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## Magnification in apical surgery using the endoscope: a review

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### Abstract

**Objective:** A review is made to determine whether the use of the endoscope in endodontic surgery offers advantages in clinical practice, and whether it improves the clinical and radiographic outcomes of the procedure.

**Material and methods:** The main search terms used were: *endodontic surgery, apicoectomy, apical surgery, endoscope, and magnification devices*. The authors searched the Medline database for articles published up to 1 September 2010. The review included experimental studies comparing endoscopic microstructural findings with the findings of the naked eye or other magnification devices, as well as prospective clinical trials comparing endodontic surgery with or without the use of an endoscope, or comparing the endoscope with some other magnification device.

**Results:** Two experimental studies on the capability of the endoscope to identify microstructures and three prospective clinical trials were included in the review. The experimental studies showed the endoscope to be highly precise in application to intraoperative diagnoses in periapical surgery. There were no significant differences in the prognosis of periapical surgery when performed with or without endoscopy. Likewise, there were no significant differences among the use of endoscopy, magnifying lenses or the microscope.

**Conclusion:** Experimental studies have demonstrated the usefulness of the endoscope in identifying microstructures during periapical surgery. However, further randomized and controlled clinical trials are needed to determine whether these advantages in clinical practice imply improved outcomes for periapical surgery.

**Key words:** *Periradicular surgery, endoscope, endodontic surgery, magnification.*

## Introduction

With the introduction of the microscope and endoscope, diagnostic practice in periapical surgery has experienced a technological revolution. Besides increasing the accuracy of the operative procedures, these devices may improve diagnostic capability, due to better visualization of the treatment field (1). As an example, they allow the detection of isthmuses, accessory canals or microfractures of the root, that are otherwise difficult to recognize and treat in the absence of proper magnification (2-4).

The use of the microscope has increased the periapical surgery success rate, reaching 96.5% after one year of follow-up and 91.5% after 5 years (5, 6). This improvement in the prognosis of periapical surgery is due to the fact that the microscope facilitates the elimination of necrotic tissue and bacterial toxins that are not visible without magnification.

In addition to magnification and illumination of the surgical field afforded by the microscope, endoscopy offers the advantage of "circumferential" vision of the entire region, making it possible to examine the lingual surface of the root or the vestibular wall of the prepared retrograde cavity or space (7). Endoscopy use in periapical surgery was described by Bahcall et al. (8) in 1999, and its application to intraoperative diagnosis has become increasingly popular, since adjustment of the angle of vision is easy and fast, and the device is moreover easy to transport (8, 9).

The purpose of this review was to analyze the current literature to determine whether the use of the endoscope in endodontic surgery offers advantages in vision and the identification of microstructures, and whether it improves the clinical and radiographic outcomes of the procedure.

## Material and methods

The main search terms used were: *endodontic surgery*, *apicoectomy*, *apical surgery*, *endoscope*, and *magnification devices*. These terms were used in combination as follows: *endodontic surgery and endoscope*; *endodontic surgery and magnification devices*; *apicoectomy and endoscope*; *apicoectomy and magnification devices*; *apical surgery and endoscope*; *apical surgery and magnification devices*. The authors searched the Medline database for articles published up to 1 September 2010.

The review included experimental studies comparing endoscopic microstructural findings with the findings of the naked eye or other magnification devices, as well as prospective clinical trials comparing endodontic surgery with or without the use of an endoscope, or comparing the endoscope with some other magnification device.

The reference lists of selected trials and relevant review articles were searched for the identification of studies.

## Results

The electronic search strategy yielded 74 studies. One more study (2) was found by searching the reference lists of other studies. From the analysis of the abstracts of these studies, only 5 clinical trials (2, 3, 10-12), two experimental studies (2, 3) and three prospective clinical trials (10-12) were identified as eligible for inclusion in the review.

Accordingly, two experimental studies on the capability of the endoscope to identify microstructures were included for review (2, 3). The first of these studies measured endoscopic effectiveness in identifying dentinal cracks created artificially in apicoectomized roots. The endoscope was found to be significantly more effective than the naked eye, the magnifying lens or the microscope (2). The second experimental study in turn evaluated the diagnostic precision of the endoscope after apical resection and retrograde cavity preparation. The endoscopic findings were contrasted with the observations under the electron microscope (taken as reference). The sensitivity and specificity of the endoscope in identifying isthmuses, accessory canals, obturation gaps, microfractures and irregularities in the margins of the cavity were high (between 73-100%). It was concluded that the endoscope is highly precise in application to intraoperative diagnoses in periapical surgery (3).

Only three prospective clinical trials met the inclusion criteria (10-12). The first of these studies compared the results of periapical surgery when performed with and without the endoscope. The differences between the two groups were not significant, with success rates of 88.9% and 75.4%, respectively (10). In the second study, the success rate in the endoscopy group was 94.9%, which was higher than the 90.6% rate obtained in the group in which magnifying lenses were used. No prognostic differences were observed according to the type of magnifying device used (11). These same authors in turn conducted a randomized study to compare the results obtained with the microscope and endoscope: the success rate after two years was 92% in the microscopy group and 90% in the endoscopy group – the differences between the groups being nonsignificant (12).

## Discussion

Experimental studies have demonstrated the capability and accuracy of the endoscope in detecting microstructures not identifiable with the naked eye (2, 3). However, as usually happens for all innovative techniques claimed to provide significant advances in clinical practice, it is essential to determine whether the use of magnification devices in endodontic surgery is also correlated to improvement in treatment outcomes (13).

We have only found three prospective, controlled clinical trials assessing periapical surgery outcomes in relation to the use of the endoscope (10-12). One compared

the results of periapical surgery when performed with or without the endoscope, while another compared the endoscope versus magnifying lenses, and the third trial compared the endoscope and microscope. None of the trials reported significant differences among the study groups. Consequently, further randomized clinical trials are needed to determine whether the use of the endoscope offers benefits in terms of the results of apical surgery.

Del Fabbro and Taschieri (13) conducted a metaanalysis on the use of magnification devices in endodontics, including the same three clinical studies selected by us in the present review (10-12). The authors concluded that there are no significant differences in outcomes among patients treated using magnifying lenses, the surgical microscope or endoscope. Similarly, no differences were found according to whether the endoscope was used or not. Thus, the type of magnification device employed only minimally conditioned treatment outcome.

Tsisis et al. (14) published a metaanalysis quantifying the outcomes of periapical surgery, and explored the influence of a number of factors upon the prognosis. They found patient age, sex, the type of tooth, the retrograde filling material and the magnification technique to have no effect upon the prognosis. However, in another meta-analysis, von Arx et al. (15) observed that the use of the endoscope resulted in borderline significance ( $p=0.05$ ) – the use of this instrument during surgery tending to result in a higher healing rate than in those cases where the endoscope was not used.

## Conclusion

Experimental studies have demonstrated the usefulness of the endoscope in identifying microstructures during periapical surgery. However, further randomized and controlled clinical trials are needed to determine whether these advantages in clinical practice imply improved outcomes for periapical surgery.

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