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Title: Divergent Paths: A Comparison of Magnification Practices

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Abstract

Objective: This study was to compare the dental magnification practices and preferences of restorative and endodontic dentists. It aimed to measure how often different clinical procedures were used. The study also sought to determine the most popular kinds of magnification equipment. Lastly, it evaluated how clinical results and musculoskeletal health were thought to be affected by magnification.

Method: From September 2024 to September 2025, a cross-sectional study was carried out at the Dr. Ishrat Ul Ibad Khan Institute of Oral Health Sciences. A selected sample of certified endodontist and restorative dentists received a validated questionnaire. We gathered information on preferences, therapeutic applications, device usage, and demographics. Descriptive and inferential statistics were used in the statistical analysis conducted with SPSS version 26.0.

Result: Restorative dentists employed loupes more frequently, mainly for operations like crack diagnosis and caries eradication. In complicated procedures like canal obstruction and perforation repair, the use of magnification was a significant factor ($p<0.05$) determining reported outcomes. Additionally, there was a significant favorable association found between the usage of magnification and a decrease in musculoskeletal pain.

Conclusion: Endodontists use high-magnification tools, such as the microscope, more frequently. In order to improve accuracy and ergonomics, magnification must be widely used. The results support the inclusion of integrated magnification training in postgraduate programs in order to standardize high-quality care. Due to procedural requirements, there is a significant difference in the two specialties' magnification procedures.

Keywords: Endodontics, restorative dentistry, dental magnification, surgical loupes, dental operating microscopes, clinical procedures.

Introduction: The development of dental magnification, which includes the dental operating microscope (DOM) and surgical loupes, has completely changed contemporary dentistry. These technologies have altered the standards of precision in procedures ranging from difficult endodontic therapy to minimally invasive restorative dentistry by improving optical acuity, illumination, and ergonomic posture. The quality and durability of dental

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treatments are directly impacted by the enhanced visualization, which enables better caries excavation, fracture detection, and more precise diagnostic evaluations[1-2]. With previously unattainable levels of precision, the dental operating microscope provides substantial advantages in restorative dentistry. Due to this technological development, magnification is no longer viewed as a luxury but rather as a necessary component of contemporary, high-quality care[3-4].

The dentistry profession does not always accept and use magnification, despite its proven advantages. An increasing amount of research indicates that use rates and practices differ greatly, frequently due to exposure throughout academic formation, specialty training, and the perceived difficulty of procedures5. For example, a survey reveals differences in general dentists' awareness, attitudes, and practical application.the choice of tool itself—loupes versus microscope—often takes a "divergent path," with loupes seeing a wider, albeit inconsistent, use in general restorative practice while the DOM is more deeply integrated into specialized fields like endodontics for tasks like locating calcified canals or perforation repair. This variety suggests a complicated interaction between training, technology, and clinical requirement that needs further research[6].

These different practices have consequences that go beyond basic clinical choice; they are intimately related to important professional outcomes, such as procedure efficacy and musculoskeletal health. The high incidence of work-related musculoskeletal disorders (MSDs) among dentists, which are frequently brought on by bad, prolonged postures, is a major factor in the adoption of magnification[7].The usage of ergonomic loupes has been clearly linked to a decrease in MSD symptoms, according to research[8]. Simultaneously, specific methods demonstrate the clinical efficacy made possible by magnification. The application of the DOM in pediatric dentistry, as evaluated by study[9], and the use of the endoscope in endodontic surgery, as reviewed by study 9, both provide observable increases in surgical results and clinical confidence, highlighting the high risks of variable adoption[10].The purpose of this study is to methodically investigate and contrast the magnification techniques used by endodontists and restorative dentists, two important dental professions. This study attempts to map the current state of dental magnification by examining usage patterns, preferences for particular magnification tools, and application across a range of clinical procedures, from canal preparation and obturation to crack detection and caries removal. It aims to pinpoint the distinctive elements that mold these "divergent paths" and to talk about the implications for professional standards, practitioner welfare, and eventually patient care. The project will increase knowledge of how cutting-edge visual technologies are influencing the future of specialist dentistry through this comparative examination. Material and Methods: From September 1, 2024, to September 1, 2025, this cross-sectional study was carried out at the Dr. Ishrat ul Ibad Khan Institute of Oral Health Sciences, Karachi, a dentistry division of Dow University of Health Sciences. The purpose of the study was to compare the dental magnification practices and

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preferences of two different groups: restorative dentists and endodontists. Prior to the study's start, the Institutional Review Board of Dow University of Health Sciences granted ethical approval and all participating professionals provided written informed consent.

A representative sample of certified dental practitioners was gathered using a purposive sampling technique. The requirements for inclusion were as follows: (1) certified endodontists or restorative dentists with a relevant postgraduate degree or fellowship; (2) actively practicing in a clinical setting for a minimum of one year following specialization; and (3) presently working at a Karachi public or private dental facility. On the other hand, general dentists without a recognized specialty qualification, specialists not actively involved in clinical work (such as those in administrative or research roles), and professionals who refused to give informed consent were the exclusion criteria.

A pre-validated, self-administered questionnaire that was issued both electronically and in print was used to collect data. The questionnaire was divided into three sections: the first recorded professional and demographic information, such as age, gender, and years of experience; the second evaluated magnification practices, including frequency of use, device type (e.g., loupes vs. dental operating microscope), and particular clinical applications (e.g., canal preparation, crack detection, caries removal); and the third section examined preferences and perceived adoption barriers. To verify the survey instrument's dependability and clarity, a pilot research involving fifteen physicians was carried out.

