Review Article

DOI: 10.17354/ijss/2015/419

Ergonomics in Dentistry: An Ounce of Prevention is Better than Pounds of Cure: A Review

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Abstract

Ergonomics in an applied science concerned with designing products and procedures for maximum efficiency and safety. It is a scientific discipline that studies workers and their relationship to their occupational environment. Dentists and dental hygienists are at more risk for developing work-related musculoskeletal disorders (MSDs) as compared to general public because of their prolonged working hours and difficult postures. The most frequent injuries occur in spine, back, shoulders, elbows, and hands leading to many complex conditions such as Carpel tunnel syndrome, and sciatica. This paper is a review study of various studies and articles from around the world and identifies the potential risks and hazards of MSDs and discuss various methods to minimize such risks.

Key words: Dentist, Ergonomics, Musculoskeletal disorders, Occupational hazard

INTRODUCTION

Just over one in four of today's 20-year-old will become disabled before they retire.[1] While it is easy to imagine a carpenter falling off a roof or a farmer getting caught in a combine. The reality is many work-related injuries occur when the worker is simply sitting in an office chair or a dental stool.

In Greek, "Ergo" means work, and "Nomos" means natural law or systems. Ergonomics, therefore, is an applied science concerned with designing products and procedures for maximum efficiency and safety.[2]

Proper ergonomic design is necessary to prevent repetitive strain injuries, which can develop over time and lead to long-term disability. Ergonomics is concerned with the efficiency of persons in their working environment. It takes account of the worker's capabilities and limitations to ensure that task, equipment's, information, and the environment suit each worker.[3]

Musculoskeletal disorder (MSD) can affect the body's muscle, joints, tendons, ligaments, and nerves. They are caused by work itself or by working environment. It has been noted that back pain is most common followed by neck pain and shoulder pain.[4] If early signs and symptoms are noted, with the understanding of mechanisms of progression of disease, MSDs can be prevented at a much larger scale.

Aims and Objectives

This review aims at:

- To identify potential risk of MSDs in dental office amongst all concerned personnel
- To discuss various preventive methods and remedies for problems arising due to poor ergonomics.

MSDs

Symptoms of MSDs[5]:

1. Excess fatigue in the shoulder and neck
2. Tingling, burning sensation in arms
3. Weak grip

Access this article online

IJSS

www.ijss-sn.com

Month of Submission : 07-2015
Month of Peer Review : 08-2015
Month of Acceptance : 08-2015
Month of Publishing : 09-2015

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

Signs of MSDs[5]:
1. Decreased range of motion
2. Loss of normal sensations
3. Decreased grip strength
4. Loss of normal movement
5. Loss of coordination.

Risk factors leading to MSDs[5]:
- Repetitions
- Forceful exertions
- Awkward postures
- Contact stress
- Vibration
- Genetics
- Poor lighting.

Mechanisms involved in MSDs:
- Prolonged state postures
- Muscle ischemia/Necrosis[6]
- Hypomobile joints
- Spinal disc herniation and degeneration[6]
- Neck and shoulder injury
- Carpal tunnel syndrome[7]
- Lower back pain.

According to a survey done by Sharma *et al* amongst the Indian Dentists revealed that 23% Dentists do not seek treatment after diagnosis of MSDs and up to 5% dentists do not seek medical advice on appearance of symptoms of MSDs.[8]

PREVENTION

MSD can be prevented to a very large extent if care and precautions are taken during work.

Seating: Continued seating results in inactivation of upper and lower erectus spinae muscle and contributes to greater lower back compressive loading in lumber spine.[9] Dental stool must be at correct height, offer optimum arm, and elbow support, be stable with five casters and stable base and offer neutral back, neck shoulder support.

Saddle style stools (Figure 1)[10] helps avoid transfer of pressure to the posterior thighs and maintains the lumbar curve of the lower back by placing pelvis in a more neutral position.

Arm support during procedures (Figure 2)[10] helps in giving rest to wrists and arms during procedure and prevents carpel tunnel syndrome.[7]

Magnification and procedure scopes: These devices can help the clinician prevent from gradually tilting his or her hand and leaning forward toward the patient (Figure 3).[11,14]

Microscopes: Using a microscope lets the clinician focus the eyes specifically on operating field. There is no need

