

Impact of Dental Loupe Usage on Professional Quality of Life Among Dental Practitioners Performing Nonsurgical Root Canal Treatment: A Cross-Sectional Study

Abstract:

Background: Successful nonsurgical root canal treatment requires adequate visualization, procedural precision, and ergonomic efficiency. Dental practitioners performing endodontic procedures are frequently exposed to prolonged static posture, visual strain, and work-related musculoskeletal discomfort. Dental loupes have increasingly been incorporated into contemporary dental practice because of their ability to improve visualization and operator ergonomics.

Aim: To evaluate the effect of dental loupe usage on the professional quality of life of dental practitioners performing nonsurgical root canal treatment, with emphasis on physical, psychological, procedural, and financial aspects.

Materials and Methods: A cross-sectional questionnaire-based study was conducted among 200 dental practitioners, including general dentists and endodontists involved in nonsurgical root canal treatment. A structured questionnaire adapted from the WHOQOL-BREF instrument was used to evaluate physical, psychological, procedural, and financial parameters. Data were analysed using SPSS version 23.0. Descriptive statistics, independent unpaired t-test, and one-way ANOVA were applied. A p-value of less than 0.05 was considered statistically significant.

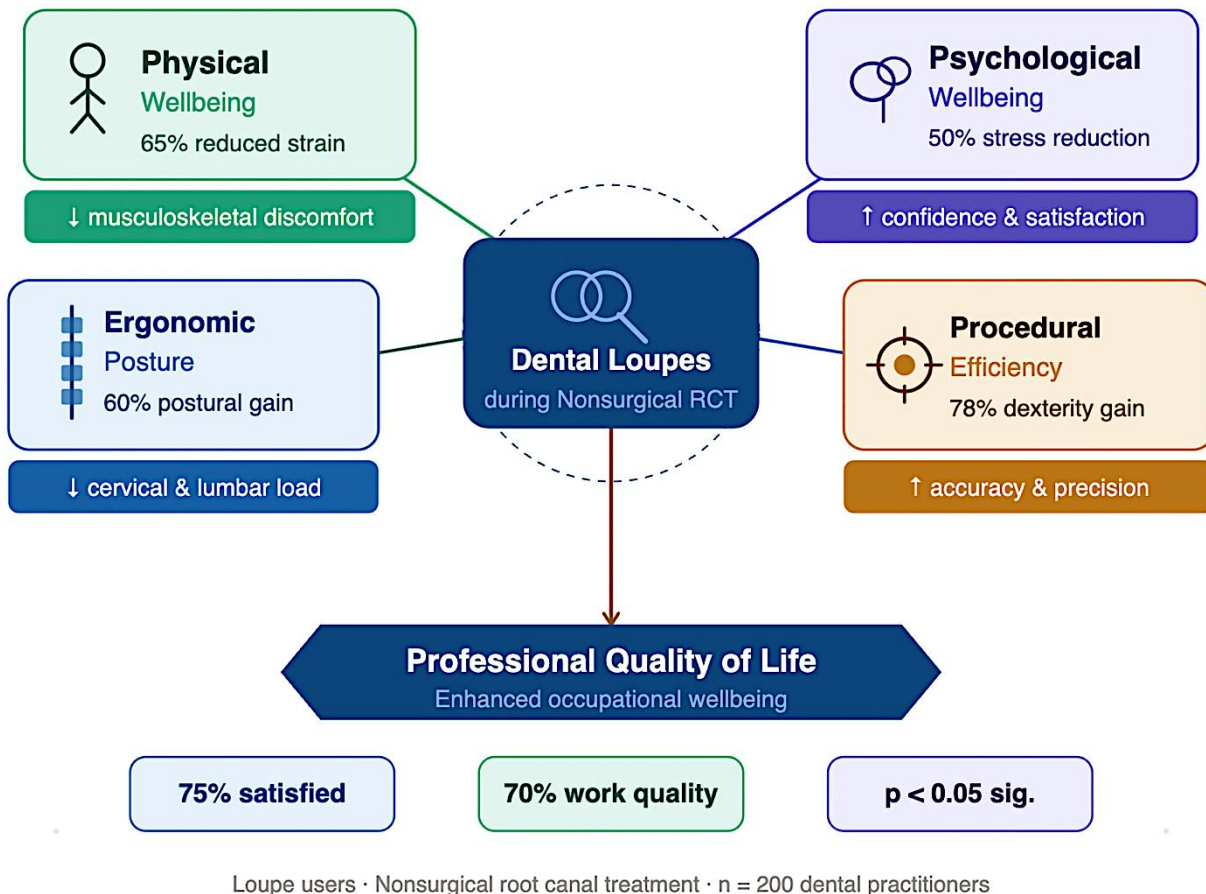
Results: A majority of practitioners reported improved manual dexterity, enhanced procedural efficiency, and better quality of work with dental loupes. Reduction in physical, postural, and psychological stress was observed among magnification users. Significant associations were found between years of clinical practice and dental loupe importance, satisfaction, procedural efficiency, and expense-related perception ($p < 0.05$).

