ENDODONTIC TREATMENT OF A LOWER MOLAR – A GENERAL PRACTITIONER'S APPROACH

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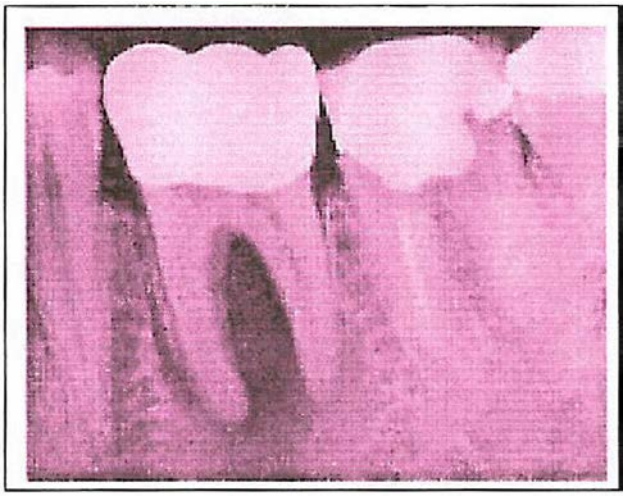
INTRODUCTION

The following paper documents an approach, by a general dental practitioner to the following case study; a patient presented with a 36, which was mobile (Class II) and was sensitive to percussion. The radiograph below was taken during consultation.



After reviewing the relevant literature and taking into account clinical experience this author made a diagnosis for this case study, of a non-vital pulp (pulp necrosis). Endodontic therapy was indicated. Different treatment techniques have been discussed involving the shaping as well as the three dimensional obturation of the root canal system

THE EXAMINATION

The following examination procedures should be carried out in order to determine the correct differential diagnosis and hopefully reaching a definitive diagnosis to treat the case at hand.

Patient History

Prior to the examination of the patient, a relevant medical and dental history should be taken in order to enhance and not complicate peri-operative and post operative treatment. The patient should be asked to give an account of their problem in their own words; *when* the patient first felt pain, *where* the pain was felt and *what* type of pain.

Extra-oral examination

Any pyrexia associated with the condition must be noted. With the patient in an upright position regional lymph nodes should be palpated in order to assess whether there is a reactive lymphadenopathy. Any pain on palpation and/or swelling must also be documented.

Intra-oral examination

The patient should be asked to locate the tooth that is troubling them.

Tooth -a discoloured tooth usually has a history of trauma,
crown margin should be probed to test for any dental caries
- restorations – faulty crown should be assessed

Draining Sinuses - any sinus tracts should be looked for and if a fistula is present, a Gutta-Percha point should be inserted in the tract and X-rayed in its position. It is important to remember that the exudate takes the path of least resistance and the fistula may exit one or more teeth away from the source of the problem.

Percussion - a patient's tooth will often be exquisitely sensitive to percussion especially when the periradicular tissues are involved. Light finger pressure is useful to elicit a response.

Vitality tests

-*Cold testing* is not accurately repeatable for approximately 10 to 15 minutes after the test. If you test with ice and the patient is in a reclining position, cold water will run to the back of the mouth affecting one or more teeth. For this reason it has been suggested (1) to test the most distal tooth then work mesially. Ethyl chloride on a cotton pellet is very useful and accurate.

-*Heat testing* is a localized test rather than a vitality test. A tooth that is sensitive to heat can be an indication of irreversible pulpitis.

-*Electronic Pulp Test* - electric pulp testers are not 100% accurate, but they are repeatable with a high degree of accuracy without a time delay. The tooth responds either positively or negatively and you quantitatively compare the degree of response with the patient's other teeth. Test the contra lateral tooth and adjacent teeth and compare readings to the suspected tooth. (1)

-*Test Cavities* – this is the ultimate vitality test for teeth with full crowns. Without the use of an anaesthetic, an opening through the crown into the dentine is made to determine if the patient feels any sensitivity, " this may be the only practical way to test teeth that have full crowns" (1)

Periodontal Probing

"Peridontal probing is one of the most neglected of the diagnostic tests" (1). Periodontal probing should be a part of every emergency examination. The patterns of periodontal probing represent a very important differential test. To distinguish *endodontic* from periodontal conditions, the tooth must be probed at very close intervals. There may be very narrow breaks in the attachment. A sudden dip usually indicates an *endodontic*

