



## The Use of Magnification and Work Posture in Dentistry – A Literature Review

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### Authors' contributions

This work was carried out in collaboration between both authors. Authors DW and PPNSG designed the study, wrote the protocol and wrote the first draft of the manuscript. Author DW managed the literature searches and gathered all information. Both authors read and approved the final manuscript.

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### ABSTRACT

**Background:** Loupes represent a type of magnification and their use can promote higher quality on dental treatment. Besides those advantages magnification can be beneficial for musculoskeletal health maintenance on dental professionals.

**Aim:** This study intends to review the literature in order to verify what has been studied regarding the influence of magnification on work posture of dentists.

**Methods:** 41 manuscripts were collected and only complete articles available in English, addressing magnification loupes in general Dentistry, were included (n=28).

**Conclusion:** Magnification contributes to the maintenance of ergonomic work posture in dentistry, once these lenses bring the operatory field closer to professional.

*Keywords:* Magnification loupes; ergonomic; dentistry; work posture.

## 1. INTRODUCTION

Loupes represent a type of magnification and their use can promote higher quality dental treatment [1-4]. Consequently, they have been used in many different dental specialties such as Restorative dentistry, where they increase the accuracy in the detection of cracks in dentin [5], improve incipient caries identification [2,6-12], help in cavity preparations and contribute to restorative decision-making [6]. In Prosthodontics, magnifying loupes improve visualization of finishing single-crown preparations [1], while in Orthodontics they allow evaluation of enamel damages after treatment [4,13]. In Endodontics, they facilitate visualization of surgical and non-surgical procedures [2,14-15], in Periodontics they increase accuracy of probe readings [16] and, finally, in interdisciplinary areas, they promote higher aesthetic quality of dental materials [17].

Dental professionals get very close to the patient's mouth [18,19-20], due to the limited operatory field and high visual demand required in dental treatment [21,18,22,23]. These movements result in body inclination, neck and spinal torsion and in hunched shoulders [20,24]. This deviation of neutral posture can cause midterm and long-term musculoskeletal disorders [21,25-30].

Thus, magnification can bring ergonomical advantages regarding work posture, once the visual field enlarged by the lenses can be an important element for maintaining ergonomic work posture in dental professionals. Nevertheless, there are few studies in literature which verify the influence of amplification of the operatory field on work posture in dentistry.

Thus, this study aims to review the literature in order to verify what has been studied regarding the influence of magnification and the work posture of dentists.

## 2. METHODS

The literature review was gathered from the following directories: Science Science Direct, SCIELO (Scientific Electronic Library Online), and MEDLINE (National Library of Medicine, USA), dating from 1980 until the present day.

The research was conducted toward magnification on dental work. The main keywords were "magnification", "ergonomics", "dentistry", "loupes", "work posture" and "microscope". 41 manuscripts were collected. The inclusion criteria was only complete articles available in English, addressing magnification loupes in general dentistry, resulting in 28 articles.

## 3. RESULTS

It was possible to verify that the publications that first addressed the use of magnification loupes in Dentistry date back to 1984 [14] (Table 1), and most of them are based on literature reviews, case reports and professional opinions (n = 28). Most of them (n = 17) address somewhat ergonomic aspects, however, few studies have scientifically confirmed the relation between the usage of the device and work posture (n = 3). Further studies were based on the benefits of magnification exclusively in clinical application. (n = 10).

## 4. DISCUSSION

The occupational problems in Dentistry are highly related to the large incidence of musculoskeletal disorders [31,32]. Most interventions aim to decrease their incidence focusing on educational ergonomics and training programs [33]. However, others strategies can be useful in order for professionals to adopt the correct ergonomic posture. Among them, magnification can be highlighted [26,34].

This study found that the ergonomic benefits of magnification have been addressed in scientific literature [1-4,15-16,26,35-38,34,39-43]. Shanalec [15] and Juggins [4] noticed that the use of loupes requires a minimal work distance between the operator's eyes and patient's mouth, which is compatible with the neutral posture of the spine and neck, contributing to the preservation of musculoskeletal health [14,16,21,35,-40,41,44,45]. Additionally, other advantages such as increased comfort and lower incidence of pain, especially in the spinal region, are observed [2-3,16,24,26,35,38,42-43].

Those advantages, related to ergonomics, were based primarily on daily clinical experiences, expert opinions and on case report [1-4,14-15,24,26,35,39,43].