Conclusion: Dental loupe usage demonstrated a positive influence on the professional quality of life of dental practitioners performing nonsurgical root canal treatment. Magnification-assisted practice improved visualization, procedural precision, ergonomic posture, and occupational comfort while reducing physical and psychological strain.

Keywords:-

Dental loupes; Endodontics; Ergonomics; Magnification-assisted dentistry; Musculoskeletal disorders; Occupational health; Root canal treatment; Professional quality of life

Graphical Abstract



Significant associations with years of practice across all outcome domains (p < 0.001)

I. INTRODUCTION

For any nonsurgical root canal treatment to be successful it is essential to visualize the root canal system with accuracy and carry out the clinical procedures with precision. The recognition of accessory canals, fine anatomic differences, fractures, calcifications and the presence of infected tissue can be difficult without the aid of vision, especially when an operative field is deep, narrow and poorly lit. The use of endodontic procedures demands high visual acuity and fine motor skills, and better visual acuity is important for the efficiency of the procedures and for the quality of the treatment and the longterm prognosis of the procedure.[1,2]

New developments in dentistry have made it much more possible for dentists to perform complex endodontic procedures with high accuracy and consistency. Of these developments, one of the areas that has become important for the present dental practice is magnification systems. Dental loupes are one of the most widely used magnification devices in clinical practice because of their practicality, portability, cost-effectiveness when compared to operating microscopes, and ease of incorporation into everyday clinical care; their ability to aid in visualization, improve illumination, and allow for an ergonomic working posture makes them particularly relevant during treatment procedures.[3,4] They help the clinician to visualize the operative field more accurately, and detect additional canals and microfractures, while providing an ergonomic working position during nonsurgical root canal treatment procedures.[5]

A number of previous investigations have shown the magnification-assisted dentistry to be associated with an enhancement of manual dexterity and precision of clinical procedures and improve the clinical performance in the treatment of restoration and endodontics procedures. [6,7] Also the magnification systems may increase treatment efficiency and increase operator confidence in technically challenging clinical procedures. [8] Magnification may also reduce the risk of technically related procedural errors, missing canals, incomplete debridement, inadequate preparation and cleaning of the root canal system, all of which are known causes of endodontics treatment failure. [9]

Beyond the benefits of using dental loupes, there is a significant amount of ergonomic importance.[10] Work-related musculoskeletal disorders (WMSDs) are recognised as highly prevalent in the dental profession, particularly due to the prolonged static posture, repetitive hand movements, awkward neck flexion and limited visual operating field for endodontic procedures.[11,12] Musculoskeletal stress and poor working posture can have a negative impact on occupational health, clinical efficiency and the sustainability of dental practice.[13-17]

A 2025 study by Danylak et al. also supported that loupes resulted in better posture for both undergraduate and graduate dental practitioners.[18] Educational studies have indicated that the early exposure to magnification systems in undergraduate and graduate training may be beneficial for the postural habits and ergonomic awareness of the user, as well as for the quality of clinical performance.

Although the use of magnification systems has been increasing in the field of dentistry, the regular use of dental loupes by dental practitioners has been inconsistent. There are still a few challenges that prevent their widespread use, such as financial cost, adaptation problems, learning curve, visual adjustment issues and lack of awareness of ergonomic dentistry.[19,20] Also, many practitioners feel that the long-term ergonomic and procedural advantages of using dental loupes justify these initial adaptation problems.

While the clinical and ergonomic benefits of magnification systems have been well studied, there is little evidence regarding the multiple interrelated dimensions of their effects on the professional quality of life and/or occupational wellbeing of dental practitioners during nonsurgical root canal treatment (NSCRT).[21] Professional quality of life is not limited to procedural success but includes several interrelated dimensions including physical comfort, psychological wellbeing, procedural efficacy, occupational satisfaction, and financial perception and the impact of dental loupe usage on the professional wellbeing of the endodontist performing NSCRT is of considerable clinical interest, particularly because of the visual and ergonomic demands of endodontics. [22]

Hence, the present cross section study was conducted to assess the impact of dental loupe usage on nonsurgical root canal treatment on professional quality of life of dental practitioners in terms of physical, psychological, procedural and financial aspects.[23] The null hypothesis was that there was no significant difference between using dental loupes and occupational wellbeing or perceived quality of work of dental practitioners.

II. MATERIALS AND METHODS

This is a cross-sectional questionnaire-based study among dental practitioners who are providing nonsurgical root canal therapy in the office-based clinical practice. Both male and female general dental practitioners and endodontists were included in the study if they were actively involved in routine endodontic procedures. 200 dental practitioners were included in the study. The study was set up to assess the effect of the use of dental loupe on the professional quality of life of dental practitioners with special focus on physical, psychological, procedural and economical aspects of magnification-assisted endodontics.