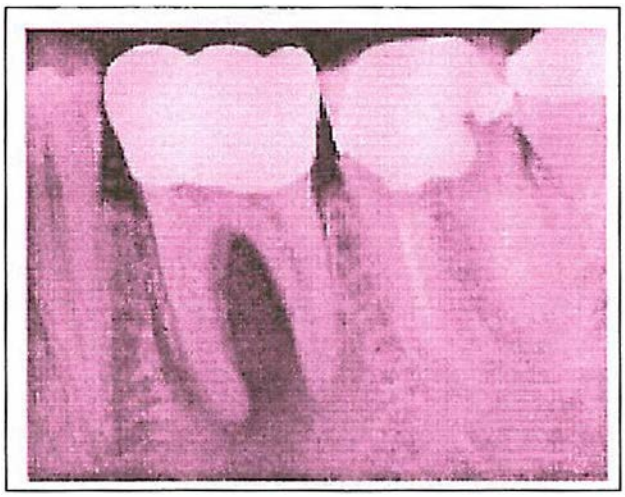
"pocket" or fistula. Peridontal pockets are generally wider and deepen more gradually than *endodontic* lesions. (1)

Mobility

This should be tested in both a buccolingual and vertical plane. The different Classes I, II and III must be recorded if present, as in this case a Class II mobility was recorded.

Special Investigations

Radiography – a periapical film is most helpful when assessing the peridontium and to determine whether the periradicular tissues have been involved or undergone any bony change. The radiograph for this case as shown below shows a radiolucency in the furcal region extending the full lengths of both mesial and distal roots of tooth 36. Interproximally the crestal bone appears intact. Tooth 36 has a crown with intact margins. Adjacent tooth 37 has been endodontically restored.



DIAGNOSIS

Differential Diagnosis

A major problem in endodontic diagnosis is identifying the symptomatic tooth when the pulp is in an irreversible state with disease restricted to the pulp canal system. Once the disease has progressed to the preiradicular tissues, the pain often localizes, and identification of the offending tooth is much easier.

It is important to note that the only diseased or pulpless teeth that respond to cold are multi-rooted teeth, with a high probability of having viable tissue in one of the remaining canals.

Through the use of the above investigations, it is possible to narrow down the diagnosis to one of the following three conditions:

1. Irreversible Pulpitis
2. Non-Vital Pulp (Pulp Necrosis)
3. Combined Endo-Pero Lesion (1)

Definitive Diagnosis

In this case due to the symptoms and clinical and radiographic findings listed below, the author's diagnosis would be a **Non-Vital Pulp** (Pulp Necrosis) with secondary furcal involvement.

Summary of Symptoms and Clinical and Radiographic Findings

1. No response to cold
2. Cold relieving pain – electric pulp test negative (even though there could have been a false negative)
3. Spontaneous pain – constant pain
4. Mobility
5. Pain to percussion

6. Radiographically there was a radiolucency furcally involving the whole interradicular area
7. No crestal bony defects
8. No periodontal pockets

TREATMENT

Treatment Options

The following treatment options should be considered:

1. Endodontic treatment of tooth 36 and thereafter full coronal coverage
2. Other options involve extraction where the resultant space could be restored by either implant or left open if the occlusion was "locked in."

In this case the treatment of choice would be the first option – *endodontic treatment.*

Endodontic Therapy of tooth 36

The objective of treatment is aimed at restoring the health of the periradicular tissue by performing root canal treatment. (2)

Methodology

Anaesthesia

A mandibular block should be given in order to work on the 36. Due to the presence of an infection, supplemental anaesthesia such as a periodontal ligament injection may be required. If pain and sensitivity persist an intra-pulpal injection can be given with a 30-gauge needle wedged into the pulp chamber. (3)

Access

In order to remove the necrotic pulp and restore periradicular health an access cavity has to be cut through the crown or the crown could be removed and thereafter access into the pulp chamber could be gained. The author feels that by leaving the crown (and not removing it) this will facilitate the use of Rubber Dam.

The access cavity;

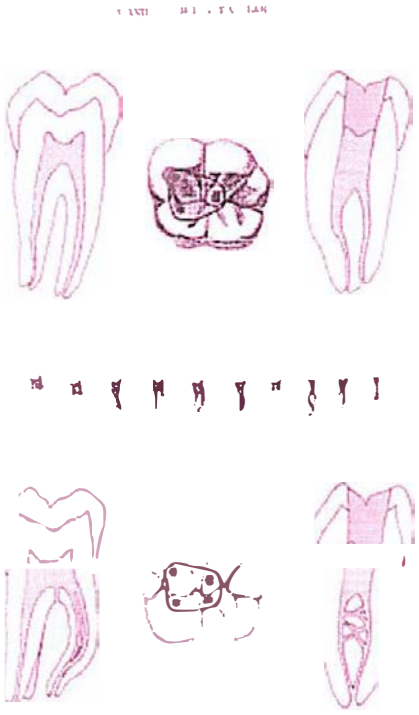
1. Will remove the roof of the pulp chamber so that the pulpal remnants can be removed and the canal entrances can be exposed.
2. Will provide straight-line access.

