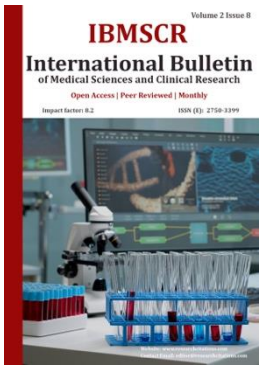

ADVANTAGES OF THE MICROSCOPE IN ENDODONTIC PRACTICE

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Abstract: The dental microscope has long been employed as a tool to enhance vision, providing greater accuracy for diagnostic procedures and clinical techniques. Its integration of stereoscopic vision and coaxial illumination has proven valuable in identifying pathologies, removing calcifications, and locating instruments that may become lodged within teeth. This device facilitates the observation and detection of tiny root-level structures while also promoting ergonomics, allowing clinicians to maintain better posture of the hands, back, head, and neck in relation to both the patient and the microscope.

In endodontics, the use of a dental microscope offers technical benefits to practitioners as well as advantages to patients, which are essential during both diagnosis and treatment. Successful root canal therapy requires precise instrumentation. However, the complex root canal anatomy of maxillary molars—particularly the frequent presence of a second mesiobuccal canal—has often been associated with higher failure rates. Advanced visualization tools such as dental microscopes and related devices have significantly improved the detection of additional canals, thereby enhancing treatment quality and outcomes.

This review was conducted with the objective of highlighting the benefits of using the dental microscope within endodontics. In total, 41 research articles were analyzed.

Keywords: Dental microscopy; Endodontics; Coaxial illumination.

Introduction

This review was developed to emphasize the importance of precision in the use of the dental microscope within endodontics, particularly its value in diagnosis and its role in improving professional ergonomics. For this reason, it is essential to communicate its benefits both to healthcare practitioners and to dental students. Over the past few decades, advances in endodontic procedures have introduced new techniques and technologies that have significantly enhanced treatment accuracy and clinical outcomes.

Endodontic practice requires critical skills from the clinician, including experience, tactile sensitivity, perseverance, and the ability to work under challenging conditions—such as the limited visibility within the pulp chamber and root canals, coupled with the constraints of radiographic imaging. In this context, the dental microscope has emerged as a vital tool, offering precise magnification, stereoscopic vision, coaxial illumination, and a stable fixation system, all of which support higher quality in endodontic treatment.

Furthermore, research into internal tooth anatomy and root canal morphology has provided valuable insights that facilitate more accurate canal shaping and filling, thereby improving the success of endodontic therapy. Dentistry as a field has witnessed remarkable progress over the years, and the incorporation of the dental microscope contributes not only

to diagnostic and therapeutic precision but also to the practitioner's ergonomics by promoting proper posture of the back, shoulders, head, and neck.

The value of the optical microscope in endodontics lies in its ability to aid in the detection of potential cracks and vertical fractures, which are particularly common in premolars and molars. Among its additional advantages is the capacity to assist in the removal of calcifications within the pulp chamber, as well as in the identification of accessory canals, isthmuses, bifurcations, and anastomoses. The microscope also enhances visualization of fractured instruments that may remain lodged inside the tooth, such as posts or pins. Most importantly, it provides the clinician with a broader and clearer view of the operative field, which not only facilitates treatment but also helps to prevent and manage possible complications. The use of the surgical microscope provides clinicians with greater precision and working capacity, particularly in challenging procedures such as the removal of fractured files. These situations are especially critical in the apical regions of the root canal, where fractured fragments pose a serious risk. In such cases, the decision must be carefully evaluated—whether to remove the fragment in situ or to refer the patient for further management.

Microscopes are available in a wide range of models, from basic designs to advanced systems equipped with magnetic stabilizers and motorized progressive zoom that offer full mobility. Modern periradicular microsurgery has incorporated several technological innovations, including the dental surgical microscope, ultrasonic devices, contemporary microsurgical instruments, and biocompatible root-filling materials. These advances have led to highly successful treatment outcomes. The higher success rates are largely attributed to enhanced visualization of the surgical field, along with precise preparation of root tips using microinstruments under high magnification and improved illumination.

