

Root end preparation techniques – Summary of papers

34 – Flath 1987

This paper presented 2 cases in which retrograde fillings were carried out using new sonic or ultrasonic instruments (endo files held in a sonic or ultrasonic handpiece), in the early days of using these techniques.

They reported that the incidence of fracture lines was greatest in roots of small diameter, i.e. less dentine thickness.

They did not like using the sonic instrument as it was not comfortable to use and created a couple of gouges on the surrounding dentine.

They noted that no fractures were created during the root resection and only during the root-end preparation.

35 – Wuchenich 1994

They compared ultrasonic root end preparation to bur root end preparation.

They concluded that the ultrasonically prepared root ends;

- Had more parallel walls
- Deeper preparations
- Followed the canal path more accurately
- Resulted in cleaner surfaces to the preparation

36 – Gutmann 1994

Apical cavities were prepared in resected root ends using rotary burs, with or without Citric acid (10% Citric acid and 3% ferric chloride) rinse or prepared with ultrasonic tips, comparing the superficial debris and the smear layer, at various levels into the root tip preparation.

Burs created a heavy smear layer at all levels.

Ultrasonic instrumentation partially removed this smear layer.

Citric acid rinse following bur preparation removed more of the smear layer than the other groups

No technique effectively removed the smear layer from the coronal 1/3 of the preparation

The least amount of superficial debris was noted in the ultrasonic group

However all systems left moderate to heavy amounts of debris coronally within the preparation.

37- Saunders 1994

They looked at the effect of different root end preparations on the apical seal of root-end fillings restored with EBA cement.

The results showed no difference in apical leakage between the groups but there was increased leakage at 7 months as sealing ability of EBA deteriorated.

Cracking of the dentine was noted most frequently in the ultrasonically treated group.

38- Gorman 1995

SEM evaluation of root end preparations, comparing preparations with ultrasonic instrumentation alone or in combination with rotary bur preparation, to those prepared with rotary burs alone.

They evaluated for; debris, smear layer and smoothness of the prep.

The preparations completed using Ultrasonics either alone, or in combination with rotary burs resulted in a lot less smear layer being present.

Preparations using U/S in combination with rotary instruments resulted in significantly less debris than rotary instruments alone.

39 – Waplinton 1995

They looked at the cutting ability of an ultrasonic retrograde cavity preparation instrument. They concluded that ultrasonic tips could be used to remove dentine. When the power is turned up the displacement amplitude increases along with the cutting ability. Concluding that ultrasonics can be used to cut dentine and will be most efficient at medium and high settings.

40 – Frank 1996

Looked at the effect of retrograde cavity preparations on root apexes. They compared; high and slow speed handpieces, sonic instruments and ultrasonic instruments at 2 power settings, high and medium levels. They were looking at the incidence of fractures lines.

They reported that;

- the highest incidence of fractures was with the ultrasonic instrument used at high power whereas (40%).
- the lowest incidence of fracture was associated with slow speed handpiece and ultrasonic instruments used at medium power (14%).

41 – Beling 1997

Investigated the effect of using ultrasonic instruments to prepare the root-ends on root-end resected teeth, using both obturated and unprepared roots and looked at the number and type of fracture lines visible. The purpose was to investigate whether using ultrasonics increased the incidence of fractures.

Several papers have reported a higher incidence of cracks in root ends prepared with ultrasonics (a paper by Layton 1995 is often quoted). These cracks may be; canal cracks, dentine cracks or cementum cracks.

They found that no significant differences were noted. They also looked to see whether the canal being filled with GP or being empty made any difference to the number of cracks – the relevance of this is that sometimes unfilled canals are

discovered and filled during root end surgery which did not have an orthograde root filling.

(CT-5 EIE (Excellence In Endodontics) tip was used followed by a CT-1 tip) (it was quicker to prepare the canals with GP in as the tips softened the GP allowing the tips to track along the canal)

42 – Mehlhaff 1997

They compared ultrasonic and high-speed bur preparations.

Ultrasonics allowed deeper preparation depth (2.1mm vs 1.4mm) and a deeper buccal-lingual preparation (2.5mm vs 2.1mm).

Bur preparations required a greater bevel angle (35°) compared to ultrasonic preparations (16°).

The ultrasonic preparations were found to stay within the uninstrumented canal space 97.4% of the time whereas all bur preparations were at an acute angle to the long axis of the root.

The bony crypt size for bur preparations was significantly greater than for the ultrasonic preparations.