Will avoid damage to the floor of the pulp chamber, as the natural floor tends to guide an instrument into the canal orifice.

4. Will conserve as much tooth substance as possible to prevent weakening and fracture of the remaining enamel and dentin
5. Will provide resistance so that the temporary filling seals the access cavity until the final restoration is placed. (4)

A round diamond is used followed by a tapered fissure tungsten-carbide burr ("Great White") to cut through the metal, aimed towards the largest part of the pulp chamber. Once the roof of the pulp chamber is removed a "safe ended" tapered diamond is used to reduce the risk of damaging the pulpal floor. It is always good to judge the depth of penetration by holding the burr in the hand piece against a preoperative radiograph. (4)

The access cavity as in this case for a mandibular first molar is rhomboid in shape, because the distal canal is either broad buccolingually or because there are two separate canals. See figure below (14)



Cleaning and Shaping

The goal for consistently successful endodontic therapy is predicated on meticulous cleaning and shaping of the root canal system, its' three-dimensional obturation and a well fitting "leakage free" coronal restoration. (5)

The microenvironment of dentinal tubules appears to favour the selection of relatively few bacterial types. These bacteria may constitute an important reservoir from which root canal infection and reinfection may occur following pulp necrosis or during and after endodontic treatment. Thus biomechanical preparation, canal irrigation and medication reduce the bacterial flora to the extent that the residual microorganisms are too few to cause reinfection and influence prognosis of endodontic therapy. The pathway of reinfection of the root canals appears to be from coronal microleakage, inadequate tempories or residual infiltration of dentinal tubules. (6)

It is important to completely eliminate bacteria from the root canal system before obturation. This objective cannot be reliably achieved in a one visit treatment because it is not possible to eradicate all the infection from the root canal without the support of an inter-appointment antimicrobial dressing. Although only a few studies have evaluated the effect of infection at the time of root filling on the prognosis of the treatment. (7)

With this in mind the author is of the opinion to treat the symptomatic tooth as in this case in two separate appointments.

The most widely used solution for endodontic irrigation is sodium hypochlorite 0.5% - 5%. The primary use of these solutions is to denature organic material and facilitate removal of necrotic tissue and debris from instrumental dentine surfaces. They are also used because of their antibacterial effectiveness. Other chemical agents such as chlorehexidine, bisdequalium acetate (BDA) and 9-amino-acridine have been suggested as possible alternative root canal irrigants. Investigators have shown that it was

important to remove the dentine smear layer to ensure complete disinfection of the area. Ethylene diamine tetracetic acid (EDTA) when used in combination with sodium hypochlorite has been shown to be very effective in removing the smear layer. (6)
Antibacterial intracanal and inter-appointment medication using calcium hydroxide has been recommended for elimination of bacteria not removed by biochemical preparation and irrigation. Other investigators have suggested the use of iodine-pottasium-iodide (IKI) in inter-appointment medicaments because of its superior antibacterial properties and non-toxicity. (8)

Working Length

Prior to shaping the canals each canal's working length must be determined. A number of problems can be encountered when negotiating the root canal system. Root canal blockage can be as a result of tissue impaction, debris accumulation or instrument separation. Any of these conditions will prevent ideal cleaning, shaping and obturation of the root canal system, immediately reducing the prognosis. (9)

RC Prep (EDTA) or other root canal lubricants can help prevent cohesion of tissues and thereby prevent soft tissue blockages. Lubricants are best used only during the initial negotiation and enlargement phase of cleaning and shaping, until enough coronal enlargement has been created to allow the effective use of aqueous irrigants. (10)

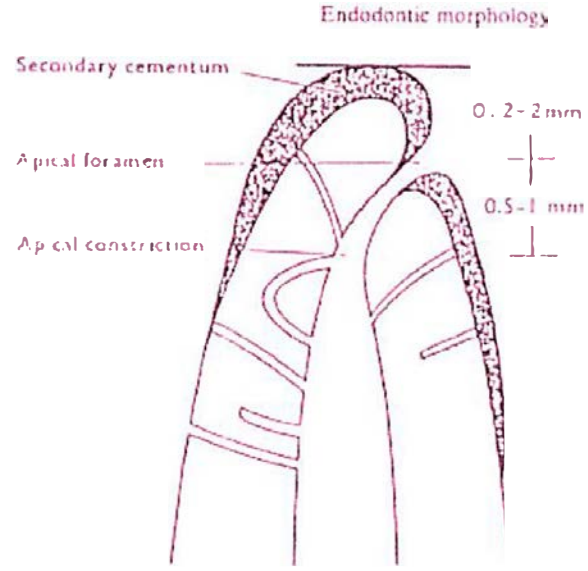
Any dentist that says he or she has never broken an instrument in a patient's mouth has not done many root canal treatments. (11) This can be prevented by checking instruments are in a "good" condition. If in doubt, discard the instrument.

