Microscope and Magnifying Loupes in Endodontics: A Literature Review

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Abstract

Endodontic treatment is the removal of pulp tissue from teeth and the filling and sealing of the canal system. The microscope allows a maximization in the visualization of the canals which facilitates a thorough examination of the piece in question and consequently achieve a much more accurate and effective treatment. Objective: To learn about the application of the microscope in endodontics in relation to the manual technique and the use of magnifying loupes. Materials and methods: An analytical and descriptive approach was used, where the collection of bibliographic information was obtained through an analysis, classification and search of articles with scientific evidence based on data from 2017 to 2022, in search engines such as: PubMed, Scielo, Latindex, Dialnet, Google academic, among others. Results: It is evident that the number of advantages of microscope use is much greater in relation to its disadvantages. Microscopes outperform magnifying loupes in most variables except cost. A series of dental treatments are detailed with the use of the microscope that allow greater precision in dental diagnosis when visualizing details in composition with the operator performing manual techniques. Conclusion: The microscope and magnifying loupe have allowed greater precision in endodontic treatment because they facilitate the work and visibility in the small canals of the dental pieces.

Keywords: microscope, endodontics, precision, avances in odotology, surgical microscope, microsurgery, maximization of condutos.

1. Introduction

Endodontic treatment, in brief features, consists of the removal of the pulp tissue of the teeth and the filling and sealing of the root canal system with a bioactive material. This treatment has a high degree of complexity for inexperienced due to the little or no visibility that the field of work presents, since it works in extremely small and sometimes inaccessible conduits. On the other hand, experienced endodontists mention that they can carry out much of their work with zero visibility and their actions are based, mainly on touch. However, in recent years, advances in dentistry and especially in endodontics have allowed clinicians to have greater precision and effectiveness in treatments using different methods, materials and instruments. Within the latter, one of them are the magnifying glasses and the one with the greatest impact in the specialty is the microscope. (1)

The microscope allows a maximization in the visualization of the canals and dental structures in general, which facilitates a thorough examination of the piece in question and consequently achieve a much more precise and effective treatment. It has been shown that the use of this device improves the working posture of operators and, therefore, reduces the occurrence of repetitive strain injuries related to poor posture, andit is interesting to study whether the technical advantages for the operator using magnifying devices are also associated with advantages for patients in relation to the success rate of the, Reduction of treatment time and with the aim of improving its quality. After the introduction of microsurgical principles in endodontics, involving new techniques for root canal therapy, several authors recommend the use of well-focused magnifying and lighting devices as a standard of care in endodontics. (2)

The increase in the working area and illumination that the microscope provides during diagnosis is important, in particular, to capture the details of

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dental anatomy, and restorations, fillings with filtration, as well as possible fissures or fractures. Specifically, Jiménez et al. 2020 establish the benefits that the microscope provides and they are listed as follows:

Minimally invasive openings. It has the objective of preparing the access cavity, seeking to achieve the entry in a straight line, preserve the major structure in healthy teeth and remove the roof of the pulp chamber to expose and eliminate the pulp horns. (1)

The goal is to go without access with obstructions of the root canal system and identification of the complex structure of its anatomy. The key to successful treatment and precise microscope working area. (1)

Localization of root canals. The position of the channel provides an important guide for the use of the microscope, generating accessory duct locations, creating a favorable prognosis in long-term endodontic treatments, avoiding infections. (1)

Recovery of fractured instruments in ducts. Magnification and lighting become essential in complicated cases, in accidents or in the handling of iatrogenies. (1)

Sealing perforations. The microscope is an instrument of undoubted value for the repair of iatrogenic perforations where the prognosis depends on the quality of the seal. (1)

On the other hand, also the use of magnifying glasses or lenses allows the operator a better and greater visibility of the operative area, thus achieving more accurate diagnoses and consequently better results increasing patient satisfaction and confidence level. There are three basic magnifying systems available in dentistry that include single lens magnifiers or Amsted, Galilean magnifiers that provide magnification of 2× to 3.5× and Keplerian or prismatic magnifiers that have multiple lenses and give greater clarity. (3)

2. Materials and Methods

In the present research an analytical and descriptive approach was used, where the collection of bibliographic information on the topic "Microscope in Endodontics". For this, databases such as Scielo, PubMed, Elsevier, also carried out an internet search in the Google Scholar search engine. Search engines for digital resources were used in the databases from 2017 to 2022.

