Apical surgery vs apical surgery with simultaneous orthograde retreatment: A prospective cohort clinical study of teeth affected by persistent periapical lesion

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Abstract

Aim: This prospective clinical study analyzed the 24-month outcome of conventional apical surgery retro-filled with calcium-silicate cement versus apical surgery with simultaneous orthograde retreatment by means of clinical and radiographic criteria.

Materials and methods: This study included 83 teeth affected by persistent periapical lesions in 68 patients. Mean age was 52 years (median = 51 years; range 19–81 years). Twenty-eight cases were treated with apical surgery, 16 cases with apical surgery with simultaneous orthograde retreatment and 39 cases with orthograde retreatment in previously treated teeth established as control group. Periapical index score (PAI) was used as radiographic criteria. Teeth were examined at 6 months, 1 and 2 years and classified as healed (without any symptoms and signs of inflammation) or non-healed (with symptoms and signs of inflammation). Results: The clinical and radiographic criteria showed a statistically significant difference between the two groups. Conclusions: Apical surgery with simultaneous orthograde retreatment is a suitable treatment option for persistent periapical lesions.

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Introduction

The aim of orthograde retreatment is the elimination of necrotic tissue, bacteria and infected obturation material such as gutta-percha and cements from root canal and seal of the canals to prevent re-infection and allow healing. \(^1\) Preparing root canals to the apical foramina\(^2\) or using a patency file\(^1\) may clean most of the apical portion of the main canal, but bacteria are still likely to remain in lateral and accessory canals or in apical ramifications\(^4\) that remain un-instrumented or out of the reach of irrigants. In specific cases when bacteria colonize the apical ramifications of the canal or in presence of extraradicular infection, a surgical procedure effectively removes the infected site and enhances chances of healing. \(^5\) However, in the majority of teeth in which bacteria colonize within the entire root canal system, root-end filling might not effectively prevent persistence or recurrence of apical periodontitis after surgical procedure, \(^3\) hence a simultaneous orthograde therapy with apical surgery would eliminate the infection and prevent re-infection. \(^5\) As orthograde retreatment is performed simultaneously with apical surgery, coronal and middle portions of the root canal system are also cleaned thoroughly. \(^7\) Therefore, the present study compared results of two different surgical approaches, with and without simultaneous orthograde retreatment. As control group conventional orthograde retreatment was considered.

PAI \(\leq 2\), healing (without any symptoms and PAI = 3) or diseased (with symptoms or PAI \(\geq 4\) and not functional) on the basis of radiographic and clinical criteria. At 24 months evaluation, healed and healing were considered as success and diseased and fracture as failure. Multilevel GLM model and an ordered logistic regression as statistical analysis was made with level of significance set at \(p < 0.05\).

Results: Total drop-out was 7\% (\(n = 6\)). After 6–9 months, 6 teeth (3 from apical surgery, 2 from simultaneous treatment and 1 from orthograde retreatment) were extracted for root fracture. Twenty-four-month success rate of apical surgery group was 78\% (\(n = 17\)), apical surgery with simultaneous orthograde retreatment presented 81\% (\(n = 10\)) and orthograde retreatment success was 80\% (\(n = 24\)). There was no statistically difference between the groups at 24 months (\(p = 0.890\)).

Conclusions: Both surgical techniques revealed a high percentage of healing, similar to that reported by previous studies. Apical surgery with simultaneous orthograde retreatment showed a faster healing after 12 months comparing to the control group.

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PAROLE CHIAVE
Chirurgia apicale; Ritrattamento; Trattamento; Endodonzia; MTA.
Materials and methods

The study was conducted in full accordance with the ethical principles, including the Declaration of Helsinki. This report was written according to Consolidated Standards of Reporting trials guidelines for reporting clinical trials.

Patient population

This study was conducted in the Department of Endodontic, Alma Mater Studiorum University of Bologna. It considered 83 teeth in 68 patients (M = 35, F = 48; mean age = 52; median = 51 years; range 19–81 years). Table 1 illustrates teeth distribution according to gender, age and treatments.

Inclusion criteria were previous root canal treatment, periodontal lesion of strictly endodontic origin with or without clinical signs or symptoms such as swelling and sinus tract and a minimum follow-up of 24 months. Only cooperative patients without any compromised medical history and use of bisphosphonates were included. Exclusion criteria were class II mobility or greater, horizontal and vertical fractures, perforations, local anatomical limits and inadequate periodontal support.

Criteria for inclusion of teeth in 3 groups were based on two different factors: lesion diameter and prosthetic restoration. When a lesion diameter was >5 mm, in presence or absence of prosthetic restoration, tooth was subjected respectively to apical surgery or apical surgery with simultaneous orthograde retreatment. Instead if a lesion diameter was ≤5 mm, tooth was subjected to orthograde retreatment independently from prosthetic restoration.

