Microsurgical instruments for root end cavity preparation following apicoectomy

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ABSTRACT

Introduction-Root-end resection, also known as apicoectomy, is a widely recognized and accepted surgical approach aimed at preserving teeth afflicted with periradicularpathosis. In cases where nonsurgical endodontic retreatment is not viable or is declined by the patient, periradicular surgery becomes a crucial method for retaining affected teeth
Materials and Methods- The study sample comprised 80 consecutively treated teeth, involving 40 patients with a mean age of 45 years (ranging from 15 to 70 years).
Results- The overall results were excellent for pain assessment, as 91.4% teeth exhibited no painful symptoms .2.8% patients reported a permanent painful condition, with a pain score of 2.
Conclusion- The newly introduced retrotips prove to be highly effective for the preparation of root-end cavities. Root-ends prepared using this innovative sono-abrasive technique has demonstrated outstanding outcomes, as evidenced by excellent results observed during the one-year follow-up examination.

INTRODUCTION

Root-end resection, also known as apicoectomy, is a widely recognized and accepted surgical approach aimed at preserving teeth afflicted with periradicularpathosis. In cases where nonsurgical endodontic retreatment is not viable or is declined by the patient, periradicular surgery becomes a crucial method for retaining affected teeth. The primary objective of periradicular surgery is the regeneration of periapical tissues, restoring them to a healthy state.[1,2]The essential aspect of this surgical procedure involves the hermetic sealing of any potentially harmful agents within the confines of the root, preventing the risk of reinfection around the new apex. To achieve this objective, it is generally agreed upon that a 3 mm segment of the root end should be resected. Additionally, it is recommended to place a root-end filling, also known as retro filling, to an adequate depth. This comprehensive approach is designed to ensure the success of the procedure and contribute to the overall health of the periapical tissues. The conventional root end cavity preparation technique using rotary buts in a microhandpiece poses several problems to the surgeon: 1)Difficult access to the root-end, especially in case of limited working space. 2)Risk of lingual perforation of the root or cavity preparation when it does not follow the original root canal path. 3)Insufficient depth and retention of the root-end filling material 4)The root-end resection procedure exposes dentinal tubules 1 Isthmus tissue cannot be removed[.3],In the early 1990s, the challenges associated with conventional root-end cavity preparation were partially addressed with the introduction of micro instruments. The initial retro tips available had a smooth working tip and were powered by ultrasonic devices. More recently, a novel set of retro tips surfaced with diamond-coated tips, driven by a sonic hand piece. In a preliminary study, we assessed the intra-operative performance of these new retro tips, focusing on their applicability, access to the apex, and efficacy in root-end cavity preparation.[1,4]

PATIENTS AND METHODS: The study sample comprised 80 consecutively treated teeth, involving 40 patients with a mean age of 45 years (ranging from 15 to 70 years). This diverse patient group provides a comprehensive representation of individuals spanning various age ranges, contributing to the robustness of the study's findings. The inclusion of a broad age range allows for a more nuanced understanding of how the proposed techniques or interventions may apply across different demographics within the patient population. The distribution of the treated teeth is given in Table 1.

Table 1: Distribution of Treated Teeth

	Maxilla	Mandible	TOTAL
Incisors	35	15	50
Canines	7	4	11
Premolars	6	4	10
Molars	4	5	9
TOTAL	52	28	80