Endodontic therapy focuses on treating infected dental pulp with the goal of eliminating infection and relieving pain. As the instruments used for this procedure have become increasingly sophisticated and precise, the use of the dental microscope has gained wide acceptance, with the expectation that it enhances treatment outcomes for patients while also providing technical advantages for the clinician.

From the operator's perspective, one of the main benefits of the microscope is that it requires minimal adjustment and effort, thereby reducing postural strain during clinical work. Since the early 2000s, the principles of minimally invasive dentistry have been widely advocated, further supporting the adoption of the dental microscope in practice. Working under magnification encourages dentists to be more conservative in preserving dental tissues, while improving the overall quality of treatment.

The microscope facilitates minimally invasive procedures by reducing unnecessary removal of hard dental tissue, increasing operator comfort and motivation, improving communication with both patients and dental assistants, and minimizing the risk of iatrogenic damage.

This review was undertaken to deepen the understanding of the relevance and advantages of using the dental microscope in endodontics. It is of great importance to inform healthcare professionals and organizations involved in dental practice about the implementation of such tools, as their application benefits both the operator and the patient. Accordingly, the present work was conducted with the aim of describing the benefits of the microscope in the field of endodontics.

Methods

This review highlights the main aspects related to the benefits of using the dental microscope in endodontics. A literature search was conducted in both English (PubMed, Scopus, Google Scholar) and Spanish (SciELO, Google Scholar) databases. The objective was to provide general dentists and specialists with updated research on the subject, emphasizing the microscope's precision in endodontic procedures, its diagnostic value, its role in improving operator posture, and the technical and clinical advantages it offers for both practitioners and patients.

The databases PubMed, Scopus, and SciELO were examined. To identify relevant studies, an advanced search was performed using combinations of keywords connected through Boolean operators. The search terms included, in English: *magnification, microscope in endodontics, accessory canals, surgical microscope*; and in Spanish: *aumento, microscopio en endodoncia, canales accesorios, microscopio quirúrgico*. Searches were conducted within titles, abstracts, and keywords, applying specific search formulas according to the syntax of each database.

From the initial pool of articles, 20 were excluded due to titles not aligning with the subject, and 4 were discarded because their abstracts did not correspond to the scope of the review. Ultimately, 36 review papers were selected. In addition, 5 directly relevant articles published in PubMed between 2017 and 2022 were included for their significance.

Results

Precision of the Microscope in Endodontics

The earliest records of magnification date back to around 800 B.C., as seen in Egyptian illustrations, where simple glass meniscus lenses were used. Seneca later observed that "letters, though small and indistinct, appear larger and clearer when viewed through spheres filled with water." By the 10th century, Alhazen introduced, through rigorous studies, the first magnification device—a significant milestone for science, particularly in the medical field. Since then, the ability to enlarge images has become essential, and the microscope has remained a valuable instrument worldwide, including in dentistry.

In endodontics specifically, the microscope plays a central role in studying the structure, morphology, physiology, and pathology of the dental pulp and periradicular tissues. Its use allows for a deeper understanding of root canal treatment, ensuring thorough mechanical and chemical cleaning of the entire root canal system, followed by complete obturation with inert filling materials. This precision contributes significantly to achieving successful endodontic outcomes.

Dental Microscope in Endodontics

The dental microscope is an optical device specifically designed to provide an enhanced and magnified view in dentistry, facilitating highly precise, comprehensive, and micrometric diagnosis and treatment. This tool enables the refinement of clinical procedures, allowing for an extremely conservative approach to both the coronal and radicular portions of the tooth.

