries, which can develop over time and can lead to long-term disability. Ergonomics is concerned with the ‘fit’ between people and their work. It takes account of the worker's capabilities and limitations in seeking to ensure that tasks, equipment, information and the environment suit each worker.

The musculoskeletal health of dental professionals has been the subject of numerous studies worldwide, and their focus has been on the pain experienced by the practitioner. Because their work area is narrow, performance of dental treatment results in a very inflexible work posture. Studies indicate that back, neck, and shoulder or arm pain is present in up to 81% of dental operators. Back pain is the most common complaint followed by neck pain and shoulder pain, though they all are usually mild. Most dentists today work in the sitting position treating the patient in the supine position. Being seated made little difference in how frequently operators experience pain. When operators sit, pain occurs not only in their backs, but also their necks, shoulders and arms. While the occasional backache or neck ache is not a cause for alarm, if regularly occurring pain or discomfort is ignored, the cumulative physiological damage can lead to an injury or a career-ending disability.

MECHANISMS LEADING TO MUSCULOSKELETAL DISORDERS (MSDS) IN DENTISTRY
1. Prolonged Static Postures (PSPs): Dentists frequently assume static postures. When the human body is subjected repeatedly to PSPs, it can initiate a series of events that may result in pain, injury or a career-ending MSD.
2. Muscle Ischemia/Necrosis and Imbalances: During treatment, operators strive to maintain a neutral, balanced posture and find themselves in sustained awkward postures. These postures often lead to stressed shortened muscles which can become ischemic and painful, exerting asymmetrical forces that can cause misalignment of the spinal column.
3. Hypomobile Joints: During periods of PSPs or when joints are restricted due to muscle contractions, synovial fluid production is reduced and joint hypomobility may result.
4. Spinal Disk Herniation and Degeneration: In unsupported sitting, pressure in the lumbar spinal disks increases. During forward flexion and rotation, a position often assumed by dental operators, the pressure increases further and makes
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the structure vulnerable to injury.

**ERGONOMIC RISK FACTORS IN DENTISTRY**

1. **Neck and Shoulder:** Repetitive neck movements and continuous arm and hand movements affecting the neck and shoulder demonstrate significant associations with neck MSDs.

2. **Wrist and Hand:** Carpal Tunnel syndrome (CTS) has been associated with both repetitive work and forceful work. Symptoms can appear from any activity causing prolonged increased (passive or active) pressure in the carpal canal.

3. **Low Back Pain:** Low-back discomfort has been associated with dental work in numerous studies. Good posture correlated negatively with back pain and dentists who sat 80 percent to 100 percent of the day reported more frequent lower-back pain, than those that do not sit as often (Shugars et al., 1987).

4. **Psychosocial Factors:** 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 with their futures.

**ROLE OF ERGONOMICS IN DENTISTRY**

A fundamental principle of Ergonomics is to design the work area and the task around the human body, rather than force the worker to adapt to poor design and task function.

The Ergonomic Standard mandated by the Occupational Safety and Health Administration (OSHA) recommended that the most efficient and effective way to remedy “ergonomic hazards” causing musculoskeletal strain should be through engineering improvements in the workstation.

Ergonomics have one primary objective – the prevention of work-related musculoskeletal disorders, or the symptoms that aggravate these disorders. In dentistry, bad working habits, repetitive tasks – such as scaling, root planning, and uncomfortable physical postures (Figure 1) contribute greatly to musculoskeletal disorders, stress, and loss of productivity.

Four-handed dentistry is ergonomically the most favorable way to provide dental services since it minimizes undesirable movements of the operating team and expedites the progress of most dental procedures.

Available research supports the idea that ergonomic hazards can be managed or alleviated effectively using a multifaceted approach that includes preventive education, postural and positioning strategies, proper selection and use of ergonomic equipment and frequent breaks with stretching and postural strengthening techniques. This represents a paradigm shift for daily dental practice.

Research shows that maintaining the low back curve-the lumbar lordosis-when sitting (Figure 2) can reduce or prevent low back pain. Proper selection, adjustment and use of magnification systems have been associated with decreased neck and low back pain, as they allow operators to maintain healthier postures.

Operators also need to know how to adjust the features of their chairs to obtain maximal ergonomic benefits. Alternating between standing and sitting also can be an effective tool in preventing injuries. Operators should take the time to position their patients...
properly for mandibular and maxillary procedures. When possible, dentists should position instruments within easy reach. To prevent injury from occurring to muscles and other tissues, the operator should allow for rest periods to replenish and nourish the stressed structures. Operators may use various stress-reduction techniques to decrease stress-related muscular tension.

Figure 2
Figure 2

It is important that dentistry incorporate these strategies into practice to facilitate balanced musculoskeletal health that will enable longer, healthier careers; increase productivity; provide safer workplaces; and prevent MSDs.

PREVENTION OF MSDS IN DENTISTS

Ergonomics problems in dentistry can be reduced by implementing various strategies. These have been summarized in Table 1. Dentists should also perform specific exercises for the trunk and shoulder girdle to enhance the health and integrity of the spinal column; stretching exercises for the hands and head & neck; maintain good working posture; optimize the function of the arms and hands; and prevent injuries. The following exercises can be practiced and performed by dentists on a regular basis in order to prevent MSDs.

Figure 3
Table 1: Strategies for Reducing Ergonomic Problems in Dentistry

<table>
<thead>
<tr>
<th>Postural Awareness Techniques</th>
<th>Positioning Strategies</th>
<th>Periodic Breaks and Stretching</th>
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<tr>
<td>• Maintaining a low back curve</td>
<td>• Avoiding static postures</td>
<td>• Chairside directional stretching</td>
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<td>• Using magnification systems</td>
<td>• Alternating between standing and sitting</td>
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<td>• Adjusting operator chair properly</td>
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Body Strengthening Exercises:

In a sitting position, extend one leg forward; bend and stretch hands as far as possible without bending the knee (Figure 3a); repeat with the other leg. Stretch one leg and put the other leg over the stretched leg; turn around as far as possible without changing the position of the legs (Figure 3b); repeat on the other side.

Figure 4
Figure 3a
Hand Exercises:

Slowly open and close hands from a completely open position (Figure 4a), to a completely closed position (Figure 4b), which ends with your fingers tucked into your palm; press the palms of your hands together and then relax them (Figure 4c); gently pull and relax each finger on each hand separately (Figure 4d); cross the wrists and gently stretch and relax (Figure 4e).²

Figure 5
Figure 3b

Figure 6
Figure 4a

Figure 7
Figure 4b

Figure 8
Figure 4c

Figure 9
Figure 4d
Neck Exercises:

Relax shoulders and tuck the chin into the neck (Figure 5a), then raise the head back (Figure 5b); tilt head to the side as if trying to touch ear to the shoulder (Figure 5c); repeat on other side (Figure 5d).²

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**Figure 12**
Figure 5b

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**Figure 13**
Figure 5c
Back Exercises:

A “full back release” should be practiced. Relax the neck, roll down slowly letting the arms and head fall between the legs (Figure 6a); hold position for a while; raise slowly by contracting stomach muscles and rolling up, bringing the head up last (Figure 6b).²
Figure 16
Figure 6b

Shoulder Exercises:
Raise shoulders up towards the ears and rotate first in clockwise direction and then in anti-clockwise direction (Figure 7).

Figure 17
Figure 7

FUTURE OF ERGONOMICS IN DENTISTRY
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. Today, more dentists are becoming aware of occupational hazards and paying more attention to the prevention of hazards. Ergonomics have come into the profession in a big way. Further development of dental ergonomics must take place on the basis of a coherent vision of the future. In this regard it must be clear exactly what ergonomics is and what developments have already taken place. Aspects of particular interest are the prevention of occupational diseases, legal responsibility for protecting the health and safety of employees and students, education in dental ergonomics for dental and oral hygiene students, the academic development and research of dental ergonomics, using organizational models in daily dental practice, and the development of ergonomics at the global level.

CONCLUSION
Repetitive strain injuries are on the rise in dentistry. Many dentists/dental hygienists have been diagnosed with MSDs, and majority have experienced some type of musculoskeletal pain in their shoulders and neck, hands and wrists, low back, or forearms and elbows. More studies need to be conducted on the impact of dental work on the development of nerve and muscle pathologies, which would prevent dentists from providing the highest quality of service and could threaten their professional careers. Meanwhile, the importance of following proper ergonomic principles should be realized so that these problems can be avoided by increasing awareness of the postures used during work, redesigning the workstation to promote neutral positions, examining the impact of instrument use on upper extremity pain, and following healthy work practices to reduce the stress of dental work on the practitioner’s body.
References

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