ejpmr, 2018,5(7), 182-188

SJIF Impact Factor 4.897

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Review Article

ISSN 2394-3211

EJPMR

ERGONOMICS IN DENTAL PRACTICE : AN UPDATE

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Article Received on 25/04/2018 **Article Revised on 15/05/2018** **Article Accepted on 05/06/2018**

ABSTRACT

Occupation related diseases are increasing day by day and one amongst them is musculoskeletal disorders due to improper ergonomics in dentistry. These disorders can result in pain and dysfunction of the neck, back, legs and hands and fingers. Ergonomics is an applied science concerned with designing products and procedures for maximum efficiency and safety. 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.

KEYWORDS: Ergonomics, Carpal tunnel syndrome (CTD), Musculoskeletal disorders (MSD's), Magnification.

INTRODUCTION

Dental professionals are commonly exposed to a variety of occupational hazards such as chemical, biological and ergonomic which create musculoskeletal disorders. Dentists often have to limit or even abandon their professional activities and as a result, MSD has negative impact on either their finance and their healthy life. A healthy dentist is one of the most important component in a successful dental practice. Despite the fact, that though 88% of dentists report good or excellent health (Kupcinskas & Petrauskas, 2003), some studies show that one out of ten dentists reports having poor general health and three out of ten dentists report having poor physical state (Gorter et al, 2000).[1] Literature suggests that the prevalence of skeletal or muscular pain in dentists, dental hygienists and dental students ranges from 93% to 64%. The most prevalent regions for pain in dentists have been shown to be the back (36.3% - 60.1%) and neck (19.5- 80%).[2]

Recently, "Ergonomics" has become a popular term. The term has been used with most professions but increasingly in the dental profession. In Greek, "Ergo," means work and, "Nomos," means natural laws or systems. Ergonomics is a way to work smarter—not harder—by designing tools, equipment, work areas and tasks to fit the individual worker. It leads to improved productivity, reduced injuries, and greater worker satisfaction.(1) It takes account of the worker's capabilities and limitations to ensure that tasks, equipment, information and the environment suit each worker(2). The international ergonomic association defines ergonomics as, the scientific disciplines concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human wellbeing and overall system performance.

The term ergonomics was coined by British psychologist Hywelmurrel, at the 1949 meeting at the United Kingdom admiralty, which later led to the foundation of the ergonomic society.

Implications in Dentistry

Though the musculoskeletal disorders are common among medical professionals, it is more common among dentists and dental hygienists, because of prevalence of different postures in dental procedures, repeated work, prolonged stature, unsupported sitting and graping smaller and thin instruments for longer time. Limited access during dental procedures is also known to be the one of the reasons for causing musculoskeletal disorders.

Goals of Ergonomics Include

1. Prevention of work related musculoskeletal disorders and conditions which might lead to it
2. Increasing safety and productivity

3. Enhanced performance by eliminating unnecessary effort
4. Improving the standard of care to the patient

Musculoskeltal Disorders (MSD's)

The world health organization defines MSD as "a disorder of the muscles, tendons, joints, intervertebral discs, peripheral nerves and vascular system, not directly resulting from an acute or instantaneous event hut installing gradually and chronically." Cumulative trauma disorders (CTDs) are health disorders arising from repeated biomechanical stress to the hands, wrist, elbows, shoulders, neck and back.[3]

MSD's Classification[4]

1. Nerve Entrapment Disorders: carpal tunnel syndrome, ulnar neuropathy.
2. Occupational Disorders of the Neck and Brachial Plexus: tension neck syndrome, cervical spondylosis, cervical disc disease, brachial plexus compression.
3. Shoulder disorders: trapezius myalgia, rotator cuff tendonitis, rotator cuff tears, and adhesive capsulitis.
4. Tendonitis of the Elbow, Forearm and Wrist: deQuervain´s disease, tendonitis, tenosynovitis, epicondylitis
5. Hand-Arm Vibration Syndrome: Raynaud's disease.
6. Low Back Disorders: chronic low back pain

Some Risk Factors for MSDs[5,9]

1. Repetition
2. Forceful exertions
3. Awkward postures
4. Contact stress
5. Vibration
6. Poorly designed equipment workstation
7. Improper work habits
8. Genetics
9. Medical conditions
10. Poor fitness level
11. Physical/mental stress
12. Lack of rest/recovery
13. Poor nutrition
14. Environmental factors
15. Poor lighting

Fig. 1.