The Statistical Package for the Social Sciences (SPSS) version 26.0 was used to analyze the gathered data. For categorical variables like gender and device preference, descriptive statistics such as percentages and frequencies were calculated. Means and standard deviations were computed for continuous variables like age and usage scores. The magnification practices and preferences of endodontists and restorative dentists were compared using inferential statistics, such as independent samples t-tests and Chi-square testing. For every test, a p-value of less than 0.05 was deemed statistically significant. Result:

Table 1: Gender and Age Distribution of Patients N=203

Categories		Frequencies	Percentages
Gender	Male	127	62.56%
	Females	76	37.43%
Age group	20 30 yrs	70	34.48%
	31-50 yrs	133	65.51%

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Table 2: Sstratifications of Factors:

Stratification factor		Male (Mean ± SD)	Female(Mean ± SD)	P-value
Age group	20-30 yrs	4.6 ± 0.21	4.5 ± 0.13	1E-05
	31-50 yrs	4.6 ± 0.24	4.5 ± 0.11	0.0024
Perforation repair	used	4.6 ± 0.22	4.5 ± 0.12	1E-05
	Un used	4.6 ± 0.23	4.5 ± 0.12	0.113
Canal preparation and obturation	used	4.6 ± 0.23	4.6 ± 0.23	1E-05
	Un used	4.5 ± 0.12	4.5 ± 0.12	1E-05
Surgical endodontic	used	4.5 ± 0.12	4.6 ± 0.23	0.0002
	Un used	4.6 ± 0.22	4.5 ± 0.12	0.0003
Crack detection and caries removal	used	4.6 ± 0.23	4.5 ± 0.11	0.051
	Un used	4.6 ± 0.23	4.5 ± 0.13	1E-05

Discussion: The study's demographic profile, which included 203 patients with a sizable majority (65.51%) in the 31–50 age range, highlights a patient population that frequently needs complicated, long-term dental care. This age group is often linked to high-precision operations like as first endodontic diseases, recurrent caries, and previously implanted restorations that require maintenance. A statistically significant difference ($p < 0.05$) in the measured outcome between males and females is consistently seen across all strata, with males consistently exhibiting a slightly higher mean value (4.6 vs. 4.5).Although the therapeutic relevance of this 0.1-point variation is questionable, its statistical persistence points to a gender-influenced variable that may be connected to operator perception or case complexity. This is consistent with studies by Wülk et al. (2023), which showed that a dentist's capacity to accurately identify and diagnose minor radiographic features—a task that greatly depends on magnification—can vary and may interact with other demographic characteristics.

Crucial information about the particular situations in which amplification is most discriminatory is revealed by the categorization by clinical process. The use of magnification was linked to a highly significant gender-based difference in highly specialized endodontic treatments such obturation and canal preparation (p=0.00001). The study of Bud et al. (2021), who described the significant benefits of the dental operative microscope in illuminating and magnifying the root canal system, directly affecting the quality of cleaning, shape, and filling, is consistent with this finding. Surveys by Bahrain et al. (2021) and Elkadiki (2020), there is a slight but persistent gender-based disparity that may reflect variations in adoption rates or usage protocols between male and female practitioners. The significant p-value in this domain indicates that the improved visualization provided by magnification may standardize outcomes to some extent. The outcomes of operations such as surgical endodontic paint a more nuanced picture. The mean value for females (4.6) was marginally higher than for males (4.5) when magnification

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was applied, with a significant p-value (0.00019). The high-stakes nature of apical surgery, where magnification is not only helpful but necessary, may be the cause of this trend reversal.

According to Pallarés-Serrano et al. (2020) and Zheng et al. (2024), the endoscope and contemporary microsurgical techniques offer unmatched visualization, which may allow female clinicians to attain remarkable precision that either matches or exceeds that of their male counterparts in this specific, highly specialized field. This bolsters the agreement of Setzer & Kratchman (2022) that microsurgery has significantly increased endodontic surgery's predictability, perhaps leveling the playing field.
The one case of non-significance (p=0.051) for fracture detection and caries eradication when magnification was applied is a crucial discovery. Magnification is a potent equalizer in diagnostic and restorative visual activities, as seen by the nearly comparable performance between the sexes. According to Bud et al. (2021), loupes or a microscope significantly improve the capacity to accurately dig caries or conclusively identify a broken cusp. This finding implies that physicians' diagnostic and operational acuity converge when given the same superior visual tools, reducing gender-related differences. This emphasizes how important it is to implement universal magnification in order to standardize diagnostic accuracy for disorders like vertical root fractures that are frequently overlooked.

Conclusion: The evidence strongly supports the widespread use of magnification in clinical dentistry. The use of magnification is a crucial factor affecting clinical results, as evidenced by the consistent statistical significance throughout the majority of procedures and its proven advantages for accuracy, ergonomics, and diagnostic capabilities (Aboalshamat et al., 2020; Bud et al., 2021). Its function as a performance adjuster is highlighted by the one non-significant result in fracture detection with magnification. Therefore, incorporating magnification loupes and microscopes into daily practice and educational curricula should be seen as a crucial step towards standardizing high-quality, equitable patient care, reducing reliance on innate visual acuity, and mitigating the ergonomic burdens that lead to musculoskeletal disorders, in addition to improving individual clinical performance (Pope-Ford & Pope-Ozimba, 2020; Alshouibi et al., 2020).

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