VOLUME - 11, ISSUE - 05, MAY - 2022 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Dental Science

ERGONOMICS IN DENTISTRY

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ABSTRACT Nature of the dental profession and postures assumed by dental surgeons during their professional work has an enormous effect on their body. Dentists nowadays are becoming more prone to musculoskeletal disorders. A well-adapted design of the workplace is a basic requirement for maintaining musculoskeletal health that will in turn enhance work efficiency. The present article discusses the various methods to stabilize the dental operatory to allow the operator to work with comfort, efficiency, and ease

KEYWORDS : Ergonomics ,Applications of ergonomics ,Musculoskeletal disorders.

Introduction

Ergonomics can be defined as an applied science concerned with structuring and organizing things commonly utilized by individuals with the goal that both people and things connect most efficiently and securely[1] improve job process by eliminating unnecessary tasks, steps & effort,Reduce potential for overexertion injury. Minimize mental/physical fatigue potential,Leverage workers 'skills/knowledge of their jobs to increase their satisfaction, comfort and fulfillment.

Consequences of poor design

Discomfort Chronic Pain Accidents Injuries Fatigue Increased Errors Work-Related Musculoskeletal Disorders (WMSDs): -Low back pain Tendonitis -Epicondylitis -Carpal tunnel syndrome(CTS) More than 70 percent of dental students of both sexes reported neck, shoulder and lower back pain by their third year of dental school. Present in up to 81% of dental operators. The common reason for early retirement among dentists is MSDs .[1]Risk factors contribute to MSDs: Prolonged use of vibrating hand tools. Static neck, back, and shoulder postures. Repetitive motions (e.g., scaling, polishing). Grasping small instruments for prolonged periods. Excessive Force (e.g. tooth extraction).

Application of ergonomics

Application of Ergonomics in Dentistry Instruments Hand instruments Vibrating handpieces Equipments Lighting magnification Operator and patient chair Work postures Patient position Dentist position.

Instruments Goals

It is to reduce force exertion while allowing for neutral joint positioning. Handle shape and size: -Dental instrument diameter ranges from 5.6 to 11.5 mm. -larger handle diameters reduce hand muscle load and pinch force. -Sleeves that fit over the handles of mirrors. -A round handle VS hexagon handle.

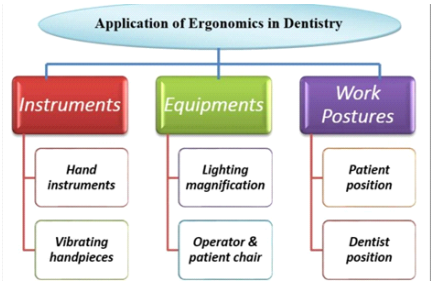

Figure-1

Weight

Light weight instruments (15 g or less). – Hollow VS Resin Balance: -The instrument should be equally balanced within the hand so that the tendency to deviate the wrist is reduced. Sharpness: -As a tool becomes dull, additional force is required to perform tasks. Texture: -Knurled handles such as diamond- shaped or crisscross patterns Color coded instruments are easier to be identified.

Dental hand piece

When selecting hand pieces, look for: Lightweight, balanced models (cordless preferred).

Sufficient power :Easy activation ,built in light sources Equipment layoutDental equipment should be located in a manner which allows you to maintain a neutral working posture and reduce postural deviation while working. Frequently used items: -"comfortable distance" (22–26 inches) -within a normal horizontal reach which is the arc created while sweeping the forearm when the upper arm is held at the side. Less frequently used items: - Should be placed within the maximal horizontal reach which created when the arm is fully extended.

Light

Goal: to produce even, shadow-free, color-corrected illumination concentrated on the operating field to also awkward working postures. Overhead light should be positioned as close as possible to the sight line. Hand mirrors to reflect the light intra orally. Use fiber optics in handpiece.

The light source should provide adequate illumination.A headlamp or fibre – optic light attached to a handpiece is recommended for operations involving the palate or deep cavities , uch as cysts or the antrum.

Magnification

Goal: to improve the neck posture and provide clear vision. Use of various magnification systems, dental professionals are able to increase their working distance and assume more of an upright body posture.

Operator chair

When working with a chair side dental assistant, the dentist should be able to complete an entire dental procedure without having to take his/her eyes or hands out of the operating field. Motions required exchanging instruments with the dental assistant should be confined to Class I, II and III movements. If the dentist frequently uses class IV and V motions, it is apparent that the .Dental team is not utilizing the principles of 4 – handed dentistry.

Classification of motion

Motions are classified into five categories from the simple to the more complex Patterns. Class 1 motions involve the movement of only fingers.

Class II motions involve movement of the fingers and wrist.