**Table 1. Scientific studies regarding magnification in dentistry**

<b>Authors</b>	<b>Study aims</b>	<b>Conclusions</b>	<b>Ergonomical approach</b>	<b>Clinical Approach</b>
Coburn [14]	Describe the importance of using magnification for dentistry	Dentists need to be aware of optical correction for operating postures	No.	Restorations, aesthetic, orthodontics, endodontics and surgical procedures.
Shanalec [15]	Describe the optical principles of loupes.	Loupes should be correctly adjusted for optimum application in dentistry.	The increase of work distance.	Prosthodontics, endodontics and periodontics.
Whitehead [6]	Investigate the influence of the use of a magnification device on decision-making behavior regarding intact and restored premolar and permanent molar teeth.	The use of magnification may exert a considerable influence on restorative decision-making behavior.	No.	Restorative diagnosis.
Strassler et al. [35]	Discuss enhanced visualization promoted by a magnification device in dental practice.	The authors recommend the use of a binocular loupe, once it allows better work distance, field of view and improved posture.	Posture and comfort enhancement.	No.
Forgie et al. [26]	Quantify the level of magnification, determining its use in general dental practice.	In Scotland, magnification was found to be used by few dentists and the routine users considered the aid useful for a larger range of clinical procedures.	Magnification led to better work posture.	No.
Christensen [1]	Answer some questions about magnification based on scientific information and personal experiences.	Working under magnification is useful, and clinicians should adopt this concept	Existence of positive relation between magnification and posture, once focal distance is well adjusted.	Cavities and prosthodontics preparations, evaluation of oral hygiene
Slaton et al. [5]	Evaluate the effectiveness of visual enhancement devices in identifying artificially created cracks in dentin at root end.	A trend of improved accuracy for each examiner with increasing magnification, although, the sensitivity, specificity and accuracy were lower than expected.	No.	Detection of cracks in dentin.
Branson et al. [36]	Assess the effect of magnification lenses on	The posture of dental students was more	Scientific study. Positive relation	No.

<b>Authors</b>	<b>Study aims</b>	<b>Conclusions</b>	<b>Ergonomical approach</b>	<b>Clinical Approach</b>
	the posture of dental hygiene students.	adequate when they wore magnification lenses	between posture and magnification	
Friedman [2]	Discuss magnification in restorative dental practice	Using the appropriate visual enhancement makes the dental practice more precise and easier and reduces the risk of musculoskeletal injury.	Positive contribution to spinal health.	No.
Sunell et al. [3]	Explore the evidences about use of surgical magnification in dentistry.	The integration of surgical magnification may maintain the musculoskeletal health of dental hygienists.	Contribution to spinal support.	No.
Juggins [4]	Discuss the principles of magnification, its advantages, disadvantages in orthodontic use and products available on the market.	The use of magnification in orthodontics must be considered, once it improves clinical practice.	Existence of positive relation between magnification and posture, because of work distance.	Orthodontics.
Maillet et al. [37]	Investigate if using magnification loupes improve dental hygiene students' posture during provision of treatment.	A significant postural benefit was found, they suggest to implement the early use of magnification loupes within the curriculum.	Scientific study. Positive relation between posture and magnification.	No.
Meraner and Nase [38]	Evaluate the experience of a dental school regarding magnification and assess its value on dental procedures.	The educators may be slow to accept magnification as a standard for practicing dentistry.	Reduction of musculoskeletal stress	Procedures which require fine motor skill.
Valachi [34]	A review about different magnification devices and their contributions to occupational health in dentistry.	When properly utilized, magnification can significantly improve posture and help prevent numerous musculoskeletal disorders.	Positive relation between magnification and posture.	No.
Branson et al. [39]	Observe the experience of a dentist during an adaptation period with magnification.	The use of the magnification loupe improved the dentist's posture.	A case study. It found a positive relation between magnification and posture.	No.
James and Glimour [40]	Address the issues surrounding the use of loupes in routine clinical practice.	The use of magnification devices requires a period of adaptation. The importance of correct	Ensure correct posture.	No.

