Tooth notation:
Upper right first permanent molar

By Prof. James Prichard, UK

**Patient Symptoms**
Severe pain (Visual Analogue Scale 9 out of 10). Poorly localized on the right hand-side. Always starting on the upper right hand side of the face. Pain radiates in to the ear and the cheek on the right hand-side. Pain is spontaneous and not responding to over the counter analgesics (ibuprofen 400mg qds). Pain has been gradually getting worse over the last 48 hours. The patient was experiencing sleep disturbance and the pain came on in waves. Extreme sensitivity to cold stimulus, not so painful with hot.

**Examination**
Upper right first and second molars are restored with amalgam. No pocketing or mobility and no tenderness to percussion. No tender-ness in the buccal or palatal sulcus. Sensibility testing with EndoFrost: UR2 +ve, UB6 ++ and triggered the patients toothache.

**Pre-operative radiograph**
Upper right first molar has a pin retained restoration, 25% bone loss mesially and distally, no obvious caries, a possible furcal radiolucency but no obvious peri-apical radiolucency at the root apices. The pulp chamber is reduced in size and the canals are not obviously visible. The mesial root exhibits severe curvature in excess of 30° (Schneider 1971—Figure 1 [b]) towards the distal aspect. The sinus outline appears to be low in and close approximation to the roots.

**Diagnosis**
Acute irreversible symptomatic pulpitis from the upper right first molar.

**Treatment Options**
Root canal treatment or extraction.

The patient opted for root canal treatment.

**Treatment**
Anesthesia was achieved with 1x 2.2 ml Lignospan (2% Lidocaine, 1:80,000 adrenaline) via buccal and palatal infiltration and isolation achieved with non latex dam (3M) and sealed with Oraseal (Optident) caulking agent.

Access was performed with a short tungsten carbide bur and the pulp chamber de-roofed with a safe ended tapered tungsten carbide bur (FKG). There was a pulp stone present in the chamber over the palatal root canal (Figures 2 [a] and [b]) which was removed with a CAP [1] Canal Access Preparation) ultrasonic tip (Acteon UK) and 3 canals were immediately identified with a DG16 endodontic probe.

Before canal shaping was performed the coronal 2/3rd was explored with a size 10 K-flex file. Shaping was performed as follows:

- *ScoutRace* (FKG Dentaire) sizes 10/02, 15/02 and 20/02 (Figure 3) were used in an NSK Endomate (NSK) running at 1000 rpm to estimated working length using 3% Sodium Hypochlorite-NaOCl (FKG) as the lubricant and irrigant. The irrigant was delivered with a 27G side vented Monoject needle attached to a 3ml syringe.

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The canal lengths were determined electronically with an Apex RNR apex locator (Medic NRG) using a zero-to-five file (ProTaper Gold) and shaped with BioFile (FKG Dentaires) R15, R25, R35, and R45 and se- quenced to length irrigations with 3% 1 NaOCl between each file.

After shaping, the root canals were cleaned with the Irrimat Pasive Ultra- sounding tips (Acteon UK) for 3 cycles of 20 seconds per canal re- plishing the irrigation between each cycle (Figure 4). Following which a soak was performed with 17% EDTA (FKG) for 60 seconds before dried and the final flush was made with 5% NaOCl.

Obturation was performed with To- talfill BC Sealer (FKG Dentaire) and size 35/04 Totalfill BC Points, gutta percha cones impregnated with bi- ocement. The cones were sized to fit each individual canal with good tug back in canals still wet with 3% sodium hypochlorite. The canals were dried with 35/04 paper points (FKG), the cones coated with Total- fill BC Sealer (Figure 5) and seated into the canals, withdrawn half way and reinserted. The coronal portion of the file was placed in the heated instrument and pocket gen- tly into the canal orifices (Figure 6 and Figure 7), and the access cavity cleaned by washing with a 3:1 v/v ti- tle syringe.

An amalgam Nayar core was placed, the dam removed and the exclusion checked. A final radiograph was taken (Figure 8) showing a well-con- densed root canal filling in all 3 ca- nals extending to length with a well-adapted coronal restoration.

Discussion

The diagnosis of acute symptomatic irreversible pulps can sometimes be difficult, however by repeating the patients’ sensitivity to cold it soon became apparent which tooth was causing the trouble. The best way to treat this is to remove the inflamed tissue as quickly as pos- sible; antibiotics have no place, as there isn’t an infection.

