Surgical Endodontics

Root end resection

1980 Harrison and Todd. The effect of root resection on the sealing property of root canal obturations.

- Root resection with a rotary instrument in a high-speed handpiece does not adversely affect the sealing property of well-condensed GP-sealer obturations. (cold lateral condensation)

Therefore should you just accept the apicectomy with no retrograde? - as apical seal would not be improved (provided seal is good in the 1st place). If doubt exists a retrofilling should be placed.

1993 Craig and Harrison. Wound healing following demineralization of resected root ends in periradicular surgery

Citric acid used to demineralise root ends resulting in more rapid and complete healing than the non-demineralized. Therefore it is proposed that demineralization enhances cementogenesis by removing the smear layer and exposing the collagen fibrils (organic component of resected cementum and dentin).

The PDL derived tissue is primarily responsible for dentoalveolar healing and endosteal-derived tissue is responsible for alveolar (osseous) healing.

Smear layer may act as a barrier to induction mechanisms for cementum deposition emanating from resected dentine or cementum. Exposure of collagen promotes early adherence of fibrin, fibronectin and reparative cells to the resected root surfaces.

Conclusions

- Demineralisation of resected root ends with citric acid enhances cementogenesis and dentoalveolar healing.
- Cementum deposition on resected root ends is essential for optimum repair which includes re-formation of a functional PDL between cementum and new bone.
- Granulation tissue emanating from severed endosteal tissues is primarily responsible for alveolar healing – better with demineraized roots

Therefore demineralization of resected root ends should be incorporated into the periapical surgery.

1994 Gilheany et al Apical dentin permeability and microleakage associated with root end resection and retrograde filling.

2 methods for leakage – one along filling/dentine surface and other through dentinal tubules. The sum of these is apical leakage.

Study adjusted angle of resection and depth of filling material

Increasing the depth of the retrograde filling significantly decreased apical leakage.

Increasing bevel increased leakage.

Permeability of resected apical dentin and microleakage around the retrograde filling material had a significant influence on apical leakage.

- No bevel and 1mm fill – no leakage
- 30 and 45 degree bevels needed 2.1mm and 2.5mm fill respectively

Radiographic angulations may result in distortion of the radiographic image of the retrofilling, thus affecting the perceived length of filling.

2005 Endo topics – Stropko, Doyon, Gutmann Root-end management: resection, cavity preparation, and material placement

Root-end resection, root-end bevel, root-end preparation, and root-end filling are discussed.

Root-end resection – rationale

Review of the literature over the last decade supports the following common indications for resection of the apical portion of the root during periradicular surgery (1) (Fig. 1):

- Removal of pathologic processes – Some examples include symptomatic fractured root apices, suspected contaminated apices (retained microorganisms and biofilms), root apices with tenaciously attached pathologic tissue, and removal of foreign material in the apical portion of the canal.

- Removal of anatomic variations – The anatomic variations most commonly encountered are apical deltas, accessory canals, apical canal bifurcations, severe curves, lateral canals, and calcifications.

- Removal of operator errors in non-surgical treatment –These include complications such as ledges, blockages, zips, perforations, and separated instruments.

- Enhanced removal of the soft tissue lesion – Root resection is often necessary to gain access to deeply placed soft tissue around the root in order to secure an adequate biopsy.

- Access to the canal system – In cases where the major canal systems are blocked with, for example, a postcore restoration, and the apical portion of the canal has not been properly cleaned, shaped, or obturated, root-end resection (RER) may be necessary to manage the untreated portion of the root canal system (Fig. 2).

- Evaluation of the apical seal – This can occur in conjunction with the previous indication, when the canal obturation is questionable, yet access to the entire root system with non-surgical retreatment is impractical or impossible.

- Creation of an apical seal – This is one of the most common indications for RER. In cases where the root canal treatment has already been performed non-surgically, RER may be necessary to create an environment for access and vision so that an adequate apical seal can be achieved.

- Reduction of fenestrated root apices – This situation is most common in maxillary teeth, but can occur anywhere in the dentition. Possible contributing factors include age, anatomical anomalies, orthodontics, and trauma.