For the collection of the information, the search keywords such as microscope, endodontics, precision, advances in dentistry, surgical microscope, microsurgery, maximization of the ducts and their respective translations into English were used: microscope, endodontics, precision, advances in odotology, surgical microscope, microsurgery, maximization of condutos.

Inclusion criteria

1. Studies that in their title will present the keywords
2. Open-Access Articles
3. Research in English or Spanish
4. Articles published in the last 5 years
5. Articles are included in which Clinical cases are mentioned.
6. Postgraduate thesis

Exclusion criteria

1. Monographs
2. Undergraduate thesis.
3. Information from non-indexed journals.
4. Articles published prior to 2017
5. Clinical cases without scientific support and without a complete database
6. Duplicate items.

Of the total of 39 articles found, according to the inclusion and exclusion criteria, 23 were selected, which were chosen to analyze data on keywords, provide readers with relevant and updated information.

3. Results

An exhaustive bibliographic search was carried out based on the keywords of this article in different search engines, thus managing to collect 39 articles of which 16 were discarded after corroborating that they did not meet certain established criteria.

Once a complete analysis was carried out, 23 articles were taken into account, of which 8 were included to perform the analysis of results.

Table 1. Advantages and disadvantages of using the microscope

	Advantages		Disadvantages
(Road Addresses 2017)	Ideal posture of trajo. (4)	(Road Addresses 2017)	High cost. (4)
(Road Addresses 2017)	Decreases eye fatigue. (4)	(Road Addresses 2017)	Long period of adaptation. (4)
(Jimenez Delgadillo et al. 2021)	Eliminates collateral vision. (1)	(Jimenez Delgadillo et al. 2021)	Need for organizational space design. (1)
(Road Addresses 2017)	Improves diagnostic capacity. (4)		Decreases the "manual" capacity of the operator. (4)
(Road Addresses 2017)	Increases the success of treatment. (4)		
(Jimenez Delgadillo et al. 2021)	Less invasive openings. (1)		
(Jimenez Delgadillo et al. 2021)	Greater localization of root canals. (1)		
(Jimenez Delgadillo et al. 2021)	Easier identification and recovery of fractured instruments within the ducts. (1)		
(Road Addresses 2017)	Disappearance of burn-out syndrome. (4)		

Source: Cevallos- Gavilanes

It is evident that the number of advantages of using the microscope is much greater in relation to its disadvantages. The use of the microscope allows the operator to work in a comfortable and ideal posture that does not cause damage to their state of health, in the same way, it decreases eye fatigue and eliminates collateral vision, improving the diagnostic capacity and increasing the success of the treatment making it less invasive in technique and time.

On the other hand, the disadvantages include the high cost of the microscope, the long period of time required by the operator to adapt and use it correctly, the need for a large and adequate space for its placement and handling and the fact that it decreases the manual and visual capacity of the operator, since he is accustomed to working with magnification and in ideal position so working without a microscope is complicated.

Table 2. General characteristics of microscopes and magnifying glasses

	Variable	Magnifiers	Microscope
(Road Addresses 2017) (Leica M320 F12. 2020)	N increases. (4)	1 time. (4)	3,6,9,12,20 times. (4)
(Road Addresses 2017)	Weight. (4)	Heavy. (4)	Weightless. (4)
(Road Addresses 2017)	Cost. (4)	Generally low. (4)	Elevated. (4)
(Road Addresses 2017) (Leica M320 F12. 2020)	Lighting. (4)	Not applicable It can be added optionally. (4)	Optical fiber incorporated into the system in the same axis of vision. (4)
(Road Addresses 2017)	Documentation. (4)	Not applicable. (4)	Photography and video. (4)

Source: Cevallos- Gavilanes

Based on the information of the articles taken into account in this table, a comparison of the general characteristics between the magnifying magnifiers and the microscope, both focused on use in endodontics, is established. Variables such as the number of increases, weight, cost, lighting and documentation are evaluated. Microscopes outperform magnification magnifiers in most variables, except cost.