Class III motions involve movement of the fingers, wrist and elbow

Class IV motion involves movement of the entire arm from the shoulder. Class V motions involve movement of the arm and twisting of the body.

Class IV and V motions are fatiguing and time consuming. They require arm and body movement, re- focusing and re-accommodation of the eyes. Efficient Dentistry will require elimination of Class IV and V movements whenever possible. Applying the following principles of motion will conserve time, save Energy, increase production and reduce fatigue.

Patient position

SITTING POSTURE: Human spine has four natural curves; cervical lordosis, thoracic kyphosis, lumbar lordosis and sacral kyphosis When sitting unsupported frequent posture in dentistry the lumbar lordosis flattens. The bony infrastructure provides little support to the spine, which now is hanging on the muscles, ligaments and connective tissue at the back of the spine, causing tension in these structures. Lschemia can ensue, leading to low back strain and trigger points. Maintaining the cervical lordosis in the proper position is equally important . [10]

Forward-head postures are common among dentists, due to years of poor posture involving holding the neck and head in an unbalanced forward position to gain better visibility during treatment. In this posture, the vertebrae no longer can support the spine properly, and the muscles of the cervical and upper thoracic spine must contract constantly to support the weight of the head in the forward posture. This can result in a pain pattern, which often is referred to as tension neck syndrome. This syndrome can cause headaches and chronic pain in the neck, shoulders and inter- scapular muscles, and it occasionally can radiate pain into the arms. [10]

The best way to reduce pressure in the back is to be in a standing position. However, there are times when the dentist needs to sit. When sitting the main part of the body weight is transferred to the scat. Some weight is also transferred to the floor, back rest and arm rests. Where the weight is transferred is the key to a good seat design.

When working in sitting postures a chair is required to support the seat and back. In this situation one should alternate active and passive sitting postures. The active posture could be defined as the correct body posture that is maintained by the muscles of the back, the back being leaned forward. This posture cannot be maintained for a very long time. The passive posture is (he one in which the back is sustained by the dentists' back of the chair. [10]

Parameters of the correct working postures 1. The sitting posture is upright and symmetrical. 2. The shoulders hanging down relaxed with the upper arms beside the upper body. 3. The forearms have been lightly elevated. 4. The angle between lower and upper legs is approx. 105-110.

Figure-2

*Normal stool RGP straddle stool

3-Position and postures:

- **Patient position:** "Supine position" -The patient's heels should be slightly higher than the tip of the nose. This position maintains good blood flow to the head. -An apprehensive patient is more likely to faint if positioned with the head higher than the heels. -The chair back should be nearly parallel to the floor for maxillary treatment areas. (Chin up) -The chair back may be raised slightly for mandibular treatment areas. (Chin down) .Chair position when treating maxillary Arch Chair position when treating mandibular arch. [10]

- **Operator position**: Neutral position is the ideal positioning of the body while performing work activities and is associated with decreased risk of musculoskeletal injury

Neutral seated position in relation to patient
1. Forearms parallel to the floor.
2. Weight evenly balanced.
3. Thighs parallel to the floor and knees are apart.
4. Hip angle of 90°.
5. Seat height positioned low enough.
6. Shoulders relaxed & parallel with floor.
7. Eyes directed downward.
8. (14-16) inches distance should be between the patient's mouth & clinician's eyes.
9. Elbows close to sides.
10. Patient's mouth at elbow height. 3-Position and postures:

Some wrong Postures In Dental Office

Scheduling Recommendations when scheduling include:

Incorporate brief "stretch break" periods between patients. Develop a patient difficulty rating scale to ensure difficult treatment sessions are not performed consecutively. Increase treatment time for more difficult patients. Alternate heavy and light calculus patients throughout the day. Alternate procedures performed.

Four handed dentistry

Four-handed dentistry has been described as a practice in which the dentist and assistant work as a team to perform some operations planned with an intention to benefit the patient.[7] .It involves the use of a trained chair side assistant to work constantly with the dentist in performing the technical procedure during the course of any dental procedure in the dental setup.[8].Proper utilization of an extra pair of hands of the dental auxiliary in a four-handed dentistry setup is generally regarded as an ideal method of delivering dental services. To practice true four-handed dentistry, the following criteria must be met.[9]

- All equipment must be ergonomically designed
- The operating team and patient must be seated comfortably in ergonomically designed equipment
- Preset trays should be utilized
- The dentist should assign all legally delegable duties to qualified auxiliaries based on the state's guidelines
- The patient's treatment plan should be planned in advance in a logical sequence.

Zones of activity

The work area around the patient is basically divided into four zones called "zones of activity."[10] Zones of activity are identified using the patient's face as the face of a clock. The four zones of activity are as follows:

- Operator's zone
- Assistant's zone
- Transfer zone
- Static zone.