- Evaluation for aberrant canals and root fractures – In some cases, the root canal obturation is judged to be satisfactory and the etiology of failure is not clinically or radiographically evident. RER will potentially expose these aberrant canal communications, complete, or incomplete vertical fractures, which can be detected on a stained root-end bevel (REB). (See following section on staining.)

Root end resection – the bevel

Long bevel vs. short bevel

The overall crown/root ratio, presence of posts or other obstacles, root anatomy, remaining crestal bone, and the periodontal status of the tooth must be considered.

Because 98% of apical canal anomalies and 93% of lateral canals system ramifications occur in the apical 3 mm, it is essential that at least 3mm of the root end is removed (6–8). 6. Vertucci F. Root canal anatomy of human permanent teeth. Oral Surg 1984: 58: 589.
7. Cohen S, Burns RC. Pathways of the Pulp, 6th edn. St Louis: CV Mosby, 1994.
8. Cohen S, Burns RC. Pathways of the Pulp, 8th edn. St Louis: CV Mosby, 2002.

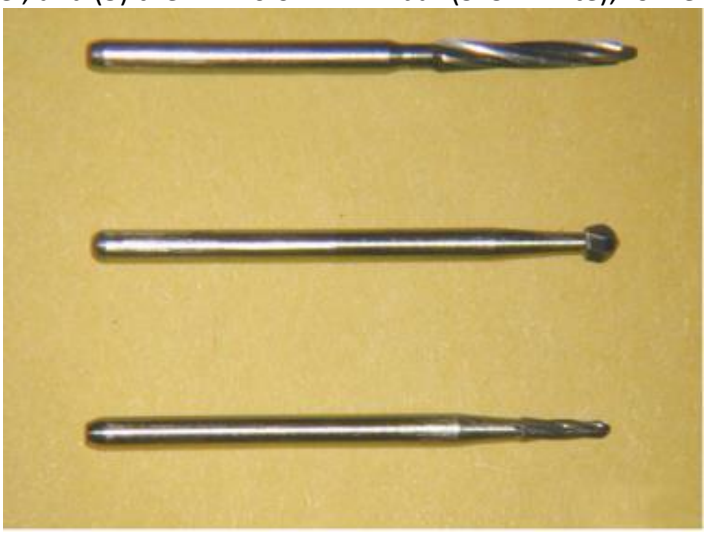
Another consideration for the 0 degree bevel is that the cavo-surface marginal dimensions of the preparation will be considerably decreased, therefore allowing an easier and more predictable seal.

Also achieves several important criteria:

Conservation of root length, Less chance of missing lingual anatomy, A shorter cavo-surface margin, Less chance of an incomplete resection, Easier to detect multiple or aberrant canals, Less exposed dentinal tubules, Easier to maintain REP within the

long axis, Easier to include the isthmus in the REP if multiple canals are present in a single root

There are only three surgical length burs necessary to accomplish the required tasks regarding the RER and REB. They are: (1) the #6 or #8 round bur (S. S. White, Lakewood, NJ, USA), for osseous access and gross removal of the apex; (2) the Lindemann bone bur (Brasseler USA, Savannah, GA, USA), for rapid hard tissue removal and cutting the initial root bevel; and (3) the #1170 or #1171 bur (S. S. White), for refinement of the bevelled surface



A high-speed handpiece that has no air exiting from the working end, such as a Palisades Dental Impact Air 45 handpiece (Star Dental, Lancaster, PA, USA) (Fig. 12), should be used to eliminate the possibility of air emphysema or an air embolism beneath the flap in the soft tissues (9, 17). For these reasons, a standard highspeed handpiece should never be used. All burs used in apical surgery must have shapes that cut sharply and flutes that are far enough apart to shed debris and avoid 'clogging.'

Heating of bone to 60 degrees C, or more, resulted in permanent cessation of blood flow and tissue necrosis. The use of diamond burs to remove osseous tissue is not recommended because of their inefficiency and tendency to overheat the osseous tissues.