Treatments

In apical surgery group a preoperative periapical radiograph (Ultraspeed, Carestream, USA) of the tooth was captured, the tooth anaeasthetized with 2% mepivacaine (Carboplyina, Molteni, Scandicci, Italy). A full-thickness mucoperiostal flap was raised. Then osteotomy with high speed water-cooled diamond burs (Intensiv, Grancia, Switzerland) mounted on a high-speed water-cooled handpiece (Castellini-Anthos, Bologna, Italy) has been done. After hemostasis, affected roots were resected for 2–3 mm with a diamond bur. Root-end cavities were prepared and filled with a hydraulic calcium silicate cement. Wound was closed using multiple interrupted sutures with Vicryl 3.0 (Johnson & Johnson, Spreitenbach, Switzerland). In different cases Coe-Pak (GC, Fuji, Japan) as a non-eugenol surgical dressing was used. Patient was recalled after 7–14 days. In this session, in case Coe-Pack was used, it was removed, wound was controlled, sutures were removed and a control X-ray was taken.

In apical surgery with simultaneous orthograde retreatment group a preoperative periapical radiograph of the tooth was captured, the tooth anaesthetized with 2% mepivacaine (Carboplyina, Molteni, Scandicci, Italy) and isolated with rubber dam (Hygienic Dental Dam, Coltène Waledent, Cuyahoga Falls, OH, USA). Straight-line access was prepared with a high-speed, water-cooled diamond bur (Intensiv, Grancia, Switzerland) mounted on a high-speed water-cooled handpiece (Castellini-Anthos, Bologna, Italy). After preliminary scouting of canals with size 10 K-files (Dentsply Sirona, Ballaigues, Switzerland), working length (WL) was established with an electronic apex locator (Root ZX, Morita, Tokyo, Japan) and confirmed radiographically. Canals were instrumented in a stepdown sequence with the coronal third enlarged with size 4-3-2 Gates-Glidden drills (Dentsply Sirona) and the middle and apical thirds instrumented by hand with K-files (Dentsply Sirona) with 1 mm increments to size 20 to 45 at WL in a step-back technique. Canals were intermittently irrigated with 5 to 10 mL of 5% NaOCl (Niclor 5, Ogna, Muggiò, Italy), cleaned with Endosolv (Septodont, Cedex, France) and finally flushed with 1 to 3 mL of 10% EDTA (Tubulicleen, Ogna). Canals were filled with vertical compaction of gutta-percha (Hygenic, Coltène, Germany) and an endodontic sealer. Then Rubber dam was removed and apical surgery as described earlier was performed. A final X-ray was taken. In different cases Coe-Pak (GC, Fuji, Japan) as a non-eugenol surgical dressing was used. Patient was recalled after 7–14 days. In this session, in case Coe-Pack was used, it was removed, wound was controlled, sutures were removed and a control X-ray was taken.

In orthograde retreatment the procedures were standardized following Pirani et al. Canals were instrumented in a stepdown sequence with the coronal third enlarged with size 4-3-2 Gates-Glidden drills (Dentsply Sirona) and the middle and apical thirds instrumented by hand with K-files (Dentsply Sirona) and obturated with Thermafil (Tulsa Dental Products, Tulsa, OK) and AH Plus sealer (Dentsply DeTrey, Konstanz, Germany).

Follow-up

A radiographic examination was performed prior to intervention, 1 week after treatment, 1 month and then every 6 months up to 24 months. Radiographs were taken with X-ray films using paralleling technique in the standardized position.

Assessment of clinical success

Clinical success was defined on the basis of clinical and radiographic criteria. Clinical criteria were presence of symptoms (swelling, sinus tract) or other signs of infection and/or normal functioning of the tooth. Radiographic criteria were examined according with periapical index. Teeth free from symptoms and PAI ≤ 2 were classified as healed.

Table 1 Teeth distribution.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>18–30</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>31–40</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>41–50</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>51–60</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>&gt;60</td>
<td>29</td>
</tr>
<tr>
<td>Treatments</td>
<td>Apical surgery</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>Apical surgery with simultaneous orthograde retreatment</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Orthograde retreatment</td>
<td>39</td>
</tr>
<tr>
<td>Total</td>
<td>83</td>
<td></td>
</tr>
</tbody>
</table>
Table 2  Final clinical outcome. Clinical success rate also considered fractures of 3 teeth in apical surgery group, 2 teeth in apical surgery with simultaneous orthograde retreatment group and 1 tooth in orthograde retreatment group. Success was defined when a tooth was considered healed or healing and failure when diseased or fractured. Final clinical outcome at 24 months for apical surgery was 78%, for apical surgery with simultaneous orthograde retreatment was 81% and for orthograde retreatment was 80%.