Accurately locating this hidden endpoint – the "Apex" is worth the effort, since cleaning and shaping procedures can have no greater precision than the working length determined. Historically radiographic imaging was the most accurate method of apical mapping until the advent and improvement of electronic apex locaters (EAL). When they are working well (80 – 90% of the time) apex locators can provide highly accurate length determination. Radiographic, electronic and tactile sense of paper point alone cannot

provide the precision of length for optimal results. In a study done to determine the effect of using EAL's to evaluate the working length, it was shown to be advantageous despite the fact that the final working length was based on radiographs.(12) Another comparative study was done (13) where the apex locator was slightly more reliable in determining apical constrictions whilst the radiographic method of determining the working length underestimated the working length.

Where should we terminate preparation and filling? Concerning the length, the average ideal termination point is ½ to 1 mm from the radiographic apex, however there are some cases that the ideal length is at the apex. Schilder, H (1974) (14) says one should file and fill completely to the apex which often results in a slight puff of cement beyond the apex. Schilder believes that it is better to be long than to be short!

The diagram below illustrates the anatomy of the apical third.



Apical third of the root. The position of the apical foramen varies with age and may be 0.2–2 mm from the anatomical apex. Similarly the apical constriction can be 0.5–1 mm from the apical foramen.

Apical Patency

While it is important to determine proper wavelength (15) it is equally important for clinicians to maintain apical patency so that they may continue to work to the length. Apical patency is a procedural term referring to the absence of soft or hard tissue obstruction in the apical third of root canals. This can be achieved by recapitulation of #8, #10 or #15 files, which may require precurving to minimize cutting forces. A patency file is any file, which moves passively through the apical constriction. (10)

Canal Instrumentation

When cleaning and shaping the root canal system a number of techniques can be performed. Before the advent of tapered instruments the most effective way of creating a tapered preparation was the Serial Step-Back instrument technique. This author prefers this method when using hand instruments. The serial Step-Back method entails the use of a series of progressively larger instruments that are worked, or "stepped back" successively further from the end of the root canal preparation, i.e. instead of taking all instruments to the same length, they are used only where they can safely fit with only the smallest files reaching to the canal terminus. Risk of ledging, instrument breakage and perforation is reduced. Recapitulation or returning to previously used shaping instruments is a powerful concept inherent in this technique. Recapitulation with smaller files will allow the larger instrument to pass deeper in the canal. An advantage of this is that it works well with all types of instruments, whether they are K files, reamers, Hedstrom files or engine driven burrs. (16)

In the past when using hand instruments to prepare the root canal, consistent shaping has rarely been achieved even with the use of the instruments in a step back fashion. Stainless steel instruments are inflexible and this leads to ledging, transportation or even a perforation in curved canals. In order to overcome the procedural errors associated with stainless steel hand instruments, Nickel titanium (NiTi) instruments were introduced to endodontics as a way of improving the quality of root canal preparation. (17)

K-files are made with square or triangular wires and they have cutting flutes of about 45 degrees. The general K file by Kerr is square and the Maillefer's Flexo-file is triangular in shape. When utilizing these K-files in the Step-back technique a #8 file and #10 file are used as patency files. The #15 file is worked all the way to the working length (WL). Thereafter a #20 file and a #25 file are also worked to the WL. Recapitulation is performed after each increase in size. Then a # 30 file is "stepped back" 2mm less than the WL. Recapitulation with a #25 file at the WL is done. The "stepping back" continues with the #35 file 3mm less than the WL. This is continued until a well-tapered canal has been produced .The file motions are primarily a "watch winding" motion (90 degrees back and forth rotational motion).

Nickel titanium (NiTi) instruments when used in rotation, stay better centered in the canal (18), whilst considerable physical properties of super elasticity (19) allows the instruments to be manufactured in greater taper, which is ideal for a tapered preparation objective (17). Bearing this in mind another method of preparing the root canal system for obturation is the use of Niti rotary instruments. There are now many commercial variants of these rotary instruments.

Principle of rotary instruments

Nowadays the preferred sequence is the Crown Down Technique (20), where the canal is prepared coronal to apical. This eliminates coronal interference and allows instruments to move from a cleaned area into a dirty area of the canal.

