



Review Article

“Magnification in Dental Ergonomics – A Comprehensive Review”

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ABSTRACT

Work related health hazard in dental professionals is increasing rapidly nowadays in all specialty of dentistry. Among various known disorders, musculoskeletal disorder is the most prevailing among dentists all over the world and more so in developing countries. Prolonged inappropriate postures can lead to cervical and spinal pain resulting in reduced efficiency of the clinician. Various guidelines and measurers have been introduced time to time to improve the working pattern but still it hasn't been tackled appropriately. To overcome the problem of musculoskeletal disorder, fruitful application of ergonomics in the form of various magnifying loupes should be introduced aiming to reduce the illness and injury of muscles and increased satisfaction and better efficacy amongst dental clinicians.

INTRODUCTION

Work related musculoskeletal disorders (MSDs) mainly refer to those muscular and skeletal illness where the working environment contributes significantly by longer working duration, improper postural position, or presence of risk factors. Nowadays these illness in dental care professionals and its team has raised substantially. Work place risk factors comprises of task requiring repetitive, forceful or prolonged exertions of hands, use of vibratory instruments such as ultrasonic scalers and hand pieces, gripping and handling of instruments in repetitive motions.<sup>[1]</sup> MSDs in dental profession are multifactorial for example improper positioning of both patient and clinician, awkward postures of clinician in order to have proper visibility and accessibility, forceful repetitive strokes of hand instruments etc. These conditions involve mainly the lumbar and cervical spines, and upper limbs. Study conducted by Alexopolus concluded that neck and shoulder pain is also strongly affiliated with the physical work load of dentists.<sup>[2]</sup> Systematic review conducted by Plessas has concluded that greater the number of patients seen for a longer duration of working hours, more is the risk of developing MSD complaints involving neck, shoulder, back and wrists among dentists.<sup>[3]</sup> Apart from work, psychological factors such as job

satisfaction, anxiety of work, balance between work and other situations are also responsible to be associated with MSDs. Therefore it becomes clear that dentists in near future are at higher risk of developing MSDs and directly going to impact the career of dental professionals. To prevent or minimize MSDs, role of ergonomics in the recent decades have been introduced. Dental ergonomics is defined by the European Society of Dental Ergonomics as the adaptation of the working environment and methods to the dentist and his or her team, with respect to their physical and psychological capacity for a healthy, safe and comfortable functioning in their professional activity.<sup>[4]</sup> An excellent ergonomics is essential in dental profession to boost up the working capacity, efficiency and achieve gain in treatment level throughout the working life. Also it assures for avoidance of illness and injury and increased satisfaction among dentists. The main objective of ergonomic interventions in dentistry is to prevent the occurrence of MSDs since they are difficult to treat once they occur and tend to recur if same work patterns are continued for longer period of time. Diniz and Diniz in 2017 have formulated standards and guidelines for dentist to follow to minimize work related hazards.<sup>[5]</sup> Recently Sachdeva have also done a comprehensive review on dental ergonomics and measures

to be taken to reduce MSDs.<sup>[6]</sup> But most of the studies on dental ergonomics emphasizes on operator's position, four handed dentistry and zone of activity but only few studies so far discusses on magnifying the working area. Visibility and accessibility is the main reason for most of cervical and lumber spine discomfort, which can be overcome up to great extent by use of magnifying loupes. Since recently various reviews have been conducted on all other factors responsible for better ergonomics but we have focused on varied MSDs particularly affecting dentists to a greater extent nowadays and the benefits of magnifications in the field of dentistry. The purpose of this paper is to discuss the role of magnifying loupes as an ergonomic intervention to overcome the problems of MSDs with its clinical importance.

### Prevalence Rate of MSDs among Dentists

In a recent systematic literature review and meta-analysis prevalence rate of MSDs among dental professionals ranged from 10.8% to 97.9%, among which neck affected mostly with 58.5%, lower back 56.4%, shoulder 31.1% and upper back with 41.1%.<sup>[7]</sup> However still there is paucity of literature showing the interrelationship between operator and MSDs in developing countries where such disorders many a times remain unreported.

### TYPES OF MSDs

According to World Health Organization, musculoskeletal disorder is defined as "disorder of muscles, tendons, peripheral nerves or vascular system which is not directly resulting from an acute or instantaneous event (eg. slips or falls). These disorders are considered to be work-related when the work environment contributes significantly to the causation.<sup>[8]</sup> Moreover they are not limited to any specific area of the body but can involve any muscle, tendon, nerve etc. of human body. Nevertheless, in dental profession they mainly involve neck, shoulder, lower back and wrist (38-82%).<sup>[9]</sup>

MSDs can occur in various forms incorporating different parts of the body-

### LOWER AND UPPER BACK PROBLEMS

More than half population of the dentist nowadays is suffering from recurrent episodes or intermittent pain of lower back region. It is mainly due to frequent motions of lumbar flexion with rotational increase risk to the lumbar disk. Along with this factor, degenerative changes are taking place simultaneously with age and the dentists are not minimizing their risk factors while working which makes the condition more detrimental. Lower back pain is relatively more common than upper back pain. Upper back pain is reported by few individuals and is mainly muscular involving postural and scapular muscles due to awkward and static posture for longer duration.