No one was coerced into participating in the study. All the participants read the purpose and the nature of the study before the questionnaires were given to them. All the participants in the study signed a written informed consent before enrollment. Participant responses were kept confidential and anonymous throughout the research process.

The study was performed within the ethical principles of the institutional review committee and following the Declaration of Helsinki.

The study included dental practitioners that met the following criteria: practitioners routinely performing nonsurgical root canal treatment; general dental practitioners and endodontists actively engaged in clinical practice; practitioners performing both single-visit and multiple-visit root canal treatment; and participants willing to provide informed consent and complete the study questionnaire. Dental practitioners who were not performing endodontic procedures, those who were not willing to participate, immature teeth and regenerative endodontic procedures, and incomplete questionnaires were excluded.

The questionnaire was adapted from World Health Organization Quality of Life assessment instrument (WHOQOL-BREF) [24-30] and modified to enquire about professional quality of life parameters specifically related to dental loupes use during nonsurgical root canal treatment. It was drafted in English and handed out by the investigators to the dental practitioners selected.

The questionnaire had two sections. Section I collected demographic and professional data such as years of clinical practice, gender, age, and whether they used dental loupes when performing root canal procedures. Section II assessed various areas related to dental loupe use such as physical factors, psychological factors, procedural efficiency, financial perception, occupational satisfaction and quality of work improvement. Eight items were used to rate the difficulty of the root canal treatment, using a three-point Likert scale: Never = 0, Sometimes = 1, and Regularly = 2, with a maximum obtainable score of 16. For dental loupe importance, satisfaction, and quality of work improvement, responses were similarly scored as Never = 0, To some extent = 1, and Regularly = 2.

Completed questionnaires were coded and data was entered into Microsoft Office Excel and then analysed by SPSS software. The collected data was summarised using descriptive statistical analysis. For all the variables, frequency distribution, percentages, mean values and standard deviations were computed. The comparison between 2 independent groups were done by independent unpaired t test. For comparing more than two groups, one-way analysis of variance (ANOVA) was used. All analyses used a p-value of < 0.05 as the criterion for statistical significance.

III. RESULTS

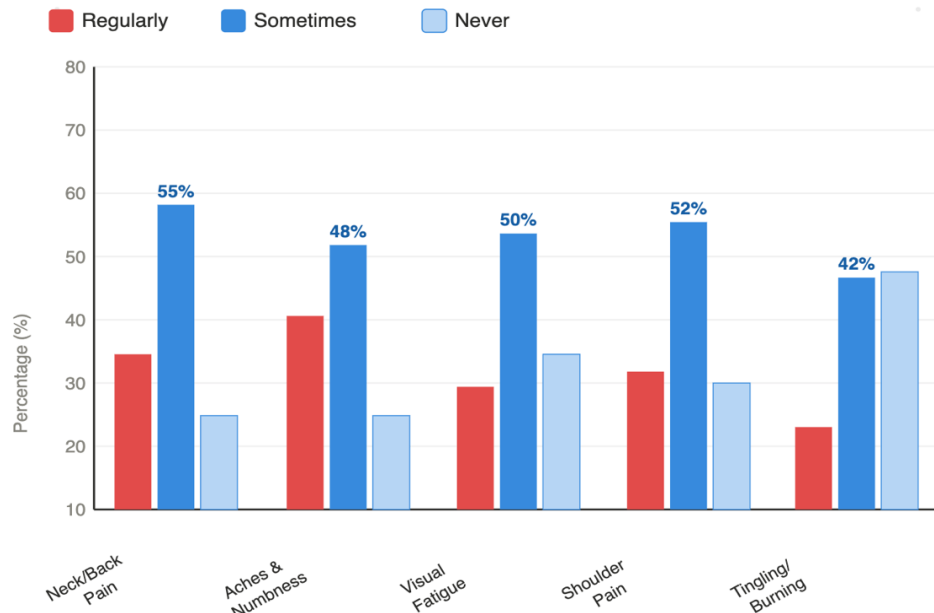
All dental practitioners successfully completed the self-administered questionnaire. The majority of participants belonged to the 25 to 35 years age group (72.0%). Most respondents were male (77.5%). With regard to clinical experience, 53.0% of practitioners had fewer than five years of practice. Among the study population, 60% of dental practitioners reported using dental loupes during nonsurgical root canal treatment, while 40% did not use magnification (Table 1).