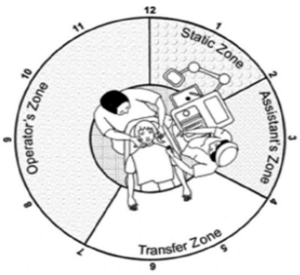

Figure-3

Four principles of work simplification

Basic Principles of Work Simplification3,4,5.Time management is an element of survival for the dental practitioners. Stress is a by-product of various pressures, created by a demand for increased productivity. To reduce stress, each team member must follow the methods that will simplify the work and reduce the fatigue.These principles can be applied in the dental office to simplify work and make a more comfortable working environment. All aspects of the dental practices should be analyzed by applying the following four principles of work simplification:[1]

1. Elimination: A 100% saving can be accomplished by elimination of unnecessary equipment, instruments, steps in procedures and movements.

2. Combination: If the functions performed by two instruments or pieces of equipment can be combined into one instrument or a piece of equipment, or if two steps in a procedure can be combined to accomplished in one step, a 50% saving can be realized.

3. Rearrangement: It may be possible to rearrange equipments and materials in the operatory, scheduling of patients, or steps in clinical procedures to take better advantage of available space and time.

4. Simplification: Every effort should be made to simplify dental office equipment and patient treatment procedures in order to introduce a minimum number of variables and permit the team to function most effectively.

Classification of motion

Motions are classified into five categories from the simple to the more complex patterns:- Class 1 motions involve the movement of only fingers.Class II motions involve movement of the fingers and wrist.

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Principles of motion

1. Use body motions requiring the least amount of time and energey.
2. Minimize the number of body motions.
3. Reduce the length of motions.
4. Smooth, continuous motions are preferable to zigzag jerky motions.
5. Minimize the number of eye fixations.
6. Design the work environment to accommodate natural and consistent movements.

Musculoskeletal Disorders

MSDs refer to a wide range of in ammatory
And degenerative disorders of muscles, Tendons, and nerves. These disorders can Result in pain and functional impairment Affecting many body parts such as the Neck, upper and lower back, shoulders, Elbows, wrists, and hands.[2]Hill et al. In 2010 reported MSDs to be one of the Most common and leading causes for early Retirement among dentists.[3]The prevalence of musculoskeletal pain in dentists ranges between 64% and 93% with the back and neck being the most affected regions.[4]MSDs affect areas such as the neck, back, Shoulder, elbow, wrist, and fingers. Early Symptoms include decreased strength, Pain, swelling, and numbness. Other Symptoms may include excessive fatigue In shoulders and neck, weak hand grip, And hypersensitivity in hands and fingers .Sustained awkward postures often lead to Stressed and shortened muscles which can become ischemic and exert asymmetrical [5].Forces causing misalignment of the spinal.Risk factors for musculoskeletal Disorders The risk factors for MSDs among dental Professionals include

- Prolonged awkward postures: Dental Personnel undertake awkward position to obtain an optimal view of the patient's teeth and to Coordinate the relative positions between himself and the assistant. An increased amount of stress is placed on the spinal disks when the back is bent or twisted. Furthermore, performing prolonged activities over the shoulder height can be stressful. In addition, the disc pressure increases rapidly when sitting in forwardly bent and rotated positions.Repetitive motions: fatigue and muscle strain can be caused if motions are repeated and that too for a prolonged period of time. The longer the period of Continuous work, the longer is the rest time period [5]

Required

inadequate lightning: compromised lightning in the Dental operatory can unintentionally lead to unnatural postures.

Implications of musculoskeletal disorders

MSDs can induce premature fatigue, pain, and a negative attitude toward work. The neck is the most commonly affected due to poorly designed workstations .Possible reasons for the same maybe due to improper vision to the patient's oral cavity. The operator has a tendency to bend into awkward positions, resulting into a deviation from the balanced posture. Furthermore, an incorrect neck position may radiate to the back thus leading to backache.[6]

Lower and upper back pain

Has also been reported by a large fraction of dentists. Lower back pain can be exacerbated by in around the hips and pelvis and relative weakness of abdominal and gluteal muscles. Constant and extension motions of the hand and wrist without any rest lead to mechanical Stress on the digital nerves. A proper ergonomically designed workplace can ensure abolishment of MSDs. [6]

Conclusion

Considering the impact of ergonomically designed and chosen equipment on the efficiency, One must modify the workplace to reduce the possibility of injuries. Among the various occupational hazards, MSDs are very much at the disposal of the clinician himself. Adopting newer techniques, armamentarium and work strategies can definitely prevent detrimental changes in the future.

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