Work related musculoskeletal disorders affect soft tissues of the body in areas like the neck, back, shoulders, elbow, hands, wrist, and fingers. Symptoms of work related musculoskeletal disorders may progress in stages from mild to severe.

Early Stage: aching and tiredness of the affected limb occur during the work shift but disappears at night and during day off work. No reduction and tiredness in work performance.

Intermediate Stage: aching and tiredness occurs early in the work shift & persists at night. Reduced capacity for repetitive work.

Late Stage: aching, fatigue and weakness persists at rest. Inability to sleep.

Signs of MSDs[10]

1. Decreased range of motion
2. Loss of normal sensation
3. Decreased grip strength
4. Loss of normal movement
5. Loss of co-ordination

Symptoms of MSDs[10]

1. Excessive fatigue in the shoulders and neck
2. Tingling, burning sensation in arms
3. Weak grip. cramping of hands
4. Numbness in fingers and hands

5. Clumsiness and dropping of objects
6. Hypersensitivity in hands and fingers

Fig. 2.

Mechanisms Leading To Musculoskeletal Disorders (Msds) In Dentistry

1. Prolonged Static Postures (PSPs): Dentists frequently assume static postures, which require more than 50 percent of the body's muscles to contract to hold the body motionless while resisting gravity. 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.[11]

2. Muscle Imbalances: During treatment, operators should strive to maintain a neutral, balanced posture. Even with best ergonomic postures can find themselves in sustained awkward postures. With forward bending and repeated rotation of the head, neck and trunk to one side causing ischemia and pain, exerting asymmetrical forces that can cause misalignment of the spinal column and decreased range of motion.[11]

3. Muscle ischemia and necrosis: With the best working postures, dental operators still maintain static contractions of the trunk muscles. Any deviation from neutral position, the muscles contract harder to maintain a working posture. As muscles become fatigued, this prolonged contraction can cause muscle ischemia. Under normal conditions, damaged tissue is repaired during rest periods. In dentistry, however, the damage often exceeds the rate of repair due to insufficient rest periods. Muscle necrosis can occur.[11]

4. Hypomobile Joints: During periods of PSPs or when joints are restricted due to muscle contractions, synovial fluid production is reduced dramatically and joint hypomobility may result.[11]

5. Spinal Disc Herniation and Degeneration: In unsupported sitting, pressure in the lumbar spinal discs increases. During forward flexion and rotation, the pressure increases further and makes the spine & disc vulnerable to injury (Al Wazzan, et al 2001).[12]

6. Neck and Shoulder Injury: Repetitive neck movements and continuous arm and hand movements affecting the neck and shoulder demonstrate significant associations with neck MSDs.[12]

7. Carpal-Tunnel Syndrome (CTS): It has been associated with both repetitive work and forceful work. Symptoms can appear from any activity causing prolonged and increased pressure (passive or active) in the carpal canal.[13]

8. Low Back Pain: Low back discomfort has been associated with dental work in numerous studies.

9. Psychosocial Factors: Dentists with work-related MSDs show a significant tendency to be more dissatisfied at work. They are burdened by anxiety, poor psychosomatic health and thus feel less confident with their future.[13]

Guidelines To Prevent Work Related Musculoskeletal Disorders

1. Workstation

Workstation Layout: 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.[14,16]

Guidelines for workstation to be followed are[17]:

- 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.

Posture[18]

- Always try to maintain an erect posture
- Use an adjustable chair with lumbar, thoracic and arm support
- Work close to your body
- Minimize excessive wrist movements
- Avoid excessive finger movements
- Alternate work positions between sitting, standing and side of patient
- Adjust the height of your chair and the patient's chair to a comfortable level

- Consider horizontal patient positioning
- Check the placement of the adjustable light.

