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IP Indian Journal of Conservative and Endodontics

Journal homepage: <https://www.ijce.in/>

## Review Article

## Beyond the chairside: A narrative review of ergonomic practices in dentistry for preventing work-related musculoskeletal disorders

Abrar Sayed<sup>1</sup>, Wendy M V Lobo<sup>1\*</sup>, Akshaya S Kadam<sup>2</sup>, Kishor Sapkale<sup>1</sup>,  
Manoj Ramugade<sup>1</sup>, David C Baker<sup>3</sup>

<sup>1</sup>Dept. of Conservative Dentistry and Endodontics, Government Dental College and Hospital, Mumbai, Maharashtra, India

<sup>2</sup>Dept. of Microdentistry, Government Dental College and Hospital, Mumbai, Maharashtra, India

<sup>3</sup>Simplyendo LLP, Formby College, Liverpool, United Kingdom



## ARTICLE INFO

## Article history:

Received 16-12-2023

Accepted 06-02-2024

Available online 20-03-2024

## Keywords:

Workrelated musculoskeletal disorders (WMSDs)

ergonomics

Cumulative Trauma Disorders (CTDs)

Repetitive Motion Injuries (RMIs)

## ABSTRACT

Work-related musculoskeletal disorders (WMSDs) refer to conditions significantly influenced or exacerbated by the work environment. Reports of WMSDs among dental professionals have increased, with specific risk factors including stress, poor flexibility, improper positioning, infrequent breaks, repetitive movements, weak postural muscles, prolonged awkward postures, and equipment mis-adjustment. Ergonomics, focusing on designing jobs and workplaces to fit workers, plays a pivotal role in preventing long-term disabilities arising from repetitive strain injuries. This article explores the prevalence, risk elements and strategies dedicated to preventing WMSDs in dental operatory settings.

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### 1. Introduction

Ergonomics, derived from the Greek word “ergon” meaning work and “nomos” meaning natural laws, is the science of tailoring job settings to suit the worker. The term “ergonomics” originated in 1857, with Hywel Murrell officially coining the term in 1949, leading to the establishment of The Ergonomics Society.<sup>1</sup> The International Ergonomics Association defines ergonomics as the application of theory, principles, data, and methods, ensuring the enhancement of human well-being and overall system performance.<sup>1</sup>

In dentistry, proper ergonomics is crucial for optimal patient care as it has been noted that dentists are prone to musculoskeletal disorders owing to prolonged use of dental instruments that lead to fatigue and chronic pain.<sup>2</sup> The precise manipulation of hand instruments demands intricate

coordination of various muscles, with prolonged use posing the risk of fatigue and underscoring the importance of ergonomic considerations to prevent conditions such as Carpal Tunnel Syndrome.<sup>3</sup>

The aim of this narrative study is to comprehensively explore the relationship between ergonomics and musculoskeletal disorders (MSDs) in dentists, with a focus on understanding the impact of ergonomic practices on the occurrence, prevention and management of MSDs in dental professionals.

### 2. Work- Related Musculoskeletal Disorders

Work-related musculoskeletal disorders (WMSDs) in dentistry, stemming from repetitive and static tasks, result in issues like neck, shoulder, back, and wrist problems. These disorders are known as Cumulative Trauma Disorders (CTDs) or Repetitive Motion Injuries (RMIs) and rank as the second leading global cause of disability. Dental professionals face a higher prevalence due to the challenges

\* Corresponding author.

E-mail address: [wenlobo96@gmail.com](mailto:wenlobo96@gmail.com) (W. M. V. Lobo).

of confined spaces and inflexible postures.

Figure 1 gives an overview of the risk elements leading to Musculo-skeletal disorders.

### 3. Extent of Ergonomic Injuries

CTS, marked by the compression of the median nerve within the carpal tunnel, has been associated with tasks involving both repetitive and forceful movements. The manifestation of CTS symptoms is linked to activities exerting prolonged pressure within the carpal canal.<sup>4,5</sup>

Among the prevalent CTDs, Carpal Tunnel Syndrome (CTS) and Low Back Pain stand out, with back injuries constituting approximately 24% of all workplace injuries.<sup>5</sup> Notably, lower back pain, a leading cause of occupational and domestic disability, affects 1 in 7 individuals in the general population and an alarming 1 in 2 dentists.<sup>5</sup>

