The rise of bioceramics

Ali Allen Nasseh presents the clinical applications of bioceramics in endodontics

The term 'bioceramics' refers to biocompatible ceramic materials, applicable for biomedical or dental use. Systematic research of ceramics for use in biomedical applications started in the early 1970s and over the past 40 years, the application of a variety of ceramics in biomedicine has greatly expanded (Kokubo, 2008). Therefore, when the new calcium silicate, calcium phosphate EndoSequence bioceramic sealer and root repair material (Brasseler USA) (Figure 1) were introduced to endodontics, there was much excitement because their predecessor bioceramic materials had also shown considerable clinical success over time. However, it is generally agreed that the limitations with the early generation of bioceramics were their handling characteristics and non-ease of use. These challenges have now been met with the new EndoSequence bioceramic sealer and root repair material.

In the previous issue of *Endodontic Practice* (April 2009), an introductory article listed the many benefits of bioceramics in both surgical and non-surgical endodontics (Koch, Brave, 2009). The benefits are so significant that the BC sealer is now an integral component of the EndoSequence instrumentation and obturation system and, along with the new root repair material, has evolved into the realm of surgical endodontics. This is a natural progression given the fact that these particular bioceramics have exceptional dimensional stability and do not shrink upon setting and, consequently, remain non-resorbable inside the root canal and retro-preparation. Furthermore, the formation of calcium hydroxide as a by-product of the setting reaction produces a very high pH (12.8) rendering the material anti-bacterial during its setting time (the pH will decrease over the next seven days). This is an important physical property for a cement, particularly if it is being used as an endodontic sealer (Torabinejad, Hong, McDonald, Pitt Ford, 1995).

In fact, in a soon to be published article by Zuang et al, it was shown that BC sealer (iRoot SP) killed all bacteria within two minutes of contact. The authors proceed to explain that its potent anti-bacterial effect may be a combination of its high pH, hydrophilic nature and its active calcium hydroxide diffusion (Zuang, Shen, Ruse, Haapasalo). The BC sealer itself sets in three to four hours (the setting reaction is initiated by the moisture present in the dentinal tubules) and this provides ample time for clinical use in surgical or non-surgical applications (Koch, Brave, 2009). Additionally, the direct application of this material into the root canal or into the retro preparation by syringe (using various tips of different diameters and configurations) makes it exceedingly efficient for clinical use.

Subsequently, the intent of this article is to demonstrate how this material is used in clinical endodontics, both non-surgical and surgical cases will be shown. Please see pages XX-XX for the case figures.

Figure 1: EndoSequence BC sealer (premixed in syringe with multiple tips)

Conclusion

In conclusion, bioceramic materials have excellent biocompatibility and material properties that render them ideal for endodontic care. The EndoSequence BC sealer and root repair material, in particular, demonstrate favorable clinical properties for their use as either an endodontic sealer or root repair material. Furthermore, the improved efficiency and mode of delivery offered by this system, makes it far easier to use than the previous bioceramic systems for both surgical and non-surgical applications.

References

Kokubo, T (2008) *Bioceramics and their clinical applications* Woodhead Publishing Limited

Koch K, Brave D (2009) Bioceramic technology – the game changer in endodontics *Endodontic Practice* **2(2)**: 17-21

Torabinejad M, Hong CU, McDonald F, Pitt Ford TR (1995) Physical and chemical properties of a new root-filling material *JOE* **21**: 349-53

Zuang H, Shen Y, Ruse ND, Haapasalo M Antibacterial activity of endodontic sealers by a modifed direct contact test *JOE* (Accepted for publication)

Koch K, Brave D, (2009) A new day has dawned: the increased use of bioceramics in endodontