ERGONOMICS, POSTURE AND MUSCULOSKELETAL DISORDERS IN DENTAL PRACTICE

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Abstract: The position of the operator in dentistry is very important for the good outcome of the dental treatment. However, many times a good visibility means a twisted body of the operator and maintaining a position that is unhealthy for a prolonged period of time, and that can lead to muscle pain, joints pain and physical impairment of the operator. Therefore, respecting the ergonomics in the dental office is important for the benefit of the operating team.
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Introduction

International Ergonomic Association defines Ergonomics (or human factors) as "the scientific discipline concerned with the understanding of the interactions among humans and other elements of a system, and the profession that applies theoretical principles, data and methods to design, in order to optimize human well-being and overall system." Ergonomics is the science of matching working conditions and human capabilities.

The goal is to allow people to perform work or other activities safely and efficiently. The basic principle in ergonomics is to match tools, equipment, and work methods to the needs of the worker in order to enable him/her perform comfortably to his/her best. Thus, the need is to recognize conditions that lead to discomfort and implement changes to minimize or eliminate those conditions.

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). [1]

The chair height and position, even the chair type can help the operator. Having a chair that adjusts to the proper height will greatly increase your ability to maintain good posture. The height of your seat should be approximately the length of your tibia (the bone in your lower leg between the knee and ankle) so when you sit your knees bend at a 90-degree angle. The seat depth should allow approximately one to three inches of space between your knees and the edge of the chair. The width of the chair should be at least two inches wider than your buttocks so you have adequate support while working. A good chair is one that is referred to as ergonomic. The ergonomic chair will support your upper back (thorax), lower back (lumbar), sitting bones (ischial tuberosities), thigh area, the area behind the knees, and your feet. A well-designed chair with correct lumbar support ensures that the region from your thorax to your neck is straight and slightly forward. It will provide extra support to your lumbar region and help maintain the natural "S" curve of your spine. A properly contoured seat supports the ischial tuberosities, relieving upward pressure that may distort the tailbone curve, and it enhances support to the thighs. A sloping edge to the seat will increase contact with your thighs, reducing pressure behind the knees and ensuring proper blood circulation.

Proper seat height ensures your feet will be flat on the floor and reduce pressure on your knees and feet. The position of the patient and operator should provide maximal accessibility to the area of operation. Improper positioning and chair height will lead to premature tiring of the operator and diminishes his effectiveness. [2]

Proper positioning of the patient and the operator, illumination and retraction for optimal visibility are fundamental to proper dental treatment. The correct positioning of the operator is very important to help him to have a good visibility and accessibility of the oral cavity.

Dental operators have long battled the problem of musculoskeletal pain, which is usually caused by

maintaining poor posture during treatment. Because of the volume of patients that the dental operators have to treat, and the duration of the procedures, pain and discomfort are inevitable. When operators adjust in order to treat hard-to-reach places in a patient's mouth, often holding these positions for long periods of time, musculoskeletal pain can develop in the wrists, elbows, shoulders, back, neck, and even the hips. Studies have shown that anywhere from 60-90% of dental operators have experienced at least one source of musculoskeletal pain.

Over the course of a dental operator's career, this pain can lead to:

- Decreased career longevity
- Inability to treat more patients more frequently
- Increased pain and discomfort
- Absenteeism and medical leaves
- Seeking medical treatment and pharmaceutical remedies
- Possible disability

For the patient, a dental visit typically involves sitting in a reclined or even supine position, and the dentist often has to contort the body to perform the oral work. From a physical effort standpoint there are many similarities between the work of dentists and surgeons: both professions typically involve working in a standing posture, both require prolonged stooping over a reclined or supine patient, both must use a variety of hand tools in a delicate manner, and both occupy extended periods of time, typically less than an hour per patient for a dentist and often considerably longer than an hour for a surgeon. The kinds of posture-related musculoskeletal problems reported by dentists and surgeons are comparable to those found in other professions involved prolonged standing work in poor postures.

In the field of ergonomics applied in dentistry one of the most discussed theme is the working posture of the dentist. The special attention on this topic is explained by the widely recognized and accepted fact that posture is the key of preventing the musculoskeletal disorders. The meaning of the posture in ergonomics is the manner in which different parts of the body are located and thus the reports established between them in order to allow a special task execution. In dentistry, the working position represented by the spatial arrangement of the dentist's entire body around the patient must be distinguished. This differentiation is useful to understand the working conditions. The ideal posture of a dentist gives him on the one hand, optimal working conditions (access, visibility and control in the mouth) and on the other hand, physical and psychological comfort throughout the execution of the clinical acts. Preserving the balanced posture and its symmetry throughout the clinical act is largely conditioned by the relationship established between the dentist and the intraoral working field. In an ideal situation, the surface of the treated teeth should be parallel to the front of the dentist and his view oriented perpendicular to the working field. It is recommended that the distance between the working field and the dentist's eyes is of 35-40 cm or slightly higher for very tall dentists. When this relationship is not established or it is lost during the clinical act, the dentist's eyes will look for it and the dentist will depart instinctively from the balanced posture. To establish such a relationship, it is important to pay attention to the dentist's position around the patient and the patient's head position on the headrest. [3]

Musculoskeletal disorders result in loss of work efficiency among dental surgeons, and the prevalence and severity of these disorders decrease by adopting ergonomic interventions. 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.[4]

Musculoskeletal disorders come in a variety of forms:

Lower Back Pain

Between 70 and 90% of people have recurrent episodes of pain, and one-third of patients continue to have persistent, recurrent or intermittent pain after their first episode. In addi-tion 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).

The cause of LBP is often multifactorial but combined motions of lumbar flexion with rotation increase risk to the lumbar disk. This is further exacerbated by inflexibilities around the hips and pelvis as well as relative weakness of the

stabilizers of the lumbar spine, including the abdominal and gluteal muscles. Furthermore, back pain can exist due to abnormal postures, relative weakness and decreased endurance, and then exacerbated by a 'specific' injury.

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.

Probably, a more frequent cause of mid back pain is muscular pain from the postural muscles and scapular muscles. The contributions of abnormal posture, static postures, poor strength and endurance, and overall individual conditioning need to be taken into account.

A predominant cause of repetitive motion hand disorders is constant flexion and extension motions of the wrist and fingers. Chronic, repetitive movements of the hand and wrist, especially with the hand in 'pinch' position, seem to be the most detrimental. Other common contributing fac-tors 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. [5]

Using Sports Medicine approach, dentistry may be viewed as a profession much like a "sport." There is an abundance of dental surgeons with work-related pain and dysfunction. Dentistry poses a huge challenge because of the ergonomics of dental work. The biggest risk factors are the awkward prolonged seated postures with no back support and the limited range of motion and isometric muscle contraction created by working in a confined area, namely the mouth. The physiologic effects of these elements are patterns of muscle imbalance and neuromuscular inhibition causing dysfunction and/or pain. Advances in ergonomics continue to ease the physical challenges of the dental profession. Use of office ergonomics does not replace the basics of a body being physically conditioned. However, one must try to learn how to work around the various risk factors. The ultimate goal should be to prevent injuries and maintain the health of the dental surgeons by rehabilitative exercises. [6]

Four handed or close support dentistry involves the operator and dental nurse working as efficiently as possible whilst both maintaining correct posture. Essentially the dental nurse carries out as many non-operative tasks as possible while the patient is undergoing treatment.6 In its purest form, all the instruments are kept on the dental nurse's side who then passes them to the operator when they are needed. In theory the operator should not need to move their eyes from the patient's mouth, avoiding having to bend and twist to reach instruments. With practice the dental nurse should be able to anticipate which instruments are needed in the correct order so that treatment can proceed without any interruptions. This should enable treatment to proceed as efficiently as possible.

As well as being actively involved in instrument exchange the dental nurse also plays a big role in ensuring the operator has good vision by retracting tissues and aspirating. Not only does this improve the efficiency of treatment but it also promotes good posture in both the operator and the dental nurse.[7]

A recent book titled "Ergonomics and the Dental Care Worker" [8] describes results from several different surveys of dentists in Nebraska, South Carolina, Canada, Denmark, Poland and Norway, which consistently showed that around 40%-60% report cervical symptoms and low back pains. Using a mail questionnaire, the prevalence of subjective complaints among 54 male orthopedists and 63 male general surgeons was investigated. Respondents were asked about their subjective musculoskeletal complaints. On average the age of the surgeons was in the early 40's, and they had worked as surgeons for between 16 and 18 years. They worked an average 9.5-hour day. Results showed a higher prevalence of musculoskeletal complaints among the orthopedists than the general surgeons. Shoulders and lower back pain symptoms were the most frequently reported complaints, followed by neck problems. Together, research results show that back disorders are relatively commonplace among dentists and surgeons, and this problem relates to their working postures, equipment design and duration of working. Fortunately, there are steps that can be taken to minimize back problems.

Serbian researchers made a study on ten right handed dentists with mean age 33 ± 3.4 and minimum 3 years of work experience. 60% preferably performed in standing working position. They recorded activities of back, shoulder and neck muscles and inclination angles

of the back. EMG (electromyography) was used to record the descending part of the upper trapezius muscle bilaterally as well the flexor and extensor muscles of the right forearm. They concluded that in everyday practice, dentists are fully committed to their patients in order to provide them with adequate treatment. During dental work potential fatigue can occur. It is hard for dentists to be concentrated to fine, controlled dental work, and to maintain good balance and adequate working posture at the same time. That indicates that it is important for dentists to pay more attention to potential fatigue during work, and to alternate their postures in order to prevent an MSD. This study indicates that there is also a great opportunity for further research and improvement in this area. This is a posture study, and its results indicate a need for creation of a Holter system for dentists, which they can wear during work, with the ability for warning when the same risk position is assumed for too long. The Holter system could also be able to detect muscular loads during different dental procedures. [9]

During work, different muscle groups were used in the standing than in the sitting position [10]. In the standing position fatigue can occur in lower extremity muscles. However, the main parts of the body which are affected by pain during dental work are back, shoulder and neck muscles. Optimal working positions are still disputable and alternating between sitting and standing could be suggested. Static muscle activity during dental work is the factor with most influence on development of MSDs [11]. Many dentists have experienced musculoskeletal pain in their shoulders and neck, hands and wrists, low back, or forearms and elbows. Further 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 [12].

It is indispensable to change the tiresome working habits in the dental profession. According to Newell and Kumar [13], dentists can diminish the risk of developing MSDs by using suitable body posture and positioning during clinical procedures, integrating regular rest breaks, sustaining good general health, and carrying out exercises for the affected regions of the body. Furthermore, they emphasized that regular physical examinations of the dentists would provide more detailed information and early diagnosis of MSDs.

In different countries dentists reported having poor general health and suffer from various health related problems. In Romania, according to Stanciu et al. [14] for the subjects of their study associations between risk factor and musculoskeletal complaints are significantly revealed. The dentistry has always been known as uneasy occupation therefore one must take into account serious difficulties before attending course. First of all, students must be aware of the health risks in dentist's job. Talking about musculoskeletal disorders it might be assumed that knowledge in ergonomics may be of some use. Secondly, all sorts of protection must be used during treatment in order to prevent infectious diseases and other injuries.

Furthermore, dentists must be taught about coping with stress patterns. There are some points in preventing psychological discrepancies. To enjoy and be satisfied with their professional and personal lives, dentists must be aware of the importance to maintain good physical and mental health. Keys to success in preventing neck and shoulder injuries and pain include maintaining a neutral head posture, maintaining a neutral shoulder posture with the patient positioned at an appropriate height, developing muscle endurance, using indirect visions, taking frequent breaks and stretches. [15]

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