Table 1. Demographic Characteristics of Study Subjects (n = 200)

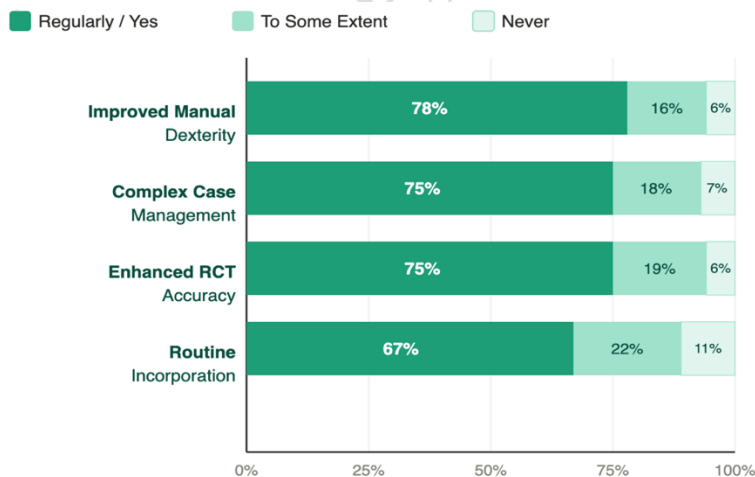
Variable	Category	n (%)
Age (years)	25-35	144 (72.0)
	36-45	34 (17.0)
	46-55	13 (6.5)
	>55	9 (4.5)
Gender	Male	155 (77.5)
	Female	45 (22.5)
Use of Dental Loupes	Yes	120 (60.0)
	No	80 (40.0)
Years of Practice	<5	106 (53.0)

5-10	45 (22.5)
10-15	27 (13.5)
>15	22 (11.0)

Work-related musculoskeletal discomfort was common with about 28% of the practitioners saying that they suffered from work-related musculoskeletal discomfort on a regular basis, while a higher percentage of practitioners said they experienced discomfort occasionally in relation to endodontic procedures. Almost 35% of respondents reported regular discomfort like aches and numbness. Less common problems were tingling or burning sensations in the arms/hands which occurred about 15% of the time (Figure 1a).



1(a)

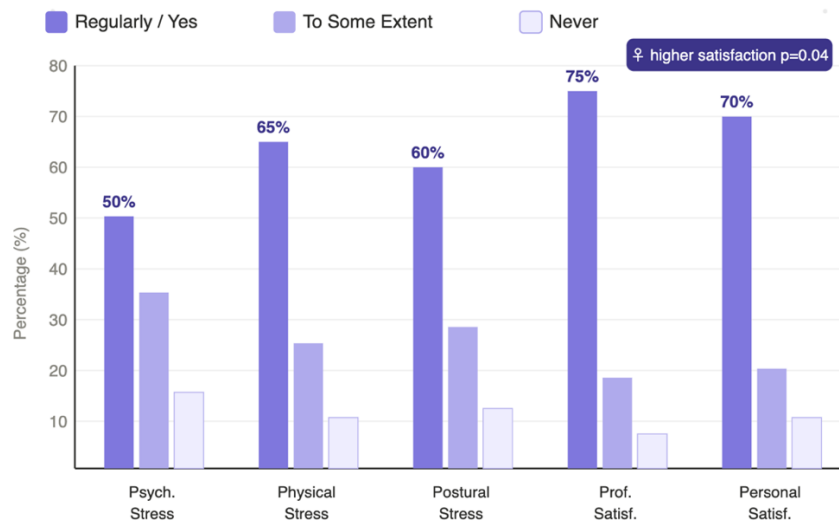


1(b)

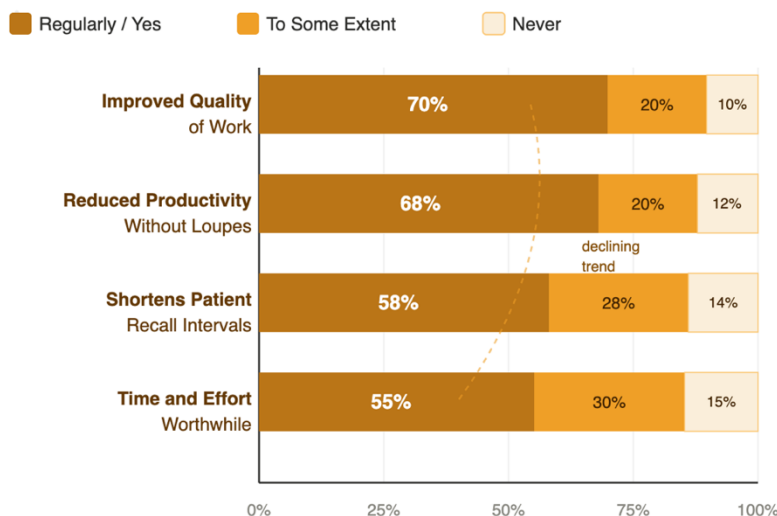
Figure 1(a). Work-Related Musculoskeletal Discomfort During Nonsurgical RCT. **1(b)** Perception Regarding Importance of Dental Loupe Usage

When asked if they felt using dental loupes was important, around 75-80% of dental practitioners agreed that the use of loupes made them more dexterous and enabled them to manage the more complex endodontic cases. Almost three-quarters felt that loupes improved the accuracy of root canal treatment. Approximately 65–70% of the practitioners reported that the use of magnification should be routinely adopted by all dentists during endodontic procedures (Figure 1b).