In endodontics, the microscope is closely linked to conventional root canal treatments as well as to apical microsurgery (apicoectomy). The initial magnification typically begins at 3x, but it can be gradually increased up to 21x. To achieve this, dental microscopes are equipped with powerful illumination sources, usually LED or xenon, which provide optimal lighting conditions even in confined or dark areas, ensuring accuracy and detail during the procedure.

Clinical Impact of the Microscope in Endodontics

The dental microscope has significantly enhanced endodontic outcomes by improving diagnostic accuracy, treatment predictability, tooth preservation, and the identification of additional canals, accessory pathways, and restorations. It allows for the detection of internal microleakage beneath restorations and crowns, identification of Class V apical fractures, visualization of isthmuses connecting two canals within the same root, and the location of difficult-to-access canal orifices.

These improvements contribute to superior results by enabling better access, debridement, shaping, and obturation of the root canal system. The literature highlights that, when combined with appropriate case selection, modern technologies, and contemporary materials, the use of the microscope can lead to improved outcomes in surgical endodontics. Moreover, this instrument has introduced a true paradigm shift not only in endodontics but also in periodontology.

Adoption of the Microscope in Dentistry

In the United States, approximately **76% of all endodontists** incorporate a microscope into their daily practice. However, the greatest market growth potential appears to lie within **general dentistry**, where the current adoption rate is estimated at only **1%**.

The **University of Washington School of Dentistry** in Seattle was the **first dental school worldwide** to provide predoctoral students with access to microscopes in clinical dentistry, marking a significant step toward integrating magnification into dental education.

Furthermore, the use of **high-quality illumination**, particularly when combined with magnification, has been strongly recommended as a **standard practice** for effective utilization of the dental operating microscope.

DISCUSSION

Endodontics is a discipline that requires both technical skill and a thorough understanding of the anatomical structures that compose the dental organ. In many clinical cases, complications arise that necessitate the use of a microscope, as it provides enhanced visualization of minute structures that cannot be effectively assessed with the naked eye.

The findings of this literature review indicate that the operating microscope offers superior precision by magnifying root canals up to three times their natural size. Historically, endodontic procedures performed without the aid of magnification were associated with higher failure rates. Compared with traditional diagnostic methods such as the **"tooth slooth" test** and conventional radiographs, the microscope has proven to be a more effective tool in identifying and managing endodontic challenges.

Throughout the years, the use of microscopes—particularly the operating microscope—has become increasingly relevant in endodontics, especially in the detection of treatment failures such as untreated or calcified canals, which represent some of the most critical challenges. The surgical microscope enables the clinician to identify each root canal orifice with greater precision.

Beyond its diagnostic benefits, one of the major advantages of the microscope lies in improving ergonomics. By promoting correct posture and reducing strain on the arms, shoulders, and back, it helps to minimize the risk of occupational health problems that were commonly observed in the past among endodontists. Conditions such as **low back pain, headaches, myalgia, carpal tunnel syndrome, hearing loss, and visual fatigue** were often the result of poor working posture during complex endodontic procedures. The microscope,

by facilitating visualization and reducing operator fatigue, decreases the likelihood of these complications.

Ultimately, the use of the microscope benefits both the professional and the patient, since it allows for more precise and comfortable execution of endodontic treatment, resulting in improved clinical outcomes.

CONCLUSION

The operating microscope has been used for many years due to its accuracy in diagnosing dental conditions, particularly in endodontics. It plays a crucial role in the detection of fissures and fractures that may compromise molars and premolars, as well as in the identification of pathologies and fractured instruments that can become lodged during treatment. This device offers significant advantages, as it shortens clinical working time, reduces complications, and helps prevent occupational health issues, particularly those affecting vision.

The use of the microscope in endodontics is now widely accepted as a valuable aid that enhances the ability of clinicians to locate root canals, especially in cases with accessory canals. Furthermore, this review aims to provide the academic community and the broader dental field with a reliable source of reference and knowledge regarding the instruments that have been implemented in the study and treatment of dental structures.

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