<b>Authors</b>	<b>Study aims</b>	<b>Conclusions</b>	<b>Ergonomical approach</b>	<b>Clinical Approach</b>
		adjustments should be considered in order to avoid eyestrain. The authors advise more studies before the recommendation of loupes.		
Baumann et al. [13]	Evaluate the influence of wearing dental loupes on enamel damage during the orthodontic debonding procedure.	Dental loupes affect the quality of the debonding procedure, resulting in less enamel damage and composite residue	No.	Orthodontics.
Maggio et al. [46]	Assess the effect of magnification loupes on psychomotor skills during preclinical procedures.	The magnification enhanced the performance during preclinical procedures.	No.	Cavity preparations.
Hoerler et al. [47]	Evaluate the effect of magnification lenses on the indirect vision skills of dental hygiene students.	No significant data to support that the use of magnification increases the indirect vision skills among dental hygiene students.	No.	Scaling and periodontal probing
Congdon et al. [16]	Determine policies and practices regarding magnification loupes among faculty and students.	Most respondents reported advantages to loupes, but clinical policies do not appear to correlate with their beliefs.	Reduction of musculoskeletal pain.	Restorations and periodontal probing.
Mitropoulos et al. [48]	Compare the power of magnification on the detection of occlusal caries by ICDAS criteria.	Magnification didn't improve the performance on detecting occlusal caries.	No.	Caries diagnosis.
Mamoun [49]	Describe the use of high magnification on prophylaxes procedures.	Magnification allows dentists to make intelligent inferences about where calculus is located on subgingival surfaces.	No.	Prophylaxes procedures.
Mamoun [10]	Describe the use of high magnification on preparing and restoring with composite resin.	Magnification improves the ability to detect and remove caries, and to restore direct composite restorations.	No.	Cavity preparations and restorations.
Dable et al. [41]	Assess the hazards caused by inappropriate work posture of dental students.	The use of the ergonomic saddle stool could maintain the natural curvature of the lower back and magnification brings a	Scientific study. Positive relation between posture and magnification.	No.

Authors	Study aims	Conclusions	Ergonomical approach	Clinical Approach
		Clearer view closer to the operator.		
Hayes et al. [42]	Explore the effect of wearing loupes on upper extremity musculoskeletal disorders among dentists.	The use of loupes presented no improvements.	Decreases musculoskeletal pain.	No.
Sisodia and Manjunath [11]	Assess the impact of low magnification level on detecting incipient caries based on the ICDAS criteria and on restorative decision-making.	The loupes were associated to higher specificity of caries detection. The low magnification level allows reliable incipient caries detection.	No.	Diagnosis of caries.
Narula et al. [43]	Assess the effect of dental magnification loupes on psychomotor skills, during operative procedures.	Magnifying loupes improved hand dexterity while preparing tooth for restoration.	Positive relation between magnification and posture.	Cavity preparations.

It is worth mentioning that not many studies confirm the influence of magnification on musculoskeletal health based on scientific evidence [36-37,41]. Branson et al. [36] and Mailet et al. [37], using the same methodology, evaluated the effect of magnification loupes on the posture of dental students. Those magnification loupes promoted an increase of x2.6 and x2.5, respectively. In both studies, the work posture was evaluated by the "Posture Assessment Instrument" (PAI) method [50]. The results showed that the work posture was more adequate when the individuals were using magnification loupes ( $p=0.19$  e  $p<0.01$ , respectively). Due to this, these authors recommended the early implementation of the devices in order to decrease the risk of the development of musculoskeletal disorders.

Dable et al. [41] performed a study with dental students, which associated magnification to a new design concept of dental stool. The loupes used promoted x1.7, x2.0, 2.5 and x3.5 of increase. All postures were evaluated by the Rappid Upper Limb Assessment (RULA) [51]. The authors emphasized that the use of furniture, which promotes the spine's natural curvature, in addition to increased vision endorsed by magnification loupes, results in significant improvement of work posture ( $p<0.01$ ). The authors suggested that the early intervention

must be implemented, providing more long-term benefits to these professionals.

Despite Branson et al. [36], Mailet et al. [37] and Dable et al. [41] have stated the positive influence of loupes on the work posture, Hayes et al. [42] highlights that the inappropriate use of loupes can impair the sense of position, orientation and movement of the head and neck, resulting in the aggravation of musculoskeletal symptoms and eyestrain [1,7]. Therefore in order to ergonomical benefits with magnification, a previous training program must occur [1,8,17,26,40,43,44]. This program should be based on the learning of physical principles such as depth of focus and field of view, which allow professionals to make the correct adjustments, according to the procedure performed [7,15,52-53].

In this review study, we could observe that only 3 studies evaluated the influence of magnification on work posture in dental students based on different methods. Therefore, further studies should be performed in order to confirm the positive effect of loupes on work posture, such as evaluation of the influence of different kinds of loupes (with different weights) on presence of pain and discomfort in neck and back, the assessment psychomotor skills while using magnification and qualitative studies about perception of magnification's users.

## 5. CONCLUSION

This study concluded that magnification contributes to the maintenance of ergonomic work posture in dentistry, once these lenses bring the operatory field closer to professional.

## CONSENT

It is not applicable.

## ETHICAL

It is not applicable.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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