Dentists' satisfaction with use of dental loupes in root canal treatment is depicted in Figure 2a. About half of practitioners reported a decrease in psychological stress. Approximately 65% reported decreased physical stress and nearly 60% reported decreased postural stress when using dental loupes. Professional satisfaction, with almost 75% of dental practitioners stating positive, and personal satisfaction, with around 70% of respondents stating positive, were the highest levels of satisfaction (Figure 2a).



2(a)



2(b)

Figure 2(a). Satisfaction Associated with Dental Loupe Usage During Nonsurgical RCT. **2(b)** Perceived Improvement in Quality of Work Following Dental Loupe Usage

About 70% of dental practitioners experienced improvement in the quality of work after using dental loupes (Figure 2b). A large percentage reported that they felt that they were less productive working without dental loupes and many practitioners felt that dental loupes helped to reduce the recall interval. Over half said that the time and effort spent on dental loupe learning was worth it.

Perceived improvement in four quality-of-work parameters, comparing yes, to some extent, and never response frequencies.

Table 2. Distribution of Dental Practitioners According to Expenses Related to DentalLoupe Use (n = 200)

Expense-Related Variable	Response	n (%)
Dental loupes are expensive	Not at all	22 (11.0)
	To some extent	88 (44.0)
	Yes	90 (45.0)
Preference for economical dental loupes	Not at all	78 (39.0)
	To some extent	62 (31.0)
	Yes	60 (30.0)

Association analysis between baseline and outcome variables, age was not statistically significantly associated with difficulty of root canal treatment, importance of the dental loupe, satisfaction with the dental loupe or improvement in quality of work ($p > 0.05$). Statistically significant relationship was found between age and the scores related to expenses ($p = 0.04$) (Table 3).

Regarding gender, there was only a statistically significant relationship in the satisfaction with dental loupe variable, where female practitioners were more satisfied than male practitioners ($p = 0.04$). There was no significant correlation between gender and other outcome variables ($p > 0.05$) (Table 3).

Statistically significant association with dental loupe importance was found when measured by comparing with use of dental loupes, with higher importance scores being reported by those who use dental loupes ($p = 0.01$). There were no significant differences between the use of loupe and other outcome variables ($p > 0.05$) (Table 3). Years of clinical practice showed a statistically significant association with multiple outcome variables. Significant differences were observed for root canal treatment difficulty ($p = 0.02$), dental loupe importance ($p = 0.01$), dental loupe satisfaction ($p = 0.01$), and improvement in quality of work ($p = 0.03$). Expense-related scores demonstrated a highly significant association with years of practice ($p < 0.001$), with higher expense scores observed among practitioners with fewer years of clinical experience (Table 3).

Table 3. Association of Dental Loupe Use Components with Baseline Characteristics (n = 200)

Variable	Category	RCT Difficulty Mean $\pm$ SD (max 16)	Loupe Importance Mean $\pm$ SD (max 14)	Loupe Satisfaction Mean $\pm$ SD (max 14)	Quality of Work Mean $\pm$ SD (max 14)	Expenses Mean $\pm$ SD (max 14)
Age (years)	25-35	8.1 $\pm$ 3.4	13.4 $\pm$ 2.6	10.6 $\pm$ 2.8	5.4 $\pm$ 2.1	2.4 $\pm$ 1.2
	36-45	9.0 $\pm$ 3.9	12.8 $\pm$ 3.4	9.8 $\pm$ 3.5	4.9 $\pm$ 2.5	2.0 $\pm$ 1.1
	46-55	8.3 $\pm$ 2.7	14.2 $\pm$ 2.1	10.4 $\pm$ 3.1	6.0 $\pm$ 1.4	1.9 $\pm$ 0.8
	>55	9.5 $\pm$ 2.9	14.5 $\pm$ 1.6	11.0 $\pm$ 3.6	5.1 $\pm$ 3.0	2.7 $\pm$ 1.3
	F	1.92	2.11	1.84	1.67	2.36
	p	0.12	0.09	0.14	0.18	0.04*
Gender	Male	8.4 $\pm$ 3.6	13.2 $\pm$ 3.0	10.3 $\pm$ 3.2	5.2 $\pm$ 2.3	2.3 $\pm$ 1.2