4. Discussion

Seen in this way in the study of Lalama et al. (2022) (5) Realizar a endodontics involves a series of steps and techniques to reach a fully satisfactory work, so it shows a challenge for the professional and uncertainty to the patient. Therefore, with the presence of technological advances such as the microscope, it has allowed an improvement in minimally invasive dentistry. Since the advancement of the same has not only provided security after the advantages and disadvantages for the professional but also for the patient.

In this way, the study of Moradas et al. (2022) (5) the increase that occurs in the field of work of the professional, with light during diagnosis, helps to recognize the anatomy more clearly and therefore the ease of seeing and evaluating in a complete way the ducts and the pulp chamber. Providing the beneficiary with greater precision in the diagnosis of their treatment.

Also supported by the study by Navarro et al. (2018) (6) which mentions that the failure of endodontic treatments is caused by incorrect diagnosis or by the lack of visibility of the operative field, the non-diagnosis of dental fissures which led to post-endodontic fractures.

Thus, the success after the correct diagnosis is also the precision of the treatment. Adequatelighting means that dental treatments can be carried out in conditions of greater safety, higher quality than in the past. Ddemonstrating that the use of the microscope allowed the localization of ducts in expert and inexperienced operators, ensuring a bettertreatment for the patient. (6) (7)

In addition, the study by Muñoz et al. (2020) (8) argues that dentistry is not only based on treatment but also on prevention to reach minimally invasive dentistry. Theeducation that the patient can maintain by viewing a microscope monitor. In addition to the documentation of clearer and more accurate clinical cases in documentation for teaching. This is also corroborated by which he mentions that the basis for analyzing human structures is the use of microcopy in conjunction with new ICTs.

However, the study by Sánchez et al. (2019) (9) mentioned that the implementation of technology increases the costs of endodontic treatment, many of the times the patient opts for an exodontia. Since according to the study the inexpertise or limited vision of the endodontist leads many of the cases to perform a retreatment and in the worst scenario the tooth extraction, by which the patient is inclined to extraction, However, the use of the microscope increases the cost, but guarantees a better treatment.

Thus one of the most relevant disadvantages is the inexpertise of the operator which is resolved in an increase in working time, learning the use of the same is at least one calendar year, to adapt and use it in the most appropriate way, Also, the operator distrusts the dental increase during a procedure

therefore the appointment is extended being a disadvantage for the patient. (4) (10)

According to (Moradas estrada 2017) (4) the number of light magnifications is 1 time, while the microscope is 3 to 20 times, according to the author there is a difference, since the microscope can be used several times, while in the magnifying glasses it can be occupied many times but they are not so effective. According to (Alina Ariceta, 2022) (11) magnifiers are the type of magnification most used today in dentistry and are the most accessible, which consists of convergent lenses, these are placed side by side and focusing the objective to amplify the image, consists of convergent lenses, these are placed side by side and focusing the objective to amplify the image, On the other hand, the microscope can achieve magnifications of X4, 6, 10, 16, 25, 40 or X63 are stereoscopic (three-dimensional vision) and coaxial illumination provides greater range of vision.

According to (Moradas estrada 2017) (4) the magnifying glasses are heavy, while in the microscope it is weightless, that is, the microscope has the opportunity to work more effectively. According to (Alina Ariceta, 2022)(11) Binocular magnifiers or stereomicroscopes are optical magnifying instruments, which have the tendency to weigh, while microscopes do not weigh, since they are a small or very small size, their use is often used to observe tissues and cells. Its use is widespread in biology, cell biology, microbiology, genetics, zoology, botany, mycology and medicine.

According to (Moradas estrada 2017) (4) the illumination in the magnifying glasses does not apply and can be added optionally, and in the microscope it has the optical fiber incorporated into the system in the same axis of vision. The illumination of these magnifiers is configured so that the light travels parallel to the vision, you must have a good optics in order to obtain a good depth of focus, which is free of any aberration and with sharp and bright colors, while in the microscope these light sources are connected to the microscope by means of a fiber optic cable and their intensity is usually regulated by a rheostat. (Ingrid Catherine Ospina Contreras, 2021) (12)

