

Use of dental operating microscope in endodontic surgery

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Endodontic surgery is an alternative therapeutic approach to endodontic treatment. The outcome of the technique is affected by several factors, some of which can be eliminated by the use of a dental operating microscope. The microscope was used during the performance of 50 apicoectomies, with or without retrograde fillings. For clinical evaluation cases treated with the dental operating microscope were compared to cases treated without it. The postoperative evaluation showed a reduced incidence of symptoms in the cases treated with the dental operating microscope. More important, the dental operating microscope enhanced and facilitated each phase of endodontic surgery. Its use is highly recommended.

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There is no universal agreement on the precise definition of an endodontic treatment failure. Bender et al.^{1, 2} have proposed criteria for successful treatment, on the basis of clinical, radiologic, and histologic findings. These criteria have been widely accepted.

Surgical intervention is a complementary therapeutic approach used when conventional orthograde root canal treatment fails to lead to regression of the pathosis. A surgical approach is also indicated when it is not opportune to try a conventional retreatment. Compared with the results of orthograde root canal treatment, long-term results after endodontic surgery appear to indicate that the percentages of successful treatment decrease. Persson³ clinically and radiologically evaluated the results of 241 teeth treated with apicoectomy after failure of conventional endodontic treatment. He reported that only 55% could be considered to be successful. Failures were reported for 10% of the cases, and the results of 35% were uncertain. Frank et al. reported a rate of failures of 42.3% on a total of 104 teeth. Percentages of success after endodontic surgery depend on several factors, each of which contributes to the final result. These factors may be placed into the following two general groups:

Group I: Anatomic-physiologic-immunologic

- a) root canal anatomy
- b) relationship of root canals with particular anatomic formations
- c) concomitant periodontal lesions
- d) biocompatibility of the retrograde filling material
- e) host response

Group II: Technical-operative factors

- a) case selection
- b) flap design
- c) adequate access to the area
- d) visibility
- e) apical seal

The effects of some of these factors can be influenced by improving illumination thereby enhancing visibility. The general use of a dental operating microscope (DOM) has been suggested by Hume and Greaves,⁴ Apotheker and Jako,⁵ Apotheker,⁶ Baumann,⁷ and Linares.⁸ In endodontics, use of the DOM has been reported by Baurmann¹⁰ and Selden.⁹ Numerous suggestions and advocacy for its use have also been made by Bellizzi and Loushine,¹¹ and Reuben and Apotheker.¹² They reported that the use of the DOM (Fig. 1) has enhanced the results of endodontic surgery because of more adequate illumination and the use of a magnifying

lens. Thus the use of the DOM leads to changes in the surgical procedures, improving the performance, and, most likely, the rate of success.

The purpose of the present study was to describe the technique and results of 50 cases that were surgically treated with the use of the DOM after conventional endodontic therapy had failed. Some of the surgical phases of the treatment are shown: osteotomy and apex preparation (Fig. 2); apical resection and evaluation of the cut root area (Figs. 3 and 4); and preparation of the apical cavity and retrograde filling (Figs. 5 and 6).



Fig. 1. Dental operating microscope and surgical team during endodontic surgery.

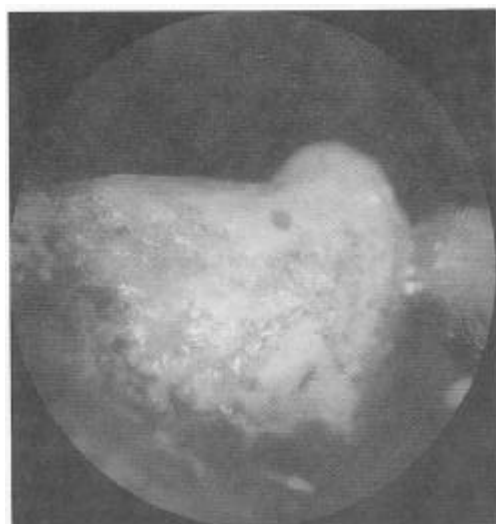


Fig. 2. Osteotomy and apex preparation.



Fig. 3. Apical resection.



Fig. 4. Evaluation of cut root area.

MATERIAL AND METHODS

Fifty teeth previously treated by conventional endodontic methods were included in the study. Subsequent check-ups revealed that associated periapical endodontic lesions had persisted or excessive overfilling was present. All cases that were considered to have been treated unsuccessfully were scheduled for endodontic surgery 6 to 12 months after the original root canal treatment. Periapical intraoral radiographs showed a marked area of radiolucency in the apical region or noticeable amount of filling material beyond the apex. Reports of episodes of pain were infrequent, however, episodes of swelling were common.