Method

Instruments of varying taper are used from a crown down sequence form a greater to lesser taper. The resultant shape optimizes irrigant exchange at the apical level. **See attachment** which sets out a 5 step procedure using profiles which was devised by Dr P J Van der Vyver (21)

Always precede the NiTi instruments with a hand file (minimum size #15) this does not mean you have to go to the full length of the canal before using rotary instruments. In fact, this practice would affect one of the best parts of the system, removing the coronal debris and opening the upper half of the canal to allow easy penetration of the apical half of the canal, remembering that canals calcify from orifice downwards. (21) Although the NiTi instruments are reported to be stronger than stainless steel files the separation of NiTi instruments within canals can occur as a result of rotational stress placed on engine driven instruments. (22)

Obturation

Once the canals have been prepared to the correct working length, a pre-obturation radiograph is taken with a master cone. The canals are then dried with paper points. Obturation is performed either using the lateral condensation technique or a thermo-plasticised technique. According to Moodnik and Hempstand (1963) (23) nearly all roots have multiple accessory and lateral canals. Endodontic lesions positioned lateral to the root or asymmetrically about the root apex and periodontal sulcular defects of endodontic origin are vivid reminders of the complexity of the root canal system with its numerous and infinite varieties and location of canal ramifications (24), particular in bifurcation and trifurcation large vessels are to be found running through the radicular dentine to supply one root canal and interradicular canals so that the pulp and peridontium are united. The consensus of literature is that there is a great deal of communication between pulp and peritonitis via accessory canals (25). In a study by Gutmann (1978), he showed that out of 102 mandibular molars 28.4% exhibited patent accessory canals in the furcation region and lateral canals were located in 10.2% of the teeth (26). These accessory canals in the furcation area if untreated may be left patent and result in possible ingress of fluids and bacteria into the peridontium with periodontal inflammation and further breakdown.

Wolcott et al (1997) have shown that all techniques used to obdurate the lateral canals are successful, but vary in amount of Gutta Percha or sealant material that seals these canals

(27). It is conceivably better if more gutta percha mass is used to seal the canal than that of sealant (6).

Lateral Condensation Technique

The master cone, gutta percha point is coated with a root canal sealant and then placed in the canal. A lateral spreader/plugger 1.2mm of the working length (28) is used. With the help of a #25 spreader fine medium cones are then placed lateral to the master cone as accessory cones. This is repeated until no more space can be achieved with a #25 spreader. Thereafter a #20 spreader is used in the same manner until no more space can be made laterally. Finally the gutta percher cones are burnt off.

Disadvantages of this method of obturation are that it is time consuming, and can prove difficult in fine curved canals. Additionally pressure exerted by certain pluggers can generate stress that may lead to micro fractures in the dentine. These cracks may propagate under occlusal load and manifest as longitudinal root fractures especially after "post" preparation.(29)

Thermoplasticised Obturation Techniques

Various techniques using this thermoplasticised gutta percha have been advocated to eliminate some of the problems of lateral condensation and reduce the amount of sealer present.

Thermafill is an extraradicular thermoplasticised gutta perch technique, where the gutta percha is heated outside the mouth, then placed inside the root. Thermafill uses smooth tapering plastic or metal carriers (29mm long, diameter from ISO #20 to #40) coated with alpha phase gutta percha. A stop is placed on the selected carrier to the length it will be inserted into the canal. The carrier is heated for a specific length of time (longer for larger carriers) and is then placed straight into the canal, which should have previously been smeared with a light coating of the appropriate sealant. The carrier is held in position with apical pressure to compensate for any cooling contraction. Once cool, the handle is cut off just above the canal orifice leaving the carrier in the canal. Special blank

tungsten carbide "prepi" bars are used to remove the plastic carrier and associated gutta percha, when post preparation is performed. (30)

Sealant

A sealer cement is used with all systems to help fill voids and act as a lubricant and as a thermo insulater during placement. Only a thin coating is required as excess cement will be forced through the apex occasionally causing severe pain. The cement of choice should not set very rapidly at the temperature of the heated gutta percha. The following types listed can all be utilized for both techniques: AH26 plus, zinc oxide/eugenol or Apexit.

CONCLUSION

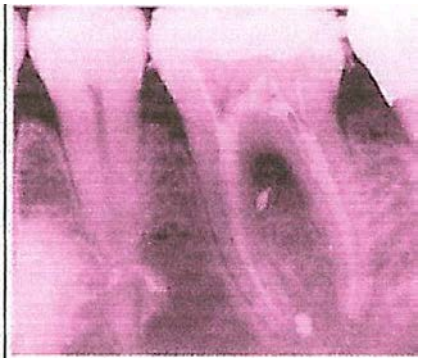
The diagnosis for this case study was pulp necrosis. Both the symptoms and clinical findings were in keeping with this condition. Due to the necrotic pulp being a nidus for infection, the pulpable tissue is likely to have been colonized by bacteria. Therefore the author chose a two-stage treatment approach, applying an inter-appointment mediacment to eliminate the presence of bacteria in the canals. Iodine-Potassium-Iodide (IKI) was the preferred choice of medicament because of its superior antibacterial properties and non-toxicity (8). Systemic antibiotic therapy was not indicated as there was no active "frank" infection, (lack of fever, malaise or lymphadenopathy)