In 1995, Liss et al. identified predictors for Carpal Tunnel Syndrome (CTS) among dental hygienists as well due to factors such as performing oral prophylaxis in patients with heavy calculus, the "clock" position around the dental chair, and years in practice. The study emphasized the need for hygienist education on musculoskeletal issues, highlighting recommendations for workstation design, posture, patient management, and scheduled rest periods.<sup>4,6</sup>

Burke et al., 1997, highlighted the significance of WMSDs as a leading cause for early retirement in dentistry. Recent years have witnessed an uptick in reported WMSDs among dental personnel, attributed to various risk factors.<sup>7–12</sup>

In August 2009, Hayes, Cockrell, and Smith reported a 64%-93% musculoskeletal pain prevalence among dental professionals.<sup>10,11</sup> Dentists commonly experienced back (36.3-60.1%) and neck pain (19.8-85%), while dental hygienists reported hand and wrist pain (60-69.5%).<sup>12</sup> A 2011 Poland survey found over 92% of dentists experiencing musculoskeletal disorders, particularly in the neck (47%) and lower back (35%), with other issues in fingers (29%), hip (23%), midback (20%), and shoulders (20%). Wrist pain was reported by 18.3%, and knees, feet, or elbows by 15-16%.<sup>13,14</sup>

In March 2013, Gopinadh et al. found 73.9% of dentists reported musculoskeletal pain, mainly in the neck and back. Over 59% were aware of ergonomic posture. Pain increased with age and working time, with prosthodontics showing higher prevalence.<sup>15</sup> In May 2016, Batham and Yasobant reported over 92% of Bhopal dentists experienced pain, primarily in the neck, lower back, and wrists. Many orthodontists and oral surgeons linked their MSDs to work-related factors.<sup>16</sup>

A comprehensive understanding of these issues is pivotal for effective preventive measures and the promotion of health-centric workplace designs across diverse industries, with ongoing research focusing on identifying risk factors and proposing targeted intervention.

### 4. Implementation of Ergonomics in Dentistry

Figure 2 gives an overview of the methods that can be undertaken to implement ergonomic practices in dentistry.

#### 4.1. Workstation layout

An ergonomic layout for a dentist is crucial to promote comfort, reduce the risk of musculoskeletal disorders (MSDs), and enhance efficiency. Here are key considerations:

#### 4.2. Dental chair and patient positioning

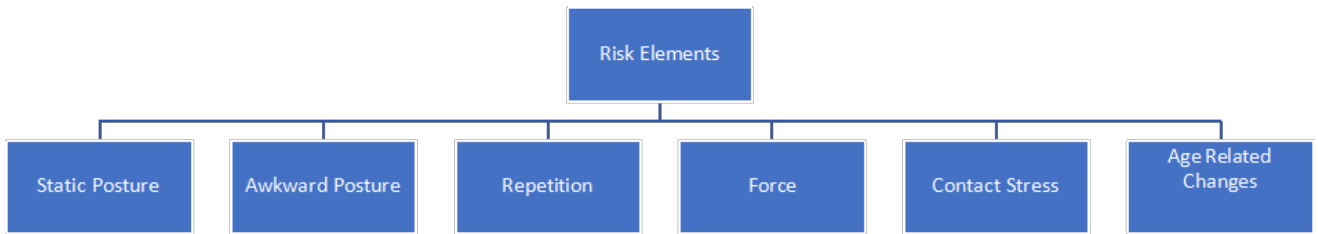
A well-designed dental chair, equipped with adjustable features, plays a pivotal role in accommodating the dentist's preferred working height, promoting a neutral and comfortable posture during procedures and reducing the risk of occupational strain. Concurrently, strategic patient positioning is a critical consideration, with the dental chair configured to provide optimal access to the oral cavity. This intentional alignment not only facilitates precise examinations and treatments but also minimizes the need for uncomfortable postures, contributing to heightened procedural accuracy. The harmonious interplay between the adjustable dental chair and thoughtful patient positioning is central to fostering an ergonomic environment. This approach not only prioritizes the well-being of dental professionals but also enhances the overall patient experience.