	Female	7.9 ± 2.9	14.1 ± 2.2	11.4 ± 2.5	5.8 ± 1.7	2.4 ± 1.1
	t	1.06	1.88	2.01	1.42	0.91
	p	0.29	0.06	0.04*	0.15	0.36
Loupe Use	Yes	8.2 ± 3.5	14.0 ± 2.8	10.5 ± 3.1	5.6 ± 2.2	2.1 ± 1.1
	No	8.4 ± 3.6	13.0 ± 2.6	10.1 ± 3.0	5.2 ± 2.1	2.4 ± 1.2
	t	0.22	2.74	0.81	0.68	1.93
	p	0.82	0.01*	0.42	0.49	0.06
Years of Practice	<5	7.6 ± 3.5	13.3 ± 2.8	10.4 ± 3.0	5.5 ± 2.1	2.6 ± 1.2
	5-10	9.3 ± 2.7	14.0 ± 2.3	11.6 ± 1.8	5.1 ± 2.0	2.0 ± 1.0
	10-15	9.4 ± 4.4	12.5 ± 3.9	9.6 ± 4.3	4.7 ± 2.9	1.4 ± 1.1
	>15	8.7 ± 2.1	14.2 ± 1.9	10.3 ± 3.2	5.6 ± 2.2	1.9 ± 1.0
	F	3.18	4.02	3.61	2.95	5.44
	p	0.02*	0.01*	0.01*	0.03*	<0.001*

IV. DISCUSSION

This cross sectional study aimed to assess the effect of dental loupe use on professional quality of life of dental practitioners during nonsurgical Root Canal Treatment. The results showed that the magnification-assisted practice was correlated with the operational efficiency, physical and psychological comfort, reduction of physical and psychological stresses and better perceived quality of work.

Understanding the role of visualization in the success of endodontic treatment is important as it directly influences the quality of treatment and the prognosis. The majority of practitioners in the current study indicated that magnification systems helped them to have better manual dexterity and better performance of the procedures. The results of this study are in line with previous studies that showed an improvement in fine motor skills and an increase in the accuracy of the procedure through the use of loupes in dentistry. [1,2] The systematic review carried out by Abasseri and Ha also confirmed the need for the use of the loupes in both the prosthodontic and endodontic aspects of dental degrees. [19]

The ergonomic importance of dental loupe use was also discussed in the present study. Many of the subjects indicated that they experienced musculoskeletal discomfort when performing nonsurgical root canal procedures. The study of Cinar et al. (2025) noted that dental loupes reduced physical and postural stress, consistent with the body of evidence linking loupes to improved working posture, across a variety of specialties.[14,15,21]

Psychological wellbeing is an integral part of the professional quality of life. In this study, almost half of the dentists stated that the use of dental loupes decreased their level of psychological stress. This may be due to less visual strain and better procedural control. The findings of the Alblowi et al. study indicated that knowledge about musculoskeletal disorders and that their use of loupes was linked to musculoskeletal disorders was a significant factor in the decision of dental practitioners to adopt loupes.[23] Similar findings were reported in previous studies that related magnification use with increased professional satisfaction and increased work efficiency. [8,9]

Cost is still a factor that hinders use of magnification devices. In the current study, a significant percentage of practitioners found dental loupes to be cost prohibitive, especially those who were less experienced clinicians. Also, a number of practitioners recognized the long-term ergonomic and procedural benefits of dental loupes and felt that the initial cost was justified. In line with the findings of Pazos et al., the study suggested that the different magnifications of the Galilean loupes produced different effects on working posture, and that their careful choice, based on the clinical need, could improve the cost-effectiveness of the practice and the ergonomic results.[25,26]

Years of clinical practice were associated with many outcome variables such as root canal treatment difficulty, loupe importance, satisfaction and quality of work improvement. More experienced clinicians seemed to have higher levels of appreciation of the ergonomic and procedural benefits of magnification systems.[27] The finding may be the result of the more advanced practitioners being more aware of occupational health. Significant differences were only found with gender with the female practitioners reporting higher satisfaction.[28] This could be due to higher awareness of ergonomics and sensitivity to discomfort due to positioning, as seen in previous gender-specific ergonomic studies. [29,30]

V. LIMITATIONS OF THE STUDY

Some limitations of the present study should be noted. The study was questionnaire-based and data was self-reported so there was a possibility of response and subjective bias. Second, the cross sectional study design does not allow for direct causal inferences between dental loupe use and the increased PQL because a single measurement was taken at a single point in time. Third, the study population was restricted to dental practitioners who performed nonsurgical RCT in private clinical practice and the results may not be generalizable to practitioners in other dental specialties, institutional practice, or geographic populations. The different types of dental loupes, different magnifications and working distances, and different times of using dental loupes were not separately analyzed. Lastly, there are no objective assessment tools for ergonomic outcomes, which are limited to self-reports. There is a need to conduct additional multicenters longitudinal studies using larger sample sizes and more objective ergonomic assessment methods.

VI. CLINICAL RELEVANCE

Magnification-assisted dentistry is gaining more and more significance in modern endodontics. The results of the present study highlighted that the use of dental loupe had a positive impact on several aspects of professional quality of life of the dental practitioners involved in nonsurgical root canal treatment. Dental loupes encourage a more ergonomic working position, which helps to prevent cervical, shoulder and lumbar strain from extended dental work. Simple adjustments in visualization and posture can make a big difference in treatment accuracy, operator comfort and long term occupational health. Understanding the effects of magnification on clinician wellbeing can also help incorporate ergonomic training and visual education through the use of loupes into dental undergraduate and post-graduate courses. These can lead to better clinical outcomes, fewer musculoskeletal issues, and a more sustainable dental practice.