<table>
<thead>
<tr>
<th>Clinical outcome</th>
<th>Success % (n)</th>
<th>Failure % (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Healed</td>
<td>Healing</td>
</tr>
<tr>
<td>Apical surgery (n = 26)</td>
<td>67% (17)</td>
<td>11% (3)</td>
</tr>
<tr>
<td>Apical surgery with simultaneous orthograde retreatment (n = 15)</td>
<td>68% (10)</td>
<td>13% (2)</td>
</tr>
<tr>
<td>Orthograde retreatment (n = 36)</td>
<td>66% (24)</td>
<td>14% (5)</td>
</tr>
</tbody>
</table>

without any symptoms and PAI = 3 in which the lesion is reduced were classified as healing and teeth with symptoms or PAI ≥ 4 were classified as diseased. At 24 months evaluation, healed and healing were considered as success and diseased and fracture as failure.

Statistical analysis

Multilevel GLM model was fitted to evaluate the existence of any significant difference regarding treatments, follow-up times (baseline, 6 months, 12 months and 24 months), and the interaction between treatments and time frames; tooth type was added to the model as covariate. An ordered logistic regression was fitted to evaluate any significant difference between treatments as final outcome. p value was previously set at 0.05.

Results

Six teeth in 6 patients were excluded for lack of follow-up (drop-out = 7%), so that 77 teeth (62 patients) were included in the study. Results at 24 months are shown in Table 2. The PAI score and the presence of pathological signs and/or symptoms were recorded at follow-ups (Figs. 1–3). Six teeth were extracted for root fracture 3 to 12 months after the treatment, 3 teeth in apical surgery group (one central upper incisor, two lateral upper incisors), two teeth in apical surgery with simultaneous orthograde retreatment group (one central upper incisor and one lateral upper incisor) and one tooth in conventional orthograde retreatment group (first upper premolar).

A statistically significant difference between apical surgery with simultaneous orthograde retreatment and orthograde retreatment was observed at 12 months (p = 0.025). Apical surgery with simultaneous orthograde retreatment showed faster healing compared to conventional orthograde retreatment (Fig. 4). It should be mentioned that apical surgery with simultaneous retreatment and orthograde retreatment at 24 months were just at the limit of statistically significant difference (p = 0.069).

Discussion

According to data from the present study, apical surgery with simultaneous orthograde retreatment showed a statistically higher healing rate (p = 0.025) at 12 months, compared to conventional orthograde retreatment.

These results are in agreement with a previous Cochrane systematic review11 which analyzed 3 different randomized controlled trials.14–16 Results of this study confirmed also a meta-analysis,17 where orthograde retreatment over a 2 years follow-up time showed a lower success rate compared to apical surgery, but considered an orthograde retreatment more effective over a 4 years follow-up time.15 Hence, a longer follow-up (4 years) is required to evaluate results before final classification.18 In a past systematic review19 apical surgery with simultaneous orthograde retreatment showed a higher success compared to apical surgery and orthograde retreatment separately.

After the introduction of microsurgical principles and new materials for apical obturation in endodontic surgery (i.e. Calcium Silicate materials) healed rates of apical surgery with root-end filling improved.20 Calcium silicate demon-

Figure 1  (A) A preoperative radiograph of a maxillary first premolar with a periradicular lesion. (B) A postoperative radiograph of tooth underwent apical surgery. (C) The radiograph taken at the 2-year recall exhibits a complete resolution of the periradicular endodontic lesion. The tooth is classified as healed.

strated good biocompatibility, antimicrobial properties, hydrophilicity, sealing ability, biointeractive and bioactive features. In the present study 5 teeth subjected to apical surgery and apical surgery with simultaneous orthograde retreatment were extracted for root fracture which were not statistically analyzed but were considered as failures in survival rates. This fact may be interesting as reviewed by Ng et al. amongst 15 studies only included extractions and retreatments in the failure category. Calcium silicate cement showed in vitro a 1.04% expansion during fluid contamination (i.e. blood). This expansion may be an initial cause for root crack during apical surgery.

In this study lesions size was a criteria for treatment selection. In small lesions resident progenitor cells/stem cells might be capable of restoring damage periapical tissue but in large lesions it will not occur and the defect will heal by fibrous connective tissue repair.

Different flap techniques (papilla base and sulcular incision) is introduced in apical surgery but there was no statistically different between these groups in term of soft tissue modifications.34

In this study all teeth were endodontically treated before the surgery but also in specific cases such as restorations and dystrophic calcification apical surgery could be as the first treatment option.35 A recent long term study shows high percentage of healing in endodontic treatments but few information is available on long-term outcome of apical surgery.36

Conclusions

Both surgical techniques and orthograde retreatment revealed a high percentage of healing.

The statistically significant difference at 12 months between apical surgery with simultaneous orthograde retreatment and orthograde retreatment showed a faster healing rate in the first group. This can be explained by slower healing dynamics in the orthograde retreatment in which the lesion in not radically removed. Anyway there was not any statistically significant difference between the groups at 24 months.

Conflict of interest

The authors have no conflicts of interest to declare.

References