The retrotips used in the study were KaVo SONIC retro tips, manufactured by KaVo GmbH in Biberach, Germany. These tips are designed in left and right configurations and are available in two shapes: Flame- for cavity preparation, and T-form for undercut preparation .The tips are equipped with a 3 mm working length coated with diamond for enhanced durability and effectiveness. Additionally, a sterile cooling agent is delivered in proximity to the working tip. These retrotips are powered by a sonic handpiece operating at a high frequency, specifically the Ah-scaler SONIC flex from KaVo in Biberach, Germany. This detailed description outlines the specific features and characteristics of the instruments utilized in the study for root-end cavity preparation. All patients in the study underwent treatment following a standardized surgical protocol, the details of which have been previously reported (referenced as elsewhere) and are succinctly summarized in this article. Local anaesthesia was employed for all surgical procedures.The surgical steps included: 1) Flap Reflection: A buccal mucoperiosteal flap was reflected following either a sulcular or submarginal incision, with additional divergent release incisions as necessary.2) Apex Localization: The apex of the tooth was identified after removing the labial or buccal bone. This process was facilitated using a round bur in a slow-speed handpiece, which included sterile coolant for optimal conditions.3) Pathologic Tissue Removal: The soft tissue associated with periapical pathology was meticulously curetted to ensure thorough removal.4) Root-End Resection: A 3 mm segment of the root-end was resected perpendicular to the long axis of the tooth.5) Root-End Cavity Preparation: A root-end cavity with a minimum depth of 2 mm was prepared using the SONIC retro tips. The use of SONIC retro tips in the root-end cavity preparation is a notable aspect of the protocol, as mentioned in the previous sections. This technique aims to enhance the precision and efficacy of the root-end preparation during periradicular surgery.

Following the repositioning of the flap, primary wound closure was achieved using interrupted sutures. To monitor the progress and outcome of the surgery, periapical radiographs were taken at three specific time points: preoperatively, at the time of suture removal (10 days postoperatively), and during the 1-year follow-up examination.For the standardization of radiographs and to ensure consistent imaging conditions, an aiming device was customized. This device was individualized for each patient using a heavy-bodied impression material. The use of such a standardized imaging approach helps maintain consistency and accuracy in radiographic assessments across different time points, allowing for a reliable comparison of preoperative, postoperative, and follow-up images.

PARAMETERS FOR ASSESSING SUCCESS AND FAILURE: A COMPREHENSIVE ANALYSIS

After one year, the evaluation was based on anamnestic, clinical, and radiographic criteria. Each tooth treated surgically received scores for pain that is 0: No pain, 1: Mild pain (temporary), 2:Mild pain (permanent) , 3: Severe pain . The clinical manifestations were Score Definition 0 No clinical manifestations 1 Apical area tender to palpation 2 Apical swelling or tooth tender to percussion 3 Sinus tract or abscess . Radiographically, the size of the periradicular bone defect (S) was approximated using the formula: S = A/2 X B/2 X IJ (where A = length and B = height of radiolucency). The percentage of osseous regeneration (R) was calculated by comparing the 1-year radiograph with the postoperative radiograph using the formula: R = 100 - (Srecall X 100/SPoStop). Considering pain and clinical scores, along with the percentage of osseous regeneration, each treated tooth was categorized as successful, improved, or failing, based on the specifications outlined in Table 2.

Table 2: Healing Classification

CLASS	DEFINATION
Failure	Limited/Incomplete Healing: Osseous regeneration below 50% or a pain/clinical score of 2 or higher.
Improvement	Partial Healing: Osseous regeneration between 50-90% with pain and clinical scores both equal to 0.

SUCCESS	Complete Healing: Osseous regeneration exceeding 90%, accompanied by pain and clinical scores both equal to 0.

RESULTS

During the follow-up period, 10teeth were lost. The reasons for tooth loss included three patients moving away, five patients not attending the recall examination, and two teeth being extracted for reasons unrelated to periapical treatment. Out of the remaining 70 teeth, the postoperative healing process was uneventful.At the1-year follow-up examination, 64 teeth showed no adverse clinical manifestations, indicating a clinical score of 0. Only 4 teeth were tender to vestibular palpation, with a clinical score of 1. The overall results were excellent for pain assessment, as 64 teeth exhibited no painful symptoms (pain score = 0). Two patients reported a permanent painful condition, with a pain score of 2.