### HAND AND WRIST PROBLEMS

The mechanical vibrations produced by some dental equipment like ultrasonic scalers and hand pieces result in chronic

extrinsic compression of the nerves in the hand and wrist which seems to be most detrimental.

### RISK FACTORS FOR MSDS

Research continues to identify the risk factors as it is quite complex and multi-faceted problem. Though the mechanisms of MSDs are still poorly understood, however following risk factors are highlighted which may contribute to the onset of MSDs.

#### a) Physical Factors

Various researches have presented strong evidence to support the relationship between dentists work exposures to repetitive forceful exertions, awkward posture for longer duration and vibration of ultrasonic scalers and hand pieces with MSDs of neck, shoulder and back pain.<sup>[10]</sup> Dentists use awkward postures to gain accessibility in posterior region or contralateral sites in indirect vision leading to spinal strain and excessive muscular stretch. Work that requires forceful exertions like tooth extraction or gripping of instruments between thumb and index finger forcefully for stain and calculus removal or cavity preparation may locate higher amount of the work load on the muscles, tendons, ligaments and joints and therefore leads to MSDs. Visual acuity is also a problem with aging dentists. Therefore contribution of physical factors to cause MSDs is well documented.<sup>[11]</sup>

#### b) Dentists Specific and Demographic Factors

Dentists who are having higher body mass index, previous history of upper and lower pain along with carpal tunnel syndrome, preexisting systemic conditions can just have additive effect to the incidence of MSDs, however the evidences are very less.<sup>[12]</sup> Demographic factors like age, sex, marital status etc. along with pre disposing factors like smoking, weight, physical fitness have found no association with MSDs in spite of few contradiction that back pain are more prevalent in younger dentist.<sup>[13]</sup> Also few studies concluded that female dentist are more affected than male dentist, but still it remains elusive. Even the occurrence of MSDs in dental practitioners varied accordingly by their own preferences of sitting or standing position of practice, use of assistants, number of working hour per day, intensity of work done etc.<sup>[14]</sup>

#### c) Psychological Stress Factors

Nowadays dentist also reports of having stresses which can be categorized on the basis of their internal work environment, external work environment or on the individual nature of the operator. Stress under internal work environment relates to the demands of doing their task in dental office with little or no time gap, performing meticulous surgery with pressure for longer duration, having anxiety before start of their work, poor communication skill with patients and lack of confidence towards their work creates unlikely stress on the dentist mind. Stress under external work environment relates the role of dentist outside with their parents, children,

relatives, friends and their duties towards them which also put psychological pressure at times. Increasing evidence to suggest relationship between psychological stress and MSDs involving different parts of body exists.<sup>[15]</sup>

### Ergonomic Interventions to Overcome MSDs

Most of the studies have discussed on preventing MSDs by identifying their risk factors first and then follow the recommended strategy. Valchi and Valchi described several ergonomic interventions to prevent MSDs which is helping many of the dentist to overcome the symptoms of muscle imbalance, tenderness, pain etc. and these rising interventions should be followed seriously to substantially reduce MSDs among dentists.<sup>[16]</sup> Leitz in their systematic review included various ergonomic intervention to prevent MSDs among dental professionals as ergonomic dental chair, magnification loupes, prismatic spectacles, dental instruments and training courses in ergonomics.<sup>[17]</sup> However there always remains a requirement for more interventional study to be implemented, so that long term approach can be adopted in preventing MSDs across all fields of dentistry. Modern technological development across all over the country are introducing new equipments in dental profession for the ease and betterment of the dentist work, and among them magnifying loupes is one of the innovation in the field of dentistry. Usage of magnifying loupes have revolutionized the dental practice, and it became an evolution from the conventional method of macrodentistry to a high precision microdentistry. Inadequate use of magnifying loupes is creating unawareness among the dentist to come across its benefits in preventing MSDs. Therefore usage of loupes is often promoted as an ergonomic solution to prevent MSDs.

### Principles of Magnifying Loupes to be used as Intervention for MSDs

As we all are aware that in the field of dentistry high level of visual acuity, especially for near vision plays an important attribute to the clinician work, this gets improved by the use of magnification devices such as magnifying loupes that helps the clinicians to have precision in their diagnosis and treatment approach. In terms of ergonomics it is allowing the dentist to work in comfort zone with proper posture, reducing the eye strain and reducing the chair side time as well.