The second phase of treatment would take place five to seven days after the initial extirpation. This would involve the cleaning and shaping of the canals as well as the obturation.. The working length would be found with the use of an electronic apex locators. This method has been proven to be slightly more reliable than the radiographic method (13) When shaping the canals, 5% sodium hypochlorite would be used to facilitate removal of necrotic tissue and debris from instrumented dentine surfaces (6)

The radiographs of this case study indicate that the root morphology would allow for the use of rotary instruments all the way to the apex and thus the author's preference would be the crown-down technique for instrumentation using the NiTi rotary instruments such

as the profile system. Eventhough the flexi-file hand instruments could be used in a step-back technique, the former method of rotary instruments would be chosen because of their speed efficiency and uniform tapered preparation of the canals (17),(18) and (19).

A thermoplasticized technique would be chosen for the obturation of all the canals instead of the lateral condensation technique because the softened gutta percha obturation exhibits less voids in the gutta percha mass (6). Due to the secondary furcal involvement in this case, the author feels that it is prudent to try and obdurate any accessory or lateral canals. The following picture was taken from a study done by Zolty (6) to highlight the need to seal any accessory or lateral canals.



Puff of sealant material is evident at the furcation and demonstrates a lateral canal. The previously unobturated lateral canal at the furcation area demonstrates the origin of the furcation lesion.

After completion of endodontic treatment of tooth 36, the patient would be required to return for follow-up examination. If patient had no signs or symptoms , full coronal coverage would be performed by preparing a crown.

REFERENCES

(1) Morrow, S, Quick Thorough Emergency Diagnosis, March 1992, p17. In: Van Der Vyver P, A Practical Endodontic Course, *The Institute for Modern Dentistry*

(2) Stock C J R, Gulabiuala K, Walker RT & Goodman JR, Colour Atlas and Text of Endodontics. In: Study material for Endodontic module, Post Grad Diploma in Clinical Dentistry, Stellenbosch University, 2002, Chapter 1, p3

(3) Morrow, S, Pain Relief and Emergency Treatment, April 1992, p25. In: Van Der Vyver, P, A Practical Endodontic Course, *The Institute for Modern Dentistry*

(4) Stock C J R, Gulabiuala K, Walker RT & Goodman JR, Colour Atlas and Text of Endodontics. In: Study material for Endodontic module, Post Grad Diploma in Clinical Dentistry, Stellenbosch University, 2002, Chapter 7, p23 – 30

(5) Glickman, G & Gutmann J, Contemporary Perspectives on Canal Obturation, *Dent Clinics of North America* 1992:36:327-41. In Zolty G, The prevalence and significance of sealing accessory and lateral canals; a literature review, *SADJ,* Sept 2001, Vol 56, No 9, p419 -423

(6) Zolty G, The prevalence and significance of sealing accessory and lateral canals; a literature review, *SADJ,* Sept 2001, Vol 56, No 9, p419 -423

(7) Sjogren U, figdor D, Person S & Sundqvist G, Influence of infection at the time of root filling on the outcome of endodontic treatment of teeth with apical periodontitis, *International Endodontic Journal*, 1997:30:297-306. In: Stock C J R, Gulabiuala K, Walker RT & Goodman JR, Colour Atlas and Text of Endodontics. In: Study material for Endodontic module, Post Grad Diploma in Clinical Dentistry, Stellenbosch University, 2002, p95 - 103

REFERENCES continued

(8) Ojuntebi BR, Dentine tubual infection and endodontic therapy implications, International Endodontic Journal, 1994:27:218 –222. In: Zolty G, The prevalence and significance of sealing accessory and lateral canals; a literature review, *SADJ,* Sept 2001, Vol 56, No 9, p419-423

(9) Buchanan LS, The Art of Endodontics, Cleaning and Shaping the Root Canal System, *Dentistry Today,* Sept 1993. In: Van Der Vyver P, A Practical Endodontic Course, *The Institute for Modern Dentistry*

(10) Buchanan LS, Cleaning and Shaping the Root Canal System, Part 2: Cleaning Concepts, *Dentistry Today*, Oct 1993. In: Van Der Vyver P, A Practical Endodontic Course, *The Institute for Modern Dentistry*

(11) Buchanan LS, Paradigm shifts in cleaning and shaping, *Calif.Dent.Assoc. J.* 1991. In: Buchanan LS, The Art of Endodontics, Cleaning and Shaping the Root Canal System, *Dentistry Today,* Sept 1993. In: Van Der Vyver P, A Practical Endodontic Course, *The Institute for Modern Dentistry*