VII. CONCLUSIONS

Based on the present study, the use of dental loupes in nonsurgical root canal treatment positively affected the professional quality of life of the dental practitioner within the scope of the study. The use of the magnification was associated with better visualization, greater efficiency of the procedures, better ergonomic posture, and lower physical and psychological stress during endodontic procedures.

Most practitioners reported that they were more dexterous, that the quality of their work increased and that they increased their professional satisfaction because of the use of dental loupes. While financial concerns and adaptation challenges continue to be significant obstacles to the regular use of dental loupes, many practitioners recognized the long-term ergonomic and procedural benefits, which they believed outweighed these drawbacks. Additionally, the study revealed that there is a relationship between clinical experience and perception and use of magnification systems. It is important, to recognize that dental loupes are not just tools for visual enhancement, but essential ergonomic components that can enhance the accuracy of procedures, the quality of work life, and the sustainability of dentistry.

The need for further longitudinal and multicentric studies is recommended to assess the long-term clinical, ergonomic and psychological advantages of using the magnifying system for endodontic practice.

249 REFERENCES

- 250 [1] Meraner, M., & Nase, J. B. (2008). Magnification in dental practice and education: Experience and
 251 attitudes of a dental school faculty. *Journal of Dental Education*, 72(6), 698-706.
 252 <https://doi.org/10.1002/j.0022-0337.2008.72.6.tb04546.x>
- 253 [2] Baharin, S. A., Fay, L. J., & Mohd-Dom, T. N. (2021). A cross-sectional survey on the use of
 254 magnification device in mainstream dental practice. *Teikyo Medical Journal*, 44, 1983-1991.
- 255 [3] Branson, B. G., Bray, K. K., Gadbury-Amyot, C., Holt, L. A., Keselyak, N. T., & Mitchell, T. V. (2004).
 256 Effect of magnification lenses on student operator posture. *Journal of Dental Education*, 68(3), 384-389.
 257 <https://doi.org/10.1002/j.0022-0337.2004.68.3.tb03742.x>
- 258 [4] Chang, B. J. (2002). Ergonomic benefits of surgical telescope systems: Selection guidelines. *Journal of the*
 259 *California Dental Association*, 30(2), 161-169.
- 260 [5] Del Fabbro, M., Taschieri, S., Lodi, G., Banfi, G., & Weinstein, R. L. (2015). Magnification devices for
 261 endodontic therapy. *Cochrane Database of Systematic Reviews*, 12, CD005969.
 262 <https://doi.org/10.1002/14651858.CD005969.pub3>
- 263 [6] Doppalapudi, N., & Burugapalli, R. K. (2020). Benefits of utilization of magnification in dentistry: A
 264 review. *Dental Research and Oral Health*, 3(3), 121-128.
- 265 [7] Low, J. F., Dom, T. N., & Baharin, S. A. (2018). Magnification in endodontics: A review of its application
 266 and acceptance among dental practitioners. *European Journal of Dentistry*, 12(4), 610-616.
 267 https://doi.org/10.4103/ejd.ejd_248_18
- 268 [8] Bowers, D. J., Glickman, G. N., Solomon, E. S., & He, J. (2010). Magnification's effect on endodontic fine
 269 motor skills. *Journal of Endodontics*, 36(7), 1135-1138. <https://doi.org/10.1016/j.joen.2010.03.025>
- 270 [9] Sunell, S., & Rucker, L. (2004). Surgical magnification in dental hygiene practice. *International Journal of*
 271 *Dental Hygiene*, 2(1), 26-35. <https://doi.org/10.1111/j.1601-5037.2004.00046.x>
- 272 [10] Christensen, G. J. (2003). Magnification in dentistry: Useful tool or another gimmick? *Journal of the*
 273 *American Dental Association*, 134(12), 1647-1650. <https://doi.org/10.14219/jada.archive.2003.0112>
- 274 [11] Maillet, J. P., Millar, A. M., Burke, J. M., Maillet, M. A., Maillet, W. A., & Neish, N. R. (2008). Effect of
 275 magnification loupes on dental hygiene student posture. *Journal of Dental Education*, 72(1), 33-44.
 276 <https://doi.org/10.1002/j.0022-0337.2008.72.1.tb04453.x>
- 277 [12] Narula, K., Kundabala, M., Shetty, N., & Shenoy, R. (2015). Evaluation of tooth preparations for Class II
 278 cavities using magnification loupes among dental interns and final year BDS students. *Journal of*
 279 *Conservative Dentistry*, 18(4), 284-287. <https://doi.org/10.4103/0972-0707.159730>
- 280 [13] Savani, G. M., Sabbah, W., Sedgley, C. M., & Whitten, B. (2014). Current trends in endodontic treatment
 281 by general dental practitioners: Report of a United States national survey. *Journal of Endodontics*, 40(5),
 282 618-624. <https://doi.org/10.1016/j.joen.2013.10.002>
- 283 [14] Neukermans, M., Vanobbergen, J., De Bruyne, M., Meire, M., & De Moor, R. J. (2015). Endodontic
 284 performance by Flemish dentists: Have they evolved? *International Endodontic Journal*, 48(11), 1112-
 285 1121. <https://doi.org/10.1111/iej.12400>
- 286 [15] Alhazzazi, T. Y., Alzebiani, N. A., Alotaibi, S. K., Bogari, D. F., Bakalka, G. T., Hazzazi, L. W., et al.
 287 (2017). Awareness and attitude toward using dental magnification among dental students and residents.
 288 *BMC Oral Health*, 17, 21. <https://doi.org/10.1186/s12903-016-0314-8>
- 289 [16] Mallikarjun, S., Devi, P., Naik, A., & Tiwari, S. (2015). Magnification in dental practice: How useful is it?
 290 *Journal of Health Research and Reviews*, 2(2), 39-44. <https://doi.org/10.4103/2394-2010.163404>
- 291 [17] Friedman, M. J. (2004). Magnification in a restorative dental practice: From loupes to microscopes.
 292 *Compendium of Continuing Education in Dentistry*, 25(1), 48-55.
- 293 [18] Danylak, S., Sloan, A. J., Walsh, L. J., & Zafar, S. (2025). A comparative study of postural impact and
 294 benefits from loupes in undergraduate and graduate dentists. *Journal of Dentistry*, 106162.
 295 <https://doi.org/10.1016/j.jdent.2025.106162>

