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 well to 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 tenderness in the buccal or palatal sulcus. Sensitivity testing with EndoFree: UR2 +ve, UR6 ++ 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 lucency 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 and in 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 (i) Channel 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.
The canal lengths were determined electronically with an Apex RNR apax locator (Medic RNR) using a size 10 K-file (Dentsply Maillefer) and shaped with BioRace (FKG Dentaire) B10, B15, B100, B25 and B40 se- quently to length irrigation with 3% NaOCl between each file.

After shaping, the root canals were cleaned with the Trismale Passive Ultra- sonic-brushing tip Acteon UK for 3 cycles of 20 seconds per canal re- plishing the irrigant between each cycle (Figure 3). Following which a soak was performed with 17% EDTA (FKG) for 60 seconds delivered before and the final flush was made with 5% NaOCl.

Obturation was performed with To- talfill BC Sealer (FKG Dentaire) and size 25/04 Totalfill BC Points, gutta percha cones impregnated with bi- ocema. 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 Totalfill BC Sealer (Figure 3) and seated into the canals, withdrawn half way and reseted. The coronal portion of the cone was cleaned by washing with a heated instrument and packed gen- tly into the canal orifices (Figure 6 and Figure 7), and the access cavity cleaned by washing with a 3:1 tv tis- syringe.

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

Discussion
The diagnosis of an acute symptomatic irreversible pulpitis can sometimes be difficult, however by repeating the patients' sensitivity to cold it may become apparent which tooth was causing the trouble. The best way to treat these cases would be to remove the inflamed tissues as quickly as pos- sible; antibiotics have noplace, as there isn't an infection.

The narrowess of the canals and the severe curvature on the root end can make instrumentation challeng- ing. Scissors of canals takes place as a result of deposition of secondary dentine and progressive deposition of calcified masses that originate in the root pulp (Bernick & Nedelman 1973), and true pulp stones are made of dentine and lined by odontoblasts (Johnson & Bevlander 1956).

Pulp stones are common, ranging from 4% of first molars Chandler et al. 2005 to 78% of primary molars (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 (Loubaine et al. 2001). When sealed on the canal and initially seated the canal wall is coated, withdrawing it and re- seating it thus there is 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 customised to improve apical control (van Zyl 2009) and that hydraulic pumping is not employed. With this technique, the GP core acts as a carrier and the sealer is employed to fill the entire canal space, thus providing the de- sired three-dimensional seal (Schul- der 1997).

Conclusions
Pulp stones are a common occurrence and act as a barrier to suc- cessful endodontic treatment. Mech- anical grade pulp preparation with Scouterace files allows predictable canal preparation in endodontic therapy.

Single cone obturation is possible and a procedure of choice.

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

References
Ahmad M, Roy RA, Kamardin AG Obturation of complex endodontic fields around an oscillating ultraso- nic Endodontic Dental Trauma- tolgy 1998; 2: 159-64.
Boutsioukis C, Gogos C, Verhaagen B, Baumgartner JC, Mader CL. A scan- ning electron microscopic evalua- tion of ultrasound after hand and rotary file debridement of open apices (Parirokh & Torabinejad 2007). The canal walls were made with 3% NaOCl.

Bioceramics (tricalcium silicates) have many uses in endodontics, providing an apical seal in teeth with open apices (Parirokh & Torabinejad 2007) and increases the reduction in bacterial load (Bhuva et al. 2010; Carver et al. 2010).


Ahmad M, Roy RA, Kamardin AG Obturation of complex endodontic fields around an oscillating ultraso- nic Endodontic Dental Trauma- tolgy 1998; 2: 159-64.

Ahmad M, Roy RA, Kamardin AG Obturation of complex endodontic fields around an oscillating ultraso- nic Endodontic Dental Trauma- tolgy 1998; 2: 159-64.

Ahmad M, Roy RA, Kamardin AG Obturation of complex endodontic fields around an oscillating ultraso- nic Endodontic Dental Trauma- tolgy 1998; 2: 159-64.

Ahmad M, Roy RA, Kamardin AG Obturation of complex endodontic fields around an oscillating ultraso- nic Endodontic Dental Trauma- tolgy 1998; 2: 159-64.


Ahmad M, Roy RA, Kamardin AG Obturation of complex endodontic fields around an oscillating ultraso- nic Endodontic Dental Trauma- tolgy 1998; 2: 159-64.

Ahmad M, Roy RA, Kamardin AG Obturation of complex endodontic fields around an oscillating ultraso- nic Endodontic Dental Trauma- tolgy 1998; 2: 159-64.

Ahmad M, Roy RA, Kamardin AG Obturation of complex endodontic fields around an oscillating ultraso- nic Endodontic Dental Trauma- tolgy 1998; 2: 159-64.

Laser Enhanced Endodontic Treatment

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, intracanal recurrent 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 debris from the canal system and associated bacteria from this anatomy, so that it can be sealed during obturation. Treatment success requires elimination of the bacteria and associated bacteria from this anatomy, so that it can be sealed during obturation. As only one thing can occupy a space at a time, obturation material can not fill all areas still occupied by pulpal tissue. Success is dependent on dissection and cleanout of all bacteria from this system so that it may be sealed during obturation. Irrigation has long been accepted as a key factor of treatment to achieve those goals.