44 – Von Arx 2000

A literature review of Microsurgical instruments used for root-end cavity preparation following apicectomy.

Describes 3 steps in surgical endodontics;

- 1- removal of pathogenic periradicular tissue
- 2- root-end resection
- 3- retrograde root canal obturation

SUMMARY OF THESE PAPERS

Using ultrasonics for root-end preparation has a number of advantages over the use of surgical handpieces;

- 1- Improved surgical site visibility and improved access to the canal system
- 2- It allows a decrease in the angle of bevel required on resected root ends which has a number of benefits;
 - Decreases the number of exposed dentinal tubules on the resected root surface as these dentinal tubules are potential avenues for leakage
 - The greater the bevel angle the deeper the root filling has to be to minimise leakage
 - Minimises the amount of root length lost
 - Minimises the surface area of the root-end filling (cementum deposition on the root end is beneficial to healing but it will only form on dentine and not onto the root end filling material)
- 3- Root end preparations performed with ultrasonics tend to be more centred within the canal compared to a ½ round bur in a high speed hand piece, so reducing the risk of lateral perforation

- 4- The root end preparations can be of a smaller diameter (ie retaining more dentine)
- 5- The preparations may be deeper and of a more regular shape, therefore easier to seal
- 6- The preparations may be cleaner (especially useful if the canal was not adequately cleaned previously, ie during orthograde tx)
- 7- They have less smear layer
- 8- Isthmuses can be cleaned out (eg between mesial canals of the lower molar) which could not be done with burs without significantly weakening the dentine

One concern about the use of ultrasonics in root-end preparations is the potential to induce fracture lines, although it's been questioned whether these fracture lines are deep enough to be of any importance

Conclusion – Ultrasonically prepared root-ends are superior to bur prepared root ends.

Limitations inherent to the conventional bur technique for root-end cavity preparation

- Axis of preparation not parallel to root canal
- Risk of perforation of lingual dentin wall
- Insufficient depth of root-end cavity
- Difficult in limited working space
- Requires a root-face bevel of 45. or more
- Enlarged area of patent dentinal tubules due to acute angle of bevel
- Reduced surgical site visibility

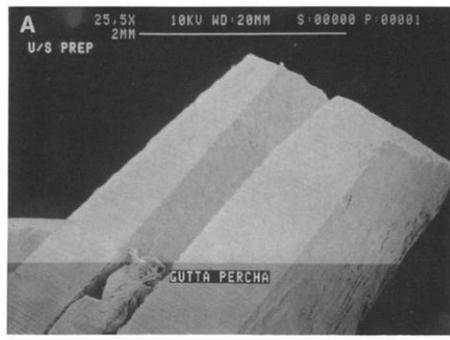
Objectives of root-end resection (apicoectomy)

- Surgical removal of apical delta (root canal ramifications)
- Enhancement of access to apex
- Creation of a working surface for retrograde preparation
- Facilitate debridement of periapical tissue
- Observation of resected root end for presence of vertical fractures

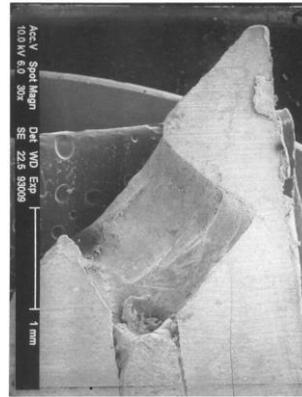
Objectives of root-end obturation

- Removing irritants during root-end cavity preparation
- Preventing penetration of microorganisms and their by-products from the root canal into the periapical region
- Optimizing conditions for periapical tissue healing including regeneration of attachment apparatus

The success rate for surgical endodontics is generally quite high, ranging from 82% - 97% in the 6 studies looked at by Von Arx.



Ultrasonic preparation



Bur preparation

How the ultrasonic works in root-end preparations

It's thought to be due to the phenomena of Cavitation and Acoustic streaming. The rapid formation and collapse of the bubbles of irrigant combined with the local circulation and vortex flow fields generated by the freely vibrating instrument tip produces hydrodynamic shear stresses large enough to remove debris and the smear layer from the walls of the root end preparation.

The use of Citric Acid

Citric acid has been shown to be very effective in removing the smear layer from the root canal system.

Citric acid (10%) used in combination with Ferric Chloride (3%) rinsed for 60 seconds has been shown to;

- enhance the bond of restorative materials
- provide a clean dentine surface, free from debris and smear layer
- stabilise the dentine collagen during the demineralisation process

Higher concentrations of CA alone for longer periods have been shown to denature collagen.