#### 4.3. Operator tool

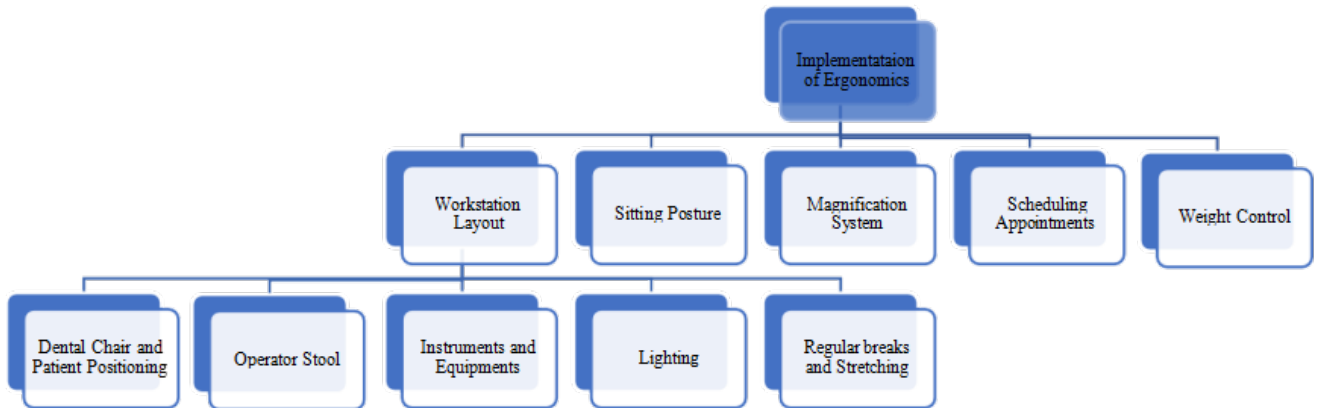
In dental ergonomics, the operator stool is pivotal for the workspace, impacting the comfort of dental professionals. Designed to support proper posture, ergonomic operator stools feature adjustable height, lumbar support, and a swivel base. This ensures a balanced foundation during prolonged procedures, minimizing fatigue and the risk of injuries. These stools contribute to overall efficiency by enabling a neutral posture and customization to individual preferences.

#### 4.4. Instrument tray and equipment

In the context of dental ergonomics, meticulous consideration of the layout of instrument trays and equipment is paramount. By strategically organizing instrument trays according to tool usage frequency, procedures become more streamlined, minimizing unnecessary movements and mitigating the potential for musculoskeletal strain among dental professionals. Furthermore, the intentional positioning of dental equipment—embracing adjustable chairs, effective lighting, and well-placed monitors—creates a workspace that not only maximizes efficiency but also prioritizes comfort. Additionally, advancements in technology have led to the



**Figure 1:** Risk Elements Leading to The Musculoskeletal Disorders



**Figure 2:** Implementation of ergonomics in dentistry

development of electric and air-driven handpieces, which can reduce vibration and noise levels, further contributing to a more comfortable and ergonomic work environment. This ergonomic approach not only reduces physical strain but also optimizes the overall workflow, contributing to the well-being and performance of dental practitioners.

#### 4.5. Lighting

Use adjustable and focused lighting to reduce eye strain and ensure proper visibility during procedures. Effective lighting is essential for ergonomic design in dentistry, ensuring optimal visibility and preventing eye strain. Strategically positioning adjustable task lighting is crucial for precise work, particularly in restorative and cosmetic procedures, while neutral or cool white light is preferred for accurate colour perception. Providing personalized, adjustable lighting options for dental professionals supports a comfortable and efficient workspace, promoting overall well-being and clinical performance. Regular eye examinations and awareness of lighting ergonomics are key to maintaining visual health in the dental setting. Top of Form

#### 4.6. Regular breaks and stretching

In dental ergonomics, incorporating short breaks and targeted stretches between appointments is crucial to counteract the strain of prolonged static postures. These

practices not only enhance flexibility and circulation but, when coupled with ergonomic workstation design and adjustable seating, contribute to a more comfortable and supportive environment, ultimately overall well-being and sustained focus.

#### 4.7. Sitting posture

Sitting with thighs parallel to the floor exacerbates the issue, rolling the pelvis backward and increasing muscle strain and disc pressure. Sloping thighs downward maintain the natural low back curve, reducing muscle strain and alleviating low back pain. To reduce disk pressure in the lumbar spine, critical support involves backward-inclining seat back and lumbar support. Optimal pressure occurs with a 120-degree backrest inclination and a 5 cm lumbar support, ensuring a supportive chain design.