Steps used in magnification are as follows-

#### Field of View

With increase in magnification, the field of view gets decreased. Too high magnifications are unsuitable for routine procedure, but at times it is helpful to perform any specific surgical procedure. Normally magnification of 2x–2.5x is used in dental practice and also recommended for new users.

#### Depth of Field

The depth of field refers to the ability of the loupes to focus on both near and far field of interest without changing the position of the dentist. Thereby with the increase in magni-

fication, the depth of field decreases and mainly focus on to the defined area of work and rest everything is out of focus. At high magnification, slight movements of the clinician or the patient will lead to loss of focus of area under treatment, and will make the work more difficult.

#### Declination (Viewing) Angle

The shallower the viewing angle, greater the need for the dentist to tilt the neck and view the object. It is ergonomically important to make sure that this angle is correct for the dentist in order to minimize strain on the neck, back and shoulders.

### ERGONOMICS BENEFITS OF LOUPES IN MSDS

Burton and Bridgeman in there study focused on the working distance between the clinician and field of interest and implemented that by using loupes, the working distance can be kept at a comfortable constant position securing upright posture of the dentist throughout the working life of the dental practitioner which will help them to work without bending or tilting their head and neck and thereby preventing MSDs.<sup>[18]</sup> An Australian survey suggested that dental hygienists who wear loupes are less likely to have any neck and shoulder, wrist/hand, or upper back pain than those not wearing loupes.<sup>[19]</sup> Based on available research data, majority of loupe manufacturers also advise their clients to invest in fibre-optic light added to loupes to increase visual acuity and to prevent extensive neck flexion or shoulder uplifting.<sup>[20,21]</sup> Reports from the findings of qualitative research at Vancouver Community College in British Columbia have provided ergonomic benefits of loupes in diminishing neck and back problems, improved vision and reducing eye fatigue.<sup>[22]</sup> Magnification of loupes maintain the axis of the eye in horizontal plane in order to avoid disorientation whereas focal distance is easily achieved by moving the patient in vertical plane thereby the clinician maintain an ideal posture. Using magnifying loupes, the field of vision becomes so clear that gripping of the instruments for longer period of time is avoidable, instrument is well adapted as per the need of the clinician with proper strokes that will prevent the resultant carpal tunnel syndrome. Studies have demonstrated that appropriate selection, adjustment and the use of magnification loupes facilitate the dentist to maintain upright posture thereby preventing back pain. Plessas A (2018) systematic review where the role of ergonomic saddle seats and magnification loupes in preventing MSDs are analyzed in which four studies on loupes as intervention are mentioned, improving the quality of dental care professionals and dental students in terms of working posture, pace of work that ultimately results in accuracy of diagnosis and detection.<sup>[3]</sup> However a recent systematic literature, Leitz J (2020) reviewed the same subject including five studies, of which three based on magnification loupes effective in improving working posture and interestingly two on prismatic spectacles that significantly reduce neck and shouder pain in dental personnel.<sup>[17]</sup>

In addition, implementing the concept of using magnification loupes early in dental education programs can significantly improve student's posture during dental work along

with improving their accuracy and quality of work. Therefore, beneficial ergonomic aspect of magnification may be the most influential factors in its adoption by the dental profession at large scale.

### CLINICAL RELEVANCE

MSDs can lead to exhaustion on the well-being, working satisfaction and finances of the dental clinicians and team. Therefore adoption of magnifying loupes as an ergonomic solution for poor posture and musculoskeletal pain is being implemented in daily clinical practice for dental professional. Microsurgery shouldn't be seen as an independent discipline but as an integral part of all field of dentistry. Despite the positive results by Cortellini & Tonetti in 2001,<sup>[23]</sup> and Rubinstein & Kim 2002,<sup>[24]</sup> and so on, the surgical microscope was very slowly accepted in prosthodontics, then endodontics and then in periodontology. Possible reasons can be long acquainting time, technical difficulties and its high cost.<sup>[25]</sup> Magnifying loupes can be a better alternative which do not have any of these difficulties. They are easy to use and much cheaper than surgical microscopes.

### CONCLUSION

Use of magnifying loupes to overcome the problem of musculoskeletal disorders have provided better ergonomics in terms of correct posture, better vision, good command on instrumentation, lesser chair side time that is going to help dentist for present as well as future perspective. Magnification can help the dentist to create more precise, more healthful, and more esthetically pleasing dentistry. In general all the dental procedures must be done under magnification to avoid any MSDs in future. Further studies should be conducted to generate data across the globe to compare the data with and without magnification to make it compulsory in dentistry.

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