In 32 of the 50 cases, regardless of the technique and the materials used for treatment, the orthograde filling was considered to be adequate by the endodontic surgeon on the basis of radiographic evidence. After surgery conventional endodontic retreatment was performed in 14 cases. In these cases root canals were reinstrumented, and the root canals were overfilled. The remaining

four patients did not want to undergo endodontic retreatment. In these cases, the surgical approach with insertion of a retrograde filling became the treatment of choice.

Surgical technique

Before surgery the condition of the periodontal tissues was evaluated by measuring the pocket depth and the width of attached gingiva to determine whether an intrasulcular or scalloping inverse bevel should be used. The surgical area was anesthetized by injection of Xylocaine with epinephrine, 1:100.000. A partial thickness beveled flap, in the two first millimeters, and then a full thickness flap were raised to permit a better flap repositioning. In almost all cases (44), releasing incisions were made. Two releasing incisions were performed in six cases. Determination of the site of bone intervention was based upon radiographic and clinical findings of the root position in the area. The dental operating microscope OPMI 1 (Carl Zeiss, Oberkochen, Germany) was used. This microscope has a five-step magnification changer. It uses a Galilean system and is fully adjustable in inclination. It is provided with a binocular optical system with built-in fiber optics. The microscope is suspended from the ceiling. After the flap was raised the instrument was used to view the area during the surgical procedure. During the procedure, magnification was changed depending on need and the required depth of field. At the initial phase of surgery the microscope was used at a magnification of X6 to help to identify the presence of perforation of the cortical plate. Osteotomy was always started with a straight 3 ram cut. The bone was then removed by means of a long-shank round bur (No. 2) in a low-speed, straight handpiece. When the apical area was reached, the magnification power was raised to x 12. At that magnification the difference between the bone and the root could be more easily detected. The root tip was then carefully denuded of bone. Care was taken to avoid alteration of the apex. The bur was used with a brush stroke. The bone was "painted away" by low-pressure, short, quick strokes. After the root apex had been freed of surrounding bone, the remaining bone was beveled, which facilitated a better accessibility to the root tip. Because of the use of the microscope, osteotomy was performed as minimally as possible. In the presence of a bulky root tip, it was occasionally necessary to remove more bone, but a conservative approach was always used. In presence of extruded endodontic material (Fig. 7), the use of the microscope was elective. Visibility of scattered particles of material in the area was enhanced so that removal was easily performed (Fig. 8). The next step was resection of the root. In an attempt to eliminate the presence of apical deltas usually no more than 2 to 3 mm of the root was removed. The apical root was cut initially about 2 ram from its tip. With the use of the microscope, further evaluation could be made to determine whether additional removal of root structure was necessary. After the apex was removed, the periodontal ligament surrounding the root could be visualized at magnification of X6 to 12. The next step was to determine the angle of the remaining resected dentin surface. The more angled the bevel, the more root structure needed to be removed. The microscope was helpful to avoid a severe angle; it enabled the surgeon to detect the presence of accessory canals on the cut root face. This second cut also allowed viewing a wider area, thus helping to determine the eventual position of the root end filling. The root was then ready for the retrograde filling. At a magnification of x 12, the microscope also helped to evaluate the orthograde filling when inadequate fillings or anatomic variations such as untreated accessory canals were present. The apical retrograde filling was judged to be needed in only 26 of the 50 apicoectomized roots on the basis of inspection through the microscope.



Fig. 5. Preparation of apical cavity.

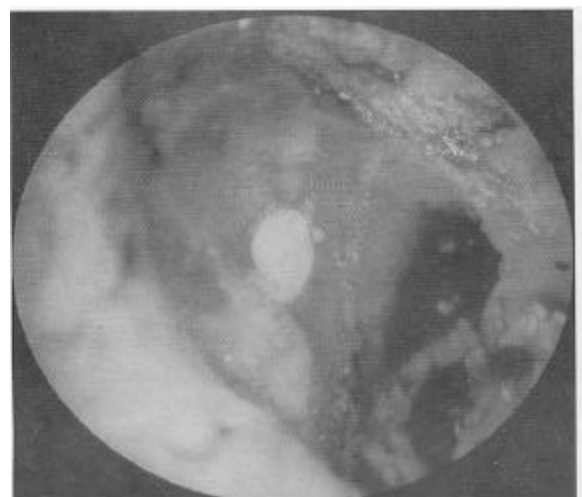


Fig. 6. Retrograde filling.

It was sometimes necessary to reshape the bone access when preparing the root end. It was found that preparation of the cavity with a long-shank round bur did not interfere with the use of microscope. Root-end cavities were prepared under a magnification of x 16. At that magnification, visualization of the cavity preparation was facilitated. The use of the microscope enabled

visualization of anatomic variations that then dictated appropriate treatment. Although an inverted cone bur may be used for shaping the root, a round bur was preferred.