Patient Position[18]

- Supine position of patient is usually the effective way by which operator achieves neutral posture
- Stability should be looked for.
- Drop down arm rests
- Patient should be positioned in such a way that the patient's mouth should be only slightly above the dentists elbow level
- There should be supplemental wrist/forearm support for operator
- Articulating head rests should be provided
- Hands free operation
- Swivel feature–allows chair to rotate in the operatory
- Large knobs should be eliminated as they, disturb the position of operator by hitting the dental chair.

Rheostat Positioning

- Rheostat should be positioned so that the operator knee is about 90–100 degree angle.

Light Illumination[18]

- Main aim is to provide shadow free ,even operating field
- Light source placed directly above or slightly behind the patients head to provide ood illumination
- The intensity ratio between the dental operatory light and room lighting should be no greater than 3–4.6.

2. Early Treatment of MSDs[19]

Early symptoms in the wrist and hand respond to conservative medical management that includes rest, icing, nonsteroidal anti-inflammatory drugs and splints. Early intervention could be important in order to achieve a better result at less cost and inconvenience.

3. Selection of Instruments[18]

Tool/instrument design should be such that it reduces force exertion and maintains hand/wrist in neutral posture.

Considerations to be kept in mind are:
1. Overall shape/size
2. Handle shape/size
3. Weight
4. Balance
5. Maneuverability
6. Ease of operation
7. Ease of maintenance

While buying Hand instruments, look for:
1. Hollow or resin handles
2. Round, knurled or compressible handles
3. Carbon steel construction (for instruments with sharp edges)

While buying Automatic hand pieces for your operatory, look for:
1. Lightweight, balanced models (cordless preferred)
2. Sufficient power
3. Built-in light sources
4. Angled vs. Straight-shank
5. Pliable, lightweight hoses
6. Swivel mechanisms
7. Easy activation
8. Easy maintenance

In Syringes and dispensers, look for:
1. Adequate lumen size
2. Ease in cleaning
3. Knurled handles (no finger cut-outs)
4. Easy activation and placement

Hand Instruments

- Use Larger Diameter, balanced Instruments with hollow or resin handles: They increase tactile sensitivity and reduce clinician fatigue. Thin instruments are difficult to grasp and increase the chance of muscle cramping.
- Instrument sharpness: An instrument with a sharp blade will be less fatiguing to the clinician and contribute to the efficacy of work. Dull instruments require more force to be exerted.
- Handles should be textured to reduce slippage, but should not be contoured. Round, knurled handles are preferred.
- Grip design: Grip span should be curved and comfortably fit the palm of the hand (4"-5") (Osuna, RDH, BS, & FAADH, 2006).

Automatic Handpieces

• Lightweight, balanced models (cordless preferred)
• Sufficient power
• Built-in light sources
• Easy activation and maintenence

Introduction of rotary instrument also lead to improved speed, efficiency and productivity.

4. Magnification[20]

Magnification enables operators to maintain a greater working distance and position patients at the proper height, with the shoulders relaxed and the forearms approximately parallel with the floor. Operating telescopes or loupes arc available with flip-up or through-the-lens designs. Working in postures with greater than 20 degrees of neck flexion have been associated with increased neck pain. The declination angle of the scopes should allow you to maintain less than 20 degrees of neck flexion. There are three basic magnification systems available:
1. Single lens Loupes
2. Galilean Loupes
3. Prismatic Loupes

Other newest technologies in the field of magnification include heads up display that involves a camera that is placed over patient and projects image to a monitor.

Other newer technological advances like CEREC helps the dentists to design and create all ceramic inlays, inlays, crowns, veneers for all teeth in one visit, by utilising digital impression technique there by eliminating the need for time consuming procedures.

5. Work Practices/Methods

Four Handed Dentistry[21]

Method of practicing dentistry ergonomically by combing the skills of dental assistant with other work practices. The work area around the patient is divided into four zones of activity. Zones of activity are identified using the patient's face compared to face of a clock. The four zones are: the operator's zone, assistant's zone, transfer zone, and static zone.

The operator's zone for a right-handed operator extends from 7 to 12 o'clock, the assistant's zone from 2 to 4 o'clock, the instrument transfer zone from 4 to 7 o'clock, and the static zone from 12 to 2 o'clock.