The narrowness of the canals and the severe curvature on the mesial root can make instrumentation challeng- ing. Scissors of takes place as a result of deposition of secondary dentine and progressive deposition of calcified masses that originate in the root pulp (Bernick & Nedelman 1975), and true pulp stones are made of dentine and lined by odontoblasts (Johnson & Bevolden 1956).

Pulp stones are common, ranging from 4% of first molars Chandler et al. 2005 to 78% of primary molars Ayres et al. 1993, and vary in size from 50 µm in diameter to several milli- metres when they may occlude the entire pulp chamber (Sayegh & Reed 1968). Therefore, if the pulp stone is not removed, the natural canal anatomy may be obscured making shaping and disinfection difficult or impossible.

Shaping canals is essential to endo- dontic success (Schilder 1993), but nickel titanium files are prone to cy- clic fatigue fracture and torsional tip fracture, avoiding an apical seal in glide path creation is essential when shaping with rotary Nickel-Titanium inst- ruments to these files (Patino et al. 2005) and mechanical glide path establishment is critical in the treatment of cases (Schilder et al. 1987). The cones were super- to stainless steel hand files in maintaining the canal shape (Ayas et al. 2013).

As shaping is only part of the process of canal debridement (Byström & Sundqvist 1981) and shaping with saline (Byström & Sundqvist 1981) and irrigation with NaCl and EDTA has been demonstrated to cre- ate cleaner canal walls (Baumgartner & Mader 1997). Additionally, the use of ultrasonic activation removes more debris from canals than syringe irrigation alone (Burleson et al. 2007).

Root canal preparation to a size 35 allows better irrigant flow and ex- change (Boutsioukis et al. 2010), creates space for the ultrasonic tip to vibrate thereby reducing tip dam- pening (Afshar et al. 2012) which in turn improves the micro- streaming (Ahmad et al. 1987) and increases the reduction in bacterial load (Buhrson et al. 2010, Carver et al. 2011).

Bioceramics (tricalcium silicate) have many uses in endodontics, taking advantage of their ability to form an apatite layer (bioac- tivity) and penetrate dentine tubules. Mineral Trioxide Aggregate (the first bioceramic) is currently employed on several endodontic techniques including root-end filling, direct pulp capping, repair of perforations and providing an apical seal in teeth with open apices (Perițk & Todej- ană 2011). The literature reports several favorable properties of ne- wly developed bioceramic sealers that include fillability of root canals with good sealing ability (Zhang et al. 2009a,b), biocompatibility (Zhang et al. 2009a,b) and adhesion to dentine (Naga et al. 2011). It is sup- plied in premixed, injectable form and sets in the presence of natural canal moisture (Loabhein et al. 2003). When placed on the canal and immediately seated the canal walls are coated, withdrawing it and re- seating it therefore will more sealer to be placed and dispersed within the complex canal ramifications. It is imperative that the cones fit well with tug back or are customized to improve apical control (van Zyl et al. 2006) and that hydraulic pumping is not employed. With this technique, the GP cone acts as a carrier and the sealer is employed to fill the entire canal space, thus providing the de- sired three-dimensional seal (Schil- dler 1997).

Conclusions

Pulp stones are a common occur- rence and act as a barrier to suc- cessful endodontic treatment. Me- chanical glide path preparation with Scout File600s allows predictable canal preparation in the majority of cases.

Single cone obturation is possible with an all bioceramic sealer.

Further information on these tech- niques, instruments and materials is available on www.fkg.com.

References


Ahmad M, Roy KA, Kamadam AG. Observations on different void filling fields around an oscillating ultrason- ic file. Endodontic Dental Traumatology 2003; 18; 197-94.


Laser Enhanced Endodontic Treatment

By Dr Gregori M. Kurtzman, USA

Endodontic success is predicated on the ability to debride and clean the canal system. That canal system is a complex array of accessory and lateral canals and other anatomic areas inaccessible to endodontic files. (Figure 1) As practitioners, we are able to clean the main canals with files, either hand or rotary. But can not mechanically remove pulp tissue and any associated bacteria or debris within the canal system present adjacent to the main canals. Treatment success requires elimination of both pulp tissue and associated bacteria from this anatomy, so that it can be sealed during obturation. Irrigation has long been accepted as a key factor of treatment to achieve those goals.