The cavity is usually undercut for retention of the filling material. Various materials may be used for the retrograde filling. These include amalgam, IRM, Super EBA disiccated ZOE, and numerous others, depending upon humidity and other factors. These other factors include root anatomy, size and shape of the cavity, and the presence of a post or other metal objects in the canal. Root-end filling was always performed at a magnification of X 16. At this magnification, removal of material and dentin debris was enhanced.

In addition the filling margins can be burnished, and the amount of material used can be limited minimizing foreign body connective tissue reactions (Figs. 9 and 10). At completion of surgery, interrupted sutures were used to help adaptation of the flap on the underlying bone. A nonsteroidal anti-inflammatory drug (Ketoprofen, 100 mg every 8 hours) was prescribed to the patients for 24 hours after the surgery.



Fig. 7. Radiograph shows extruded endodontic material on lower right first molar.

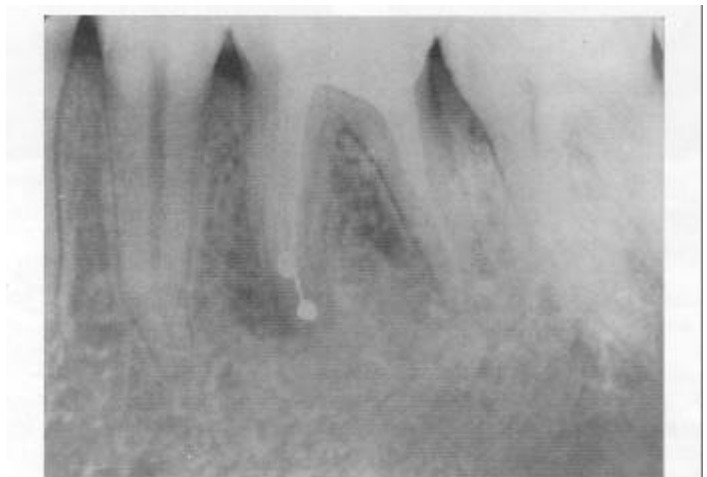


Fig. 8. Radiograph of lower right first molar after endodontic surgery performed with DOM.



Fig. 9. Presurgical radiograph of upper left first incisor. Overfilling is visible.



Fig. 10. Postsurgical radiograph on upper left first incisor shows minimal amount of retrograde filling used.

For statistical analysis of the outcome of the procedure, 20 subjects treated using the microscope were compared with 20 patients treated without it. The subjects were randomly chosen from two groups of patients treated according to the two protocols. The

results are shown in Table 1. Two postoperative parameters were recorded, pain and swelling. Pain was divided into four levels: absence, slight, moderate, and severe. An examiner not participating in the study evaluated the swelling, which was also assigned to four levels: absence, slight, moderate, and severe. A chi-squared test was performed between the two groups. A chi-squared contingency table analysis was used to compare the two groups for both pain and swelling at three points in time. There was a statistically significant association between type of treatment and degree of pain at 24 and 48 hours after surgery. As can be seen in Table 1, there is a tendency for a lesser degree of pain for the DOM group, particularly for an absence of pain. A similar pattern is seen for level of swelling, although the association is not statistical significant.

Table 1. Percentages of postsurgical pain and swelling

	24 hours after surgery		48 hours after surgery		1 week after surgery	
	A (%)	B (%)	A (%)	B (%)	A (%)	B (%)
Pain						
Absence	30	5	90	30	100	100
Slight	30	50	10	30	0	0
Moderate	10	35	0	30	0	0
Severe	30	10	0	10	0	0
		$p = 0.025$		$p = -0.001$	0	0
Swelling						
Absence	50	25	30	20	95	80
Slight	10	30	30	40	5	20
Moderate	40	35	35	30	0	0
Severe	0	10	0	10	0	0
		$p = 0.125$		$p = 0.396$	0	0

A = group assisted with dental operator microscope.

B = group not assisted with dental operator microscope.

DISCUSSION

Various endodontic surgical phases are more easily performed with the use of the DOM. Some of the factors that influence the outcome of treatment can be changed and lead to a higher rate of success. The DOM is very useful in the first phase of osteotomy and apex preparation. The following conditions are facilitated: a reduction in the amount of bone removal; better visualization of the apical area, which markedly improves detection and inspection of apical and periapical zones; enhanced detection of anatomic variations and visualization of the pathosis; ready detection of extruded material from orthograde endodontic filling; and easier apex preparation because detection of the presence of accessory canals, fractures, and perforations in the apical area is facilitated. The second phase, the removal of the root tip, is of crucial importance for the success of the treatment. Because the apical delta may contain bacteria, 16-19 it is imperative to remove the pathologic tissue from the apical region, to clean the canal or the accessible parts of it, and to seal it from the apical tissues. The third phase of endodontic surgery is apex preparation and retrograde filling. With the use of the DOM at a magnification of $\times 16$ to 32, visual acuity is improved, which enables better detection of debris or particles of material that otherwise would remain in the bone cavity. The presence of such material contributes to development of a foreign body reaction and promotes failure of the endodontic surgery. Furthermore, when the root-end filling is necessary, a limited amount of material is used, and the operator is able to place it with higher precision.