(12) Fouad AF & Reid LC, Effect of using electronic apex locators on selected endodontic treatment parameters, *Journal of Endodontics*, Vol 26, No 6, June 2000. In: Stock C J R, Gulabiuala K, Walker RT & Goodman JR, Colour Atlas and Text of Endodontics. In: Study material for Endodontic module, Post Grad Diploma in Clinical Dentistry, Stellenbosch University, 2002, p91

(13) Pratten DH & McDonald NJ, Comparison of radiographic and electronic working lengths, *Journal of Endodontics*, April 1996, Vol 22, No 4. In: Van Der Vyver P, A Practical Endodontic Course, *The Institute for Modern Dentistry*

(14) Van Der Vyver P, Chapter on Root Canal Preparation, A Practical Endodontic Course, *The Institute for Modern Dentistry*

(15) Schilder H, Cleaning and Shaping the Root Canal, *Dent Clinic, North America* 18;269:1974. In: Buchanan LS, Cleaning and Shaping the Root Canal System, Part 2: Cleaning Concepts, *Dentistry Today*, Oct 1993. In: Van Der Vyver P, A Practical Endodontic Course, *The Institute for Modern Dentistry*

(16) Buchanan LS, Cleaning and Shaping the Root Canal System, Part 3: Shaping Concepts, *Dentistry Today*, Nov/Dec 1993. In: Van Der Vyver P, A Practical Endodontic Course, *The Institute for Modern Dentistry*

(17) Machtou P & Martin D, Advances in rotary instrumentation sequences, *Dentistry SA*, Mar/Apr 2001. In: Stock C J R, Gulabiuala K, Walker RT & Goodman JR, Colour Atlas and Text of Endodontics. In: Study material for Endodontic module, Post Grad Diploma in Clinical Dentistry, Stellenbosch University, p41

(18) Frick K, Walia H, Deguzman J & Austin BP, Qualitative comparison of 2 NiTi rotary file systems to hand filing, *J Endo*:1997:23:273. In: Machtou P & Martin D, Advances in rotary instrumentation sequences, *Dentistry SA*, Mar/Apr 2001. In: Stock C J R, Gulabiuala K, Walker RT & Goodman JR, Colour Atlas and Text of Endodontics. In: Study material for Endodontic module, Post Grad Diploma in Clinical Dentistry, Stellenbosch University, p41

(19) Walia H, Brantley A & Gerstein H, An initial investigation of the bending and torsional properties of NiTinol root canal files, *J Endo,* 14:346-351:1998. In: Machtou P & Martin D, Advances in rotary instrumentation sequences, *Dentistry SA*, Mar/Apr 2001. In: Stock C J R, Gulabiuala K, Walker RT & Goodman JR, Colour Atlas and Text of Endodontics. In: Study material for Endodontic module, Post Grad Diploma in Clinical Dentistry, Stellenbosch University, p41

(20) Goering AC, Michelich RJ and Schultz HH, Instrumentation of the root in molar using the step-down techique, *J Endo*, 8:550-554:1982. In: Machtou P & Martin D, Advances in rotary instrumentation sequences, *Dentistry SA*, Mar/Apr 2001. In: Stock C J R, Gulabiuala K, Walker RT & Goodman JR, Colour Atlas and Text of Endodontics. In: Study material for Endodontic module, Post Grad Diploma in Clinical Dentistry, Stellenbosch University, p41

(21) Van Der Vyver P, Chapter on NiTi instruments for root canal preparation, A Practical Endodontic Course, *The Institute for Modern Dentistry*

(22) Gambarini G, Cyclic fatigue of profile rotary instruments, often prolonged clinical use, *International Endodontic Journal*, 34:386-389:2001. In: Stock C J R, Gulabiuala K, Walker RT & Goodman JR, Colour Atlas and Text of Endodontics. In: Study material for Endodontic module, Post Grad Diploma in Clinical Dentistry, Stellenbosch University, p41

(23) Moodnik R & Hempstead NY, Clinical correlations of the development of the root apex and surrounding structures. *O.S, O.M & O.P.* 1963:16:600 – 07. In: Zolty G, The prevalence and significance of sealing accessory and lateral canals; a literature review, *SADJ,* Sept 2001, Vol 56, No 9, p419 -423