According to (Moradas estrada 2017) (4) the cost of magnifying glasses is extremely low since it does not have as much efficiency, while the microscope has a high cost due to its efficiency and efficiencyin the treatment. Surgical magnifiers with simpler and inexpensive individual lenses, which, when focusing on an object, the distance of this with the operator decreases when applying the magnification of the device, which represents a disadvantage in the ergonomics of the professional, instead with the microscope they are expensive and it is an optical instrument that focuses on the magnification of vision in order to provide an adequate diagnosis and treatment of conservative ducts through micrometric precision. (4) (13)

According to (4) its documentation does not apply in magnifying glasses, while in the microscope orbcontains photography and video. It is demonstrated by a comparison that the magnifying glasses do not haven documentation but in the case of the microscope photography and video are obtained, these expand the communication of the professional with the patient, offering the possibility of obtaining high quality photos and enlargements, documents that can be usedin r Egistros and articles, for referrals to other professionals, insurance companies, for legal purposes and to assist in patient education. (4) (14)

The use of microscope and magnifying loupes in endodontics has become increasingly popular due to the numerous benefits they offer, such as improved visualization and increased precision during root canal procedures. However, the success of endodontic treatments is influenced by various factors, including medical conditions like diabetes mellitus. In their recent study, Pérez Solis et al.(15) proposed a neutrosophic multicriteria method to estimate the success or failure of endodontic treatments in patients with diabetes mellitus. This method takes into account various factors such as age, gender, and the presence of systemic diseases like diabetes mellitus, making it a useful tool in predicting the outcomes of endodontic treatments.

Moreover, the study by Romero Fernández et al.(16) highlights the importance of dental emergency preparedness in dentistry students. The study used neutrosophic values to assess the level of knowledge in dental medical emergencies among dentistry students, indicating the potential role of neutrosophic approaches in assessing and improving the competencies of dental students in emergency situations.

In addition, Vázquez et al. (17) demonstrated the application of sentiment analysis as a qualitative tool in legal research. This approach can be useful in identifying the attitudes and opinions of patients towards endodontic treatments, thereby providing insights into their perceived effectiveness and outcomes.

Furthermore, Armijos Briones et al. (18) proposed treatment alternatives to gingival hyperpigmentation using neutrosophic correlation coefficients. This study highlights the potential of neutrosophic approaches in developing alternative treatments for various dental conditions, including those related to endodontic procedures.

Finally, Mena Silva et al. (19) used neutrosophic statistics to analyze the prevalence of dental fluorosis, indicating the potential application of neutrosophic approaches in dental research.

Neutrosophic approaches have the potential to play a significant role in the field of endodontics, ranging from predicting the success of treatments in patients with diabetes mellitus to developing alternative treatments for various dental conditions(20).

5. Conclusions

1. The microscope and magnifying glass have

allowed greater precision in the treatment of endodontics because they facilitate the work and visibility in the small ducts of the teeth, thus generating a high effectiveness in the process and leading to a timely success, since thanks to the technological improvement there is an easy detection of the affected area or ducts of the teeth.

2. As for the challenge contemplated by the fact of handling this type of instruments has been somewhat complex since it can represent difficulty in adapting to the use of these, however, the technological advance in dentistry represents a synonym of productivity in the achievement of results, the fact of handling this type of technology will give greater reliability in dental treatments.
3. The dental microscope has favored the visualization of the dental anatomy in the endodontic process since thanks to the magnification of human vision it facilitates the elimination of infected pulp tissue and perform proper cleaning, to later fill it with a biocompatible material and achieve a good seal, avoiding the existence of infected remains.
4. The use of both the microscope and the magnifying glass in endodontic treatment has its advantages among them the fact of minimizing the risks for the patient through a better diagnosis either of the ducts of the teeth or other iatrogenic alterations.
5. In consideration of those who make use of this type of instruments that is a professional in the dental area is beneficial since it provides greater comfort in terms of posture, also decreases eye fatigue due to the great magnification that these instruments have and finally the treatment time will be less and more efficient.
6. The use of the microscope in dentistry is currently well understood by dentists, this instrument not only improves ergonomics and diagnosis, but also provides the operator with improved vision, allowing him to use smaller instruments and much less invasive procedures. This contributes to lower morbidity and greater comfort for the patient.
7. The operator should look for microscopes that provide not only the required optical and illumination results, but are also flexible and easy to maneuver, with binocular tilt for better posture and stability.

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