The results of the present study indicate that patients treated with help of the DOM recovered sooner as compared with patients treated without the instrument with respect to postoperative pain, whereas in the evaluation of swelling, no statistical difference was found. After preliminary consideration of the postoperative symptoms, it seems that patients treated under microscopic observation refer to only minor incidence of them. This outcome may be due to minimized trauma for both soft and hard tissues, including minimal osteotomy, accuracy in the curettage of the area, and optimized visualization of possible factors that cause the persistence of the pathosis, such as accessory canals that are nondetectable to a naked eye examination. To use the microscope effectively, the surgeon must familiarize himself or herself with the instrument. The assisting staff must also adapt to the differences in instrument handling and chair-side assistance. Most of the communications between the surgeon and the assistant have to be changed. When the instrument is first used, problems such as trembling hands and altered perception and evaluation of the dimensions of the structures arise and may be discouraging. However, within a short time, both the surgeon and the staff will become familiar with the nuances of operating with the DOM. The benefits derived from the use of the DOM may be summarized as better visibility as a result of higher magnification and better illumination as a result of the use of fiber optics.

The disadvantages of the DOM include its cost, the time needed to train staff, and possibly increased surgical time.

Considering that quality and precision are highly improved, the DOM enhances the efficacy of surgical endodontics. Further studies are needed to compare the rate of success in endodontic surgery with the use of DOM to that of the usual techniques.

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REFERENCES

1. Bender IB, Seltzer S, Soltanoff W. Endodontic success: a reappraisal of criteria-part 1. ORAL SURG ORAL MED ORAL PATHOL 1966;22:780-9.
2. Bender IB, Seltzer S, Soltanoff W. Endodontic success: a reappraisal of criteria-part 11. ORAL SURG ORAL MED ORAL PATHOL 1966;22:790-803.
3. Persson G. Bedomning av resultatet efter rotamputation [in Swedish]. Svensk Tandlak Tdskr 1966;59:219-28.
4. Frank AL, Glick DH, Patterson SS, Weine F. Long-term evaluation of surgically placed amalgam fillings. J Endodont 1992;18:391-8.
5. Hume WJ, Greaves IC. The stereophotomicroscope in clinical dentistry. Br Dent J 1983;154:288-90.
6. Apotheker H, Jako GJ A microscope for use in dentistry. J Microsurg 1981;3:3-7.
7. Apotheker H. The applications of the dental microscope: preliminary report. J Microsurg 1981;3:103-6.
8. Baumann RR. How may the dentist benefit from the operating microscope? Quintessence Int 1977;5:17-8.
9. Linares JM. Microscope operatoire et odontologie. Chir- Dent France 1989;59:478-9.
10. Baumann RR. Endodontic und Operationsmikroskop. Die Quintessenz 1975;10:55-8.
11. Selden HS. The role of the dental operating microscope in endodontics. Pa Dent J 1986;53:36-7.
12. Selden HS. The role of a dental operating microscope in improved nonsurgical treatment of "calcified" canals-ORAL SURG ORAL MED ORAL PATHOL n. 1989;68:93-8
13. Bellizzi R, Loushine R. Adjuncts to posterior endodontic surgery. J Endodont 1990;16:604-6.
14. Reuben HL, Apotheker H. Apical surgery with the dental microscope. Oral Surg 1984;4:433-5.
15. Barnes IE. Surgical endodontics: a color manual. Littleton, Massachusetts: PSG Publishing Company Inc., 1984:1-117.
16. Block RM, Bushell A, Rodrigues H, Langeland K. A histopathologic, histobacteriologic, and radiographic study of periapical endodontic surgical specimens. ORAL SURG ORAL MED ORAL PATHOL 1976;42:656-78
17. Sjogren U, Hagglund B, Sundqvist G, Wing K. Factors affecting the long-term results of endodontic treatment. J Endodont 1990;16:498-504.
18. Molven O, Halse A, Grung B. Surgical management of endodontic failures: indications and treatment results. Int Dent J 1991;41:33-42.
19. Tidmarsh TG, Arrowsmith MG. Dentinal tubules at the end of apicected teeth: a scanning electron microscopy study. Int Endod J 1989;22:184-9.
20. Seltzer S. Endodontology: biologic considerations in endodontic procedures, 2nd ed. Philadelphia, Lea & Febiger, 1988:1566