Yet, complete clearing 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 and EDTA) but also improves disinfection of the canal system, clearing accessory 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 pulpal tissue and associated bacteria is not effectively removed by files. Irrigation with an appropriate irrigant solution is necessary to remove debris from the canal walls. NaOCL is still the accepted irrigant to clear the tooth. Studies have demonstrated that addition of an Er:YAG laser to activate the irrigation solution greatly enhances not only the efficiency of the tooth but also improves the irrigation solution of up to 12 m/s traveling throughout the tooth. This results in tensile stress with penetration depth of the laser radiation. Bubble expansion and collapse cause the surrounding fluid to flow at a speed of up to m/s travelling throughout the canal system. This causes rapid displacement of intra-canal fluid via radial and longitudinal pressures sufficient to drive irrigant into the canal anatomy and clean the dentin. The mechanical action of the Er:YAG laser is utilized to clear debris and remaining bacteria from the canal wall, decreasing the potential of file separation which can occur when instrumentation a dry canal. (Figure 5)

Photo-activation of the irrigant within the canal system is performed using the Er:YAG laser with a 0.04 or 0.06 for the final instrumentation which assists in removal of the debris created by the files. Between each change of irrigant, the Er:YAG laser is utilized with NaOCL and the tip of the laser is placed into the canal and the solution activated with the laser at 40 W with an average power of only 0.06 or 0.04 for 20-30 seconds. (Figure 6) The chamber is suctioned and fresh NaOCL is placed in the tooth and the next syringe is used for instrumentation. It is unnecessary to place the lasers tip into the canal system after each syringe or irrigation. The end point of the solution within the chamber transmits down the irrigant into the canals to the apical aspect of the roots. Laser activation may also be performed with EDTA solution alternating with NaOCL. The benefit of EDTA solution is its chelation effect in opening canals within the chamber fluid. The next round of NaOCL can reach more pulp tissue not accessible to the files in files, as well as accessory and lateral canals following instrumentation of the canals with the irrigant solution, the files are changed with NaOCL and the Er:YAG tip is placed into the canal chamber and activated for a minimum of 60 seconds. This allows the photo-activated irrigant to clear the residual debris and remaining bacteria from the tissue from the complete canal system. The irrigant is suctioned from the chamber and fresh irrigant placed and photo-activated repeated until no visible debris (evident on suction in the chamber fluid. This indicated that all accessible debris has been removed from the canal system. Any remaining solution is suctioned from the tooth and the canal is dried with paper points. This procedure is repeated until all debris has been removed from the chamber. (Figure 7)

References
3. Plodiv, Bulgaria) removed fully using standard irrigation protocols. (Figure 1, 2)
4. Lyon, France)
5. Figure 2: SEM showing bacteria and pulpal debris in the apical 1/3 that was not removed fully during standard irrigation protocol. (Courtesy Prof. Georgi Tomov, Plovdiv, Bulgaria)
6. Figure 3: SEM showing complete removal of bacteria and pulpal debris following activation of the LT-IPI™ protocol using debriding laser for tooth 
0.06 for the final instrumentation is recommended. Sodium hypochlo- ride NaOCL is utilized within the chamber and chambers during instrumentation both as a pulp tissue decontamination and to lubricate the fluids within the canal, decreasing the potential of file separation that can occur when instrumentation a dry canal. (Figure 5)

Photo-activation of the irrigant within the canal system is performed using the Er:YAG laser with a 0.04 or 0.06 for the final instrumentation which assists in removal of the debris created by the files. Between each change of irrigant, the Er:YAG laser is utilized with NaOCL and the tip of the laser is placed into the canal and the solution activated with the laser at 40 W with an average power of only 0.06 or 0.04 for 20-30 seconds. (Figure 6) The chamber is suctioned and fresh NaOCL is placed in the tooth and the next syringe is used for instrumentation. It is unnecessary to place the lasers tip into the canal system after each syringe or irrigation. The end point of the solution within the chamber transmits down the irrigant into the canals to the apical aspect of the roots. Laser activation may also be performed with EDTA solution alternating with NaOCL. The benefit of EDTA solution is its chelation effect in opening canals within the chamber fluid. The next round of NaOCL can reach more pulp tissue not accessible to the files in files, as well as accessory and lateral canals following instrumentation of the canals with the irrigant solution, the files are changed with NaOCL and the Er:YAG tip is placed into the canal chamber and activated for a minimum of 60 seconds. This allows the photo-activated irrigant to clear the residual debris and remaining bacteria from the tissue from the complete canal system. The irrigant is suctioned from the chamber and fresh irrigant placed and photo-activated repeated until no visible debris (evident on suction in the chamber fluid. This indicated that all accessible debris has been removed from the canal system. Any remaining solution is suctioned from the tooth and the canal is dried with paper points. This procedure is repeated until all debris has been removed from the chamber. (Figure 7)

Conclusions

The key to Endodontic success is two pronged, clearing the system and sealing it. Although, rotary files have improved the efficiency of instrumentation they are unable to reach any more of the anatomy that handfiles are able to reach. Cleaning of the canal system is key to irriga- tion of the canal system to improve the ability to debride and clean the entire canal system. (Figure 6, 7)

Dr. Kurtzman is in private general practice in Silver Spring, Maryland and a former Assistant Clinical Professor at Uni- versity of Maryland with a former AADP implant experience. (Photo courtesy of Dr. Kurtzman, Maryland implants.

The full list of references is available from the publisher.

endo trilune.com/E3

ENDO TRIBUNE
Now, everyone in your dental team can **SHOOT**!

Ultra-Light
**SIMPLE** Compact
**Accurate** Intuitive

**SHOFU** Smart Digital **EyeSpecial**
- The only true dental camera
- 8 automated pre-set dental modes
- Intuitive one-touch operation with built-in anti-shake
- Large LCD touchscreen with on-screen guide
- Fast auto-focusing capability and excellent depth of field
- Water and chemical resistance
- Registration and imprinting of patient ID
- Uncomplicated photo management system

For more information, simply contact us or your nearest **SHOFU** dealer.