DISCUSSION

The present report focuses on analyzing the outcomes of periradicular surgery, specifically employing a novel retrotip for root-end cavity preparation. The advent of micro instruments has significantly transformed the surgical approach to root-end surgery, with various descriptive and experimental studies exploring the potential and efficacy of these retrotips. Despite this, there remains a scarcity of clinical follow-up studies. A singular experimental study was identified, utilizing sonic retrotips in an in vitro setting. This scanning electron microscopy study involved the preparation of root-end cavities using sonic tips, with a subsequent comparison to cavities created by burs in a conventional hand piece.[5] The incidence of root-face cracking was found to be low, with no significant difference observed between the two preparation techniques. However, there was a notable drawback in sonically prepared cavities, where marginal chipping was worse compared to cavities prepared conventionally.[6] Notably, this study reported a significantly higher occurrence of crack formation in the walls of root-end cavities prepared by ultrasonic tips compared to those made with a bur. Conversely, a separate report indicated no instances of root-face cracking after cavity preparation using ultrasonic retrotips at various power settings. Nevertheless, it was highlighted that, unlike bur-prepared root-end cavities, there was a consistent observation of chipping along all the ultrasonically prepared root-end cavosurface margins.[7]

A study reported a correlation between the frequency setting of ultrasonic retrotips and the incidence of root-face alterations. The study identified three types of cracks on resected root-ends: canal cracks, intradentin cracks, and cemental cracks. In cases where cracking occurred, the use of high-frequency ultrasonic root-end preparation was associated with a significantly higher number of canal cracks per tooth compared to a low-frequency preparation technique. To comprehensively understand the potential impact of cracks, further research is warranted. It should explore the likelihood of cracks occurring at various preparation depths and assess their implications on other variables, such as leakage. A particularly intriguing aspect would be to compare sonic instrumentation with ultrasonic instrumentation, specifically regarding the type and frequency of root-face alterations. The formation of cracks reaching the coronal aspect of the root-end filling raises concerns about compromising the benefits derived from the shape of the root-end cavity prepared by retrotips. Therefore, a more in-depth investigation into these aspects is crucial for a comprehensive understanding of the implications of root-face alterations in root-end surgery.[8,9,10]Studies have demonstrated that the use of micro instruments facilitates optimal root-end preparation, both in terms of dimension and direction. Root-end cavity preparations made with micro instruments exhibit more parallel walls and greater depth, enhancing retention capabilities. Importantly, these preparations closely follow the original root-canal system compared to those prepared with burs. Additionally, micro instruments enable the effective removal of any isthmus tissue that may be present between two canals within the same root. The advantages of microinstrumentation in achieving precise dimensions, direction, and adherence to the root-canal system highlight its efficacy in root-end surgery.[11,12]

The root-end resection can be executed in a more perpendicular manner to the long axis using sonic root-end cavity preparation. This approach helps prevent the creation of a bevelled root surface at the neo-apex. Findings from dye leakage and scanning electron microscopy studies on resected roots suggest that there might be a potential for leakage through exposed apical dentinal tubules. Therefore, employing sonic root-end cavity preparation not only allows for a more perpendicular root-end resection but also necessitates consideration of potential leakage issues through exposed dentinal tubules at the apical region.The reported success rates for periradicular surgery, employing conventional root-end preparation techniques, fall within a range of 50% to 70%. Due to variations in study designs, surgical approaches, follow-up durations, and success criteria, a direct comparison among these clinical studies proves challenging. Nevertheless, a consistent observation emerges: for a majority of teeth, the treatment outcome, when evaluated at the one-year follow-up, tends to remain stable thereafter. It is emphasized that

cases exhibiting partial or incomplete radiographic healing at the one-year follow-up, in the absence of adverse clinical findings, need not be considered for retreatment. From the clinician's perspective, such cases may be viewed as successes rather than failures.[13,14,15]

CONCLUSION

The newly introduced retrotips prove to be highly effective for the preparation of root-end cavities. They streamline the surgical process for treating root ends in cases where access is constrained, simplifying the procedure. Root-ends prepared using this innovative sonoabrasive technique has demonstrated outstanding outcomes, as evidenced by excellent results observed during the one-year follow-up examination.

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