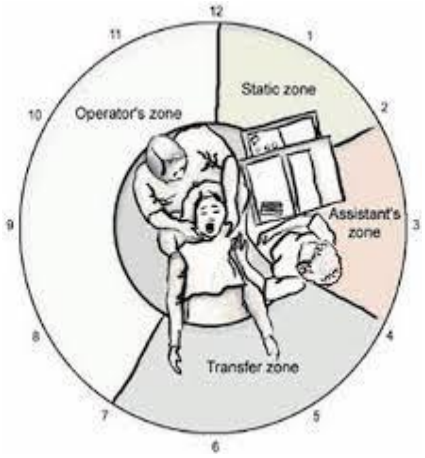

Fig 3

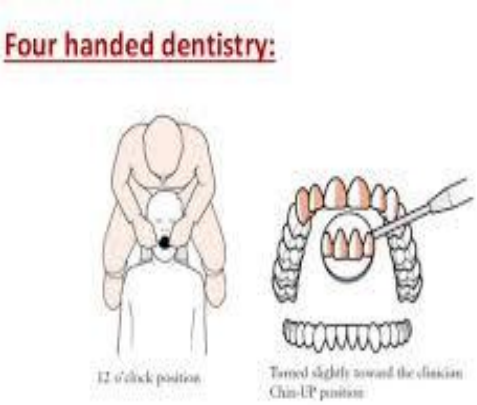

Fig 4

Instrument Transfer and Exchange[22]

Principles of Instrument Transfer

- The assistant must understand the sequence of the treatment procedure and anticipate when an instrument transfer will be required.
- The transfer of instruments should be accomplished with a minimum of motion involving only the fingers, wrist, and elbow.
- Instruments are transferred in the position of use.
- An instrument is transferred so the dentist can grasp the instrument for its appropriate use.
- The instrument being transferred must be positioned in the dentist's hand firmly.
- The assistant will transfer dental instruments and dental materials with his or her left hand (Banerjee, 2013).

Expanded–Function Dental Assistant

Expanded function refers to specific intraoral tasks that are completed as a procedure or part of a procedure by the clinical dental assistant that have been delegated by the dentist.

• Increased productivity
• Less stress on dentist
• More patients seen
• Increased job satisfaction

Quadrant Dentistry

Doctor time is maximized. Completing multiple restorations on one patient takes less time than doing the same number on multiple patients. It minimizes cost. There is less paid in non–productive employee wages, fewer disposable goods, and less impression material, etc., which leads to huge savings. It reduces office and doctor stress. Fewer patients equals less scheduling headaches, no–shows, and cancellations.

Gloves

Each dental healthcare worker must have gloves of proper size and fit. Although the influence of gloves on hand discomfort has yet to be explored, they have been cited indirectly as a potential contributor to carpal tunnel syndrome.

6. 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.

7. Scheduling

- Schedule Rest Breaks Between Patients
- Rotate Between Tasks
- Schedule Enough Time for Each Patient
- Switch Between Positions Throughout the Day

8. Exercise[23]

It is important to stabilize the low back curve by contracting the transverse abdominal muscles. To do this while sitting, sit tall with a slight curve in the low back, exhale, pull your navel toward the spine without letting the curve flatten. Continue breathing while holding the contraction for one breath cycle. Repeat five times. Strive to maintain this stabilization regularly throughout the workday.

Chair-side Directional Stretching: Having operators take frequent breaks andreverse their positions is integral in an effective injury prevention program. Directional stretches can he performed in or out of the operatory and can be incorporated into a daily routine that facilitates balanced musculoskeletal health. Directional stretching involves a rotation, side-bending or extension component that generally is in the opposite direction of that in which the operator frequently works. Various hand exercises need to be performed to reduce carpel tunnel syndrome. Frequent stretching breaks address the detrimental physiological changes that can develop while working in optimal or awkward prolonged static postures.

CONCLUSION

The successful application of ergonomics assures high productivity, avoidance of illnesses and injuries, andincreased satisfaction among workers. Unsuccessful application, on the other hand, can lead to work-related musculoskeletal disorders (WMSDs). Good ergonomic design of tools, processes and furniture DOES improve personnel comfort, health, morale, productivity and readiness. It is critical to seek prompt medical aid for symptoms of ergonomic stress/detect risk factors. So, take charge of your health and stay fit!

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