(24) Xu G and Zhang Z, Filling of the lateral canal. *Oral Surgery*, 1984:58: 221- 24, Nicholls E, Lateral radicular disease due to lateral branching of the root canal. *O.S., O.M & O.P.* 1963:16:839-45 and Rubach WC & Mitchell DF, Periodontal disease, accessory canals and pulp pathosis, *Journal of Periodontology* 1965:36:34 –8. In: Zolty G, The prevalence and significance of sealing accessory and lateral canals; a literature review, *SADJ,* Sept 2001, Vol 56, No 9, p419 -423

(25) Rubach WC & Mitchell DF, Periodontal disease, accessory canals and pulp pathosis, *Journal of Periodontology* 1965:36:34 –8, Langeland K, Rodrigues H &

REFERENCES continued

Dowden W, Periodontal disease, bacteria and pulpal histopathology, *Oral Surg.* 1974:37:257-70, Selzer S, Bender IB, Smith J, Freedman I, Nazimov H, Endodontic Failures – an analysis based on clinical, roentgenographic and histologic findings. *O.S., O.M & O.P.* 1967:23:500-30 and Kirkham DB, The location and incidence of accessory pulpal canals in periodontal pockets, *J Amer Dent Assoc* 1975:91:353-56. In Zolty G, The prevalence and significance of sealing accessory and lateral canals; a literature review, *SADJ,* Sept 2001, Vol 56, No 9, p419 –423

(26) Gutman JL, Prevalence, location and patency of accessory canals in the furcation region of permanent molars. *Journal of Periodontology* 1978:49:21-26. In: Zolty G, The prevalence and significance of sealing accessory and lateral canals; a literature review, *SADJ,* Sept 2001, Vol 56, No 9, p419 -423

(27) Wolcott J, Himel Van T, Powell W & Penney J. Effect of two obturation techniques on the filling of lateral canals and the main canal. *Journal of Endodontics* 1997:23:632-35. In: Zolty G, The prevalence and significance of sealing accessory and lateral canals; a literature review, *SADJ,* Sept 2001, Vol 56, No 9, p419 -423

(28) Allison D, Weber C & Walton R, The influence of the method of canal preparation on the quality of apical and coronal obturation. *J Endo* 5:289-305:1979. In: Machtou P & Martin D, Advances in rotary instrumentation sequences, *Dentistry SA*, Mar/Apr 2001. In: Stock C J R, Gulabiuala K, Walker RT & Goodman JR, Colour Atlas and Text of Endodontics. In: Study material for Endodontic module, Post Grad Diploma in Clinical Dentistry, Stellenbosch University

(29) Murgel CAE & Walton R, Vertical root fractures and dentine deformation in curved roots. The influence of spreader design, Endodon.Dent.Traumatol,1990:6:273-288. In: Batti Sa & Joshi R, Thermoplasticized gutta perch obturation techniques, Dental Update, Jan/Feb 1997. In: Van Der Vyver P, A Practical Endodontic Course, *The Institute for Modern Dentistry*

REFERENCES continued

(30) Batti Sa & Joshi R, Thermoplasticized gutta perch obturation techniques, Dental Update, Jan/Feb 1997. In: Van Der Vyver P, A Practical Endodontic Course, *The Institute for Modern Dentistry*

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ROOT CANAL PREPARATION PROCEDURE

ep 1: Effective access
Locate canals
EDTA - establish patency
Hand file (no 15) - 2/3 of canal

!ep 2: Coronal enlargement (ProFile Orifice Shapers - 275 rpm)
Large canals (5-4-3) **Average canals (4-3-2)** **Narrow canals (3 -2-1)**

Type of Instrument	Taper in mm/mm	Colour	Shaper number	Depth
ProFile Orifice Shaper	05	Silver	1	Straight part of root canal
ProFile Orifice Shaper	.06	Gold	2	Straight part of root canal
ProFile Orifice Shaper	06	Red	3	Straight part of root canal
ProFile Onfice Shaper	.07	Blue	4	Straight part of root canal
ProFile Orifice Shaper	08	Green	5	Straight part of root canal
ProFile Orifice Shaper **(only for large canals)**	.08	Black	6	Straight part of root canal

Step 3: ProFile .04 (crown-down technique) running at about 250 - 350 rpm.

Type of Instrument	Taper	Colour	ISO Ref	Depth
ProFile	.04	Red	025	2/3 of canal
ProFile	.04	Blue	030	2/3 of canal
ProFile	.04	Yellow	020	3/4 of canal

Step 4: Determination of working length
(Pre-bent manual K - file or Nitiflex file)

Step 5: Apical preparation

Type of Instrument	Taper	Colour	ISO Ref	Depth
ProFile	.04	White	015	Working length **If resistance repeat step 3**
ProFile	.04	Yellow	020	Working length
ProFile	04	Red	025	Working length
ProFile	04	Blue	030	Working length
ProFile	.04	Green	035	Working length or step back
ProFile	04	Black	040	Working length or step back

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