- [19] Abasseri, T., & Ha, W. (2023). Value of including loupes in prosthodontic and endodontic components of dental degrees: A systematic review. *British Dental Journal*. <https://doi.org/10.1038/s41415-023-6112-2>
- [20] Bonilla, E. D., Mishail, D., Zhang, E., Hayashi, M., & Pameijer, C. H. (2023). Hallmark of dentistry: The evolution and benefits of the dental magnifying loupe. *Journal of the California Dental Association*, 51(1). <https://doi.org/10.1080/19424396.2023.2176579>
- [21] Cinar, R., Aydinoglu, S., Arslan, I., & Gunacar, D. N. (2025). Postural effects of dental loupes in pediatric dental practice. *BMC Oral Health*. <https://doi.org/10.1186/s12903-025-05766-0>
- [22] Alrejaie, M., Ibrahim, N. M., Malur, M. H., & Alfouzan, K. (2015). Use of dental operating microscopes by endodontists: A questionnaire-based study. *Saudi Endodontic Journal*, 5(2), 134-137. <https://doi.org/10.4103/1658-5984.154039>
- [23] Alblowi, J. A., Alghamdi, A. S., Alqarni, A. A., Alshareef, A. T., & Alzahrani, A. A. (2020). Practices and attitudes of dental loupes and their relationship to musculoskeletal disorders among dental practitioners. *International Journal of Dentistry*, 2020, 8828709. <https://doi.org/10.1155/2020/8828709>
- [24] World Health Organization. (1998). WHOQOL User Manual. Geneva: World Health Organization.
- [25] Anggraini, W., Ranggaini, D., Ariyani, A. P., & Sulistyowati, I. (2024). World trends in dental ergonomics research: A bibliometric analysis. *International Journal of Environmental Research and Public Health*, 21(4), 493. <https://doi.org/10.3390/ijerph21040493>
- [26] Pazos, J. M., Moraes, R. R., & Garcia, P. P. N. S. (2022). Effect of magnification factor by Galilean loupes on working posture of dental students in simulated clinical procedures. *PeerJ*, 10, e13021. <https://doi.org/10.7717/peerj.13021>
- [27] Soo, S. Y., Ang, W. S., Chong, C. H., Tew, I. M., & Yahya, N. A. (2023). Occupational ergonomics and related musculoskeletal disorders among dentists: A systematic review. *Work*, 74(2), 469-476. <https://doi.org/10.3233/WOR-211094>
- [28] Almeida, M. B., Barreto, S. M., & Martins, A. M. E. B. L. (2023). Prevalence of musculoskeletal disorders among dental students: A systematic review and meta-analysis. *Heliyon*, 9(9), e19956. <https://doi.org/10.1016/j.heliyon.2023.e19956>
- [29] Anshasi, R. J., Alsyoud, A., Alhazmi, F. N., & AbuZaitoun, A. T. (2022). A change management approach to promoting and endorsing ergonomics within a dental setting. *International Journal of Environmental Research and Public Health*, 19(20), 13193. <https://doi.org/10.3390/ijerph192013193>
- [30] Ohlendorf, D., Erbe, C., Hauck, I., et al. (2020). SOPEZ: Study for the optimization of ergonomics in the dental practice. *Journal of Occupational Medicine and Toxicology*, 15, 22. <https://doi.org/10.1186/s12995-020-00273-0>