Yet, complete cleaning of residual bacteria especially in the apical portion of the canal system has been difficult to achieve with traditional methods using even sodium hypochlorite (NaOCL) irrigation. (2) Studies have demonstrated that addition of an Er:YAG laser to activate the irrigation solution greatly enhances not only the efficiency of the irrigation but also makes it possible to remove debris from the canal walls. NaOCL is still the accepted irritant but also improves disinfection of the canal system, clearing accessory canals so that it may be sealed during obturation. (Figure 3, 4).

Irrigation the key to Endodontic success

Although, instrumentation with files is important to enlarge the canals and ready them to be obturated, debris consisting of pulp tissue and associated bacteria is not effectively removed by files. Irrigation with an appropriate solution needs to be utilized to remove that debris from the canal walls. NaOCL is still the accepted irritant due to its tissue dissolving ability and antibacterial nature. Yet, it can not effectively reach far beyond the main canals to remove the residual tissue. Tissue dissolution can be enhanced to more effectively remove prolonged debris and bacteria further into the accessory anatomy to allow better sealing of the canal system improving treatment success.

Smear layer within the canal system plays a factor in success in endodontic treatment. The smear layer contains bacteria which when left within the canal system can prevent any mechanical debridement and cause the occurrence of infection endodontically. When compared to traditional irrigation methods, laser enhanced irrigation has demonstrated better intracanal smear layer removal. (3) As previously stated, bacteria which when left within the canal system are present on the apical canal and debris or smear layer within the canal system. (Figure 2) Smear layer within the canal system presents adjacent to the main canals. Treatment success requires elimination of both pulp tissue and associated bacteria from this anatomy, so that it can be sealed during obturation. Irrigation has long been accepted as a key factor of treatment to achieve those goals.

The Laser Touch™ Er:YAG laser system is utilized to activate the irrigation solution within the chamber and canals during instrumentation to improve the efficiency of the irrigation. (4) When the Er:YAG laser is activated, a heat pulse is generated by the laser radiation delivered via a sapphire tip into an absorbing liquid (irrigant). This results in tensile stress with cavitation bubble expansion and collapse cause the surrounding fluid to flow at a speed of up to m/s traveling throughout the canal system. This causes rapid displacement of intra-canal fluid via radial and longitudinal pressures sufficient to drive irrigant into the canal system and clean the dentino- enamel junction. The mechanical debridement of the irrigant includes the irrigant increasing its effectiveness in debridement of dentinal walls and its rigidity is set at a sub-ablative physical properties of the irrigants.

The Laser Touch™ induced Photomechanical Irrigation system is initiated with access to the pulpal chamber, which may be performed by traditional methods using burs or by ablation of the enamel and dentin with the Laser Touch™ Er:YAG laser. As the laser is ineffective in removal of ceramics and metals, such as those found in fixed prosthetics, amalgam, caries and diamonds the enamel and dentin is removed by the laser. (Figure 8) Once the laser has been activated the laser can be utilized to unroof the pulpal chamber (hard tissue mode). An additional benefit of the Er:YAG laser to access the pulpal chamber is it provides decontamination and removal of bacterial debris and pulpal tissue to yield a cleaner chamber aiding in the identification of the canal orifices (soft tissue mode).

Once the canal orifices are identified, the channel is widened gently with hand files with a glide path working length of each canal. Canals are then enlarged to access the intracanal debris removal in that the files are unable to clean when instrumentation is not fully cleaned canals are unable to fill this leaving bacteria to inhabit those areas which may lead to recurring endodontic failures. A laser enhanced activation of endodontic irrigants cleans more anatomy adjacent to the main canals so that a more complete obturation of the canal anatomy is possible. An added benefit of the laser is that it has an antibacterial effect, killing bacteria within the canal system killing access to the root canal system and any remaining debris removal in that the irrigation solution may reach essentially sterilizing the entire tooth to the periodontal ligament.

References

The full list of references is available from the publisher.

Dr. Kurtzman is in private general practice in Silver Spring, Maryland and is a Clinical Professor at University of Maryland and a former AADL Implant Mou. Graphic Assistant program director at Howard University College of Dentistry. He has lectured internationally on the topics of Restorative dentistry, Endodontics and implant surgical, failure outcomes and fixed prosthetics. Periodontics and has over 510 published articles. He has earned Fellowship in the AGD, AACP, AAID, ICOI, Peri-implant, AGD, Membership in the AGD and ICOI. Dr. Kurtzman was invited to be included in “The Leaders in Continuing Education” by Dentistry Today annually since 2006 and was featured on their June 2012 cover. He can be reached at dr_kurtzman@mglandimplants.com.
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