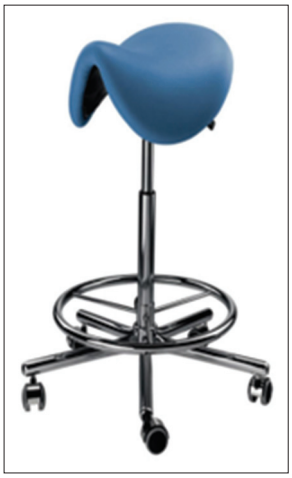

Figure 1: Saddle style stool

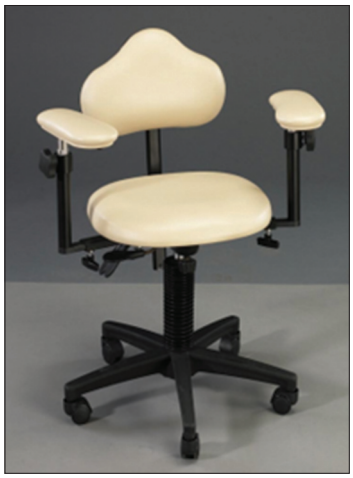

Figure 2: Stool with arm rests

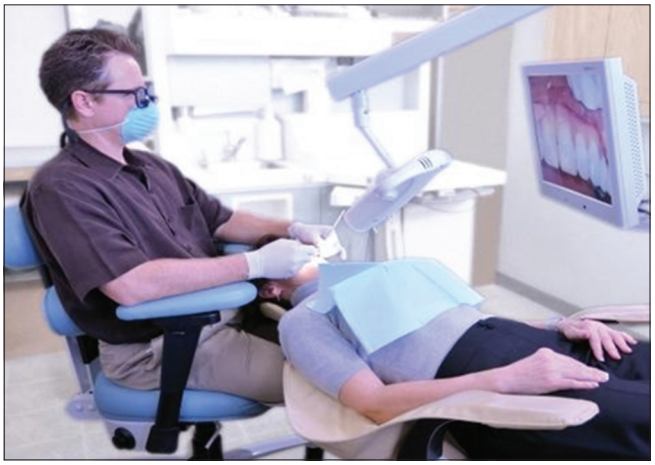

Figure 3: Magnification scope

to flex the neck, upper spine, and lower back to improve visibility (Figure 4).[12]

Dental loupes: Most frequent used. They offer ×2-5 magnification. They do not allow more than 25° forward tilting of the head.[10] Loupes are of two types – flip Up loupes (Figure 5),[13] they can be flipped during procedure but are bulky and need to be realigned frequently.

The other variety is fixed loupes (Figure 6), they are lighter and give a wider field vision.

Selection of instruments: The instrument must reduce exertion of force and maintain hand and wrist in neutral position. Ergonomic guidelines for instrumentation are:[11]

For hand instruments:

- Hollow or resin handles
- Round, knuckled, or compressible handles
- Carbon steel construction.

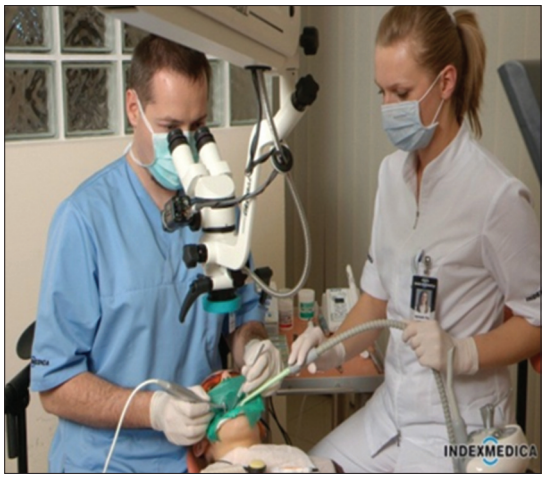

Figure 4: Microscope

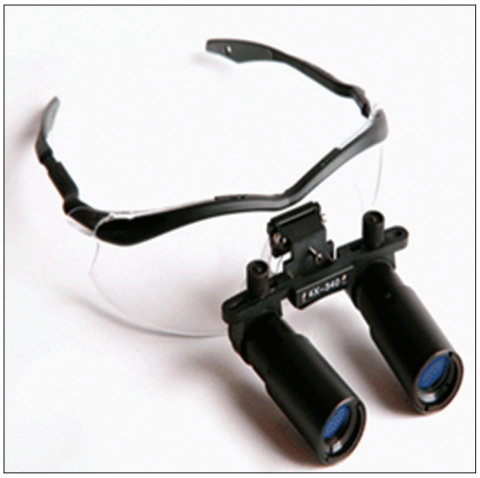

Figure 5: Flip up loupes

For automatic handpieces:

- Lightweight
- Sufficient power
- Built in light source
- Swivel mechanisms
- Easy activation
- Easy maintenance.