Methylene blue stain

The dried surface is then stained with 1% methylene blue (MBS) (8, 15, 26), which is allowed to remain undisturbed on the resected surface for 10–15 s before once again gently flushing with a sterile solution and drying with an irrigator.

To obtain the maximum benefits of MBS, and to inspect the bevelled surface thoroughly:

- the surface must be clean and dry before applying the MBS;
- theMBS must be applied for 10–15 s to saturate the surface and periodontal ligament;
- the surface must then be rinsed and dried thoroughly;
- the REB should be examined using varying powers of the SOM to see whether the RER is complete and to insure that no abnormalities are present.

Root end preparation

Ultrasonic REP

The requirements for an REP include (3, 7–9, 15):

- the apical 3mm of the canal system is thoroughly cleaned and shaped;
- the preparation is parallel to, and centered within, the anatomic outline of the pulpal space;
- there is adequate retention form for the REF material used,
- all isthmus tissue is removed;
- the remaining dentinal walls are not weakened.

Care must be exercised when using diamond-coated tips because they can leave a heavily abraded surface. The debris generated by these tips can collect in these abrasions surface and if not removed can affect the apical seal of the REF.

In general, the lighter the touch, the more efficient the cutting efficiency will be. The correct amount of water is also important. If too much spray is used, visibility and cutting efficiency are both decreased. If too little water is used, the necessary amount of cooling and rinsing of the debris will not occur. This can cause overheating of the REP.

Numerous studies have shown that when ultrasonic instrumentation is used properly, microcracks are uncommon and should be of no concern to the clinician (29–31). A good rule to follow is to always prepare an isthmus when there are two canals in one root.

In the majority of cases requiring non-surgical retreatment, Enterococcus faecalis is the main and persistent microbial species (40–44). If the vast majority of teeth requiring endodontic surgery do not responding favorably to previous non-surgical endodontic treatment, it is imperative that treatment be directed at eradicating bacterial infection including E. faecalis from within the REP. Two percent chlorhexidine (CHX) gluconate is an effective antimicrobial irrigating agent for this purpose, and is available as a liquid or gel

Root end filling

Filling materials

The ideal material for use as an REF should meet the following requirements (8, 9, 15):

1. Provide for easy manipulation and placement with adequate working time.
2. Maintain dimensional stability after being inserted.
3. Seal the REP completely.
4. Conform and adapt easily to the various shapes and contours of the REP.
5. Be biocompatible and promote cementogenesis.
6. Be non-porous and impervious to all periapical tissues and fluids.
7. Be insoluble in tissue fluids, not corrode or oxidize.
8. Be non-resorbable.

9. Be unaffected by moisture.
10. Be bacteriostatic, or not encourage bacterial growth.
11. Be radiopaque, or easily discernable on radiographs.
12. Not discolor tooth structure of the surrounding tissues.
13. Be sterile, or easily and quickly sterilizable immediately before insertion.
14. Be easily removed if necessary.
15. Be non-carcinogenic, and non-irritating to the periapical tissues.

Amalgam

Exhibits the greatest amount of leakage when compared with newer materials such as S-EBA and MTA

Zinc oxide-eugenol cements

IRM and Super EBA. The success rates over a 10-year period were reported to be 95% for EBA, 91% for IRM, and 75% for amalgam.
The addition of ortho-ethoxybenzoic acid to the formulation of IRM in Super-EBA decreased the amount of the tissue-irritating eugenol in the liquid portion of the formula to 37.5% vs. 99% eugenol in the IRM liquid. The setting time of S-EBA can be unpredictable, sometimes setting too quickly, and at other times, taking too long.

Composites

The ability to have total control of moisture in the apical surgical environment has led to the use of bondable composite resins as REF materials.

MTA

MTA has been shown to have superior sealing qualities when compared with S-EBA and amalgam (60). One of the most important advantages of MTA is that histological responses show evidence of tissue regeneration (reformation of bone, periodontal ligament and cementum as a functional unit) as opposed to tissue repair (fibrous connective tissue) (84–87)
It is imperative that enough bleeding be re-established to ensure that the crypt is filled with blood. If necessary, gentle curettement of the surgical crypt will initiate the required hemorrhage (1, 90).