#### 4.8. Magnification system

It has a main goal of enhancing neck posture and clarity in dental procedures. Traditional scopes necessitate a 20-degree forward head bend, causing low back discomfort. In contrast, procedure scopes with 0-degree forward head bending and an external camera projecting images onto an LCD screen offer better ergonomics.<sup>17</sup>

#### 4.9. Scheduling appointments

The primary goal is to provide ample recovery time for staff, mitigating the risk of chronic muscular fatigue. Several strategies can be employed to achieve this objective. Firstly, extending treatment time for more challenging patients allows practitioners to pace themselves effectively. Varying procedures within the same appointment minimizes repetitive strain on specific muscle groups. Additionally, shortening patient recall intervals contributes to a balanced workload.

#### 4.10. Weight control

Low back pain and weak postural muscles are induced by excess weight. For each additional 10 pounds of weight, 100 pounds of force is generated to the low back.<sup>17</sup> The significance of weight control for operators extends beyond aesthetics—it directly impacts occupational health. Sustaining a healthy weight is pivotal in preventing musculoskeletal issues and minimizing the risk of workplace injuries among dental professionals. Excess body weight can contribute to fatigue during extended procedures and heighten strain on the spine, shoulders, and neck, influencing overall posture. By prioritizing regular exercise, maintaining proper nutrition, and managing weight effectively, dental practitioners not only enhance their well-being but also reduce the likelihood of chronic health conditions, promoting sustained professional performance and quality patient care.

#### 4.11. Endurance strengthening

Dentists should prioritize enhancing the endurance of specific trunk stabilizing muscles to prevent low back pain. These muscles include the transverse abdominus (whose contraction is linked to reduced pain levels), erector spinae (crucial for back extension, especially in unsupported sitting), internal oblique (responsible for upper trunk movement), external oblique (engaged in lower trunk movement), and quadratus lumborum (facilitating side bending). Strengthening these muscles can be achieved through exercises with readily available Swiss balls.<sup>17</sup>

#### 4.12. Dental personnel training

Training stands acknowledged as a fundamental component of any successful safety and health initiative. Within a realm of ergonomics, the overarching objective of training is to empower managers, supervisors, and employees to pinpoint elements within job tasks that could elevate the risk of work-related Musculoskeletal Disorders (MSDs). This includes fostering the ability to recognize signs and symptoms associated with these disorders and fostering participation in the formulation of strategies to manage or prevent them. Employee training serves to ensure a

comprehensive understanding of potential hazards, enabling active engagement in the identification and mitigation of workplace exposures. Top of Form

### 5. Discussion

The escalating trends of musculoskeletal disorders (MSDs) in dentists represent a growing concern within the profession. The demanding nature of dental work, characterized by intricate and precise procedures, prolonged static postures, and repetitive movements, contributes significantly to the increasing incidence of MSDs. The upward trajectory of MSDs in dentists is likely influenced by several factors, including the intensification of clinical workloads, advancements in dental technology requiring prolonged screen time, and inadequate attention to ergonomic practices in the dental workplace. As the profession continues to evolve, addressing the increasing trends of MSDs in dentists necessitates a proactive approach.

### 6. Conclusion

This review emphasizes the multifactorial nature of the issue, urging the development of new educational models for dental operators. It highlights the high prevalence of MSDs among dentists and offers strategies for implementing good ergonomics in the field, encompassing redesigned workstations, improved physical conditions, and targeted training courses.

### 7. Source of Funding

None.

### 8. Conflict of Interest

None.


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## Author biography


**Abrar Sayed**, Professor and Head

**Wendy M V Lobo**, Assistant Professor  <https://orcid.org/0000-0003-1894-0634>

**Akshaya S Kadam**, Student of Fellowship in Microdentistry  <https://orcid.org/0009-0000-4983-3458>

**Kishor Sap kale**, Associate Professor  <https://orcid.org/0000-0001-8675-3836>

**Manoj Ramugade**, Associate Professor  <https://orcid.org/0000-0001-9543-6867>

**David C Baker**, Tutor  <https://orcid.org/0009-0007-7379-8649>

**Cite this article:** Sayed A, Lobo WMV, Kadam AS, Sap kale K, Ramugade M, Baker DC. Beyond the chairside: A narrative review of ergonomic practices in dentistry for preventing work-related musculoskeletal disorders. *IP Indian J Conserv Endod* 2024;9(1):15-19.