For syringes and dispensers

- Adequate lumen size
- Ease in cleaning
- Knurled handles
- Easy activation and placement.

Rheostat positioning: The rheostat must be placed close to the operator or that the knee is at about 90-100° angle. If placed outside this zone, the operator must shift weight to one side leading to asymmetric stresses on the back.[11]

Exercises: The importance of exercises cannot be overstated in the prevention of MSDs. The workout should not require any special equipment, should not be technically difficult to master and should be of short duration. Three most common used exercises are:[11]

- The Un-Twister (Figure 7)[11]

  Legs in tripod position
  ↓
  Rest left elbow on left knee
  ↓
  Stretch arm overhead toward ceiling
  ↓
  Hold for 2-3 breath cycles, repeat

- Trunk Rotation (Figure 8)[11]

  Sit tall, cross right leg over left leg
  ↓
  Place left forearm on right thigh and turn trunk to right
  ↓
  Hold and repeat

- The Reversal (Figure 9)[11]

  Support wrists on hips and slowly lean backward
  ↓
  Do not overextend the head
  ↓
  Hold and repeat

Weight control: For additional 10 pounds of weight we carry, 100 pound of force is generated to lower back.

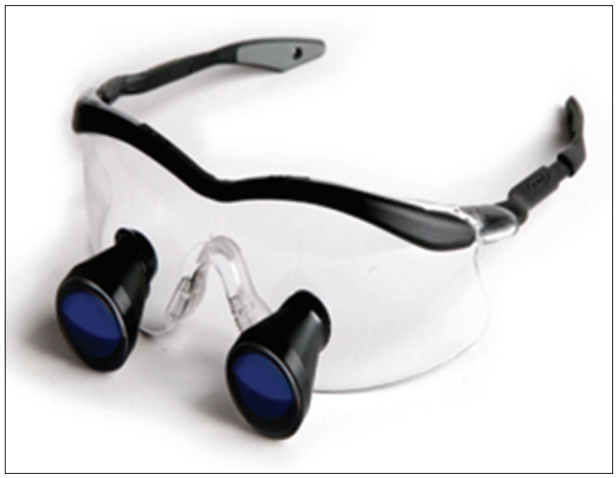

Figure 6: Fixed loupes

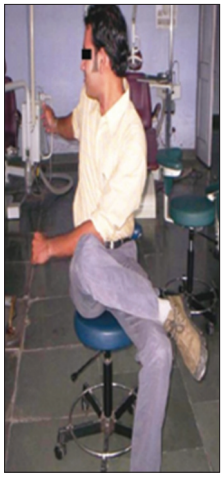

Figure 8: Trunk rotation

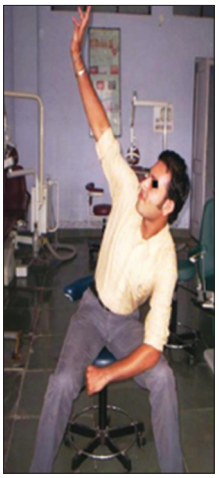

Figure 7: The untwister

Figure 9: The reversal

Dentist micro breaks: The operator can take a break to do stretching while the assistant light cures or mixes cements, etc.

DISCUSSION

Dental professionals are amongst the most targeted group for MSD because of their long procedural working hours and awkward postures. Development of disorders ranging from a simple sprain to carpel tunnel syndrome can be seen amongst clinicians.[15] More awareness about good ergonomics in necessary for better health of dentists. A study was done by Kanteshwari *et al.* showed only 50% of the respondents were aware about ergonomics[16] and 59.6% in another study done by Gopinadh *et al.*[17] These statistics clearly demonstrate the need for awareness regarding ergonomics.

Many other factors like a constant vibration in the handpiece, lighting of workplace, shape of stool, micro breaks, etc. affect the efficiency of the Dentist. Åkesson *et al.* in their study[18] noted that practice of four-handed dentistry proved to be significant in reducing stress which was supported by Finkbeiner.[19,20] In a study done by Lund, he appreciated the need for optimum temperature and lighting of the workplace for better ergonomics.[21]

The successful application of ergonomics assures high productivity and avoidance of illnesses and injuries. Unsuccessful application on the other hand can lead to work-related MSD. It is critical to seek prompt medical care for symptoms of ergonomic stress/detect risk factors.

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How to cite this article: Rajvanshi H, Anshul K, Mali M, Sarin S, Zaidi I, Kumar VR. Ergonomics in Dentistry: An Ounce of Prevention is Better than Pounds of Cure: A Review. Int J Sci Stud 2015;3(6):183-187.

Source of Support: Nil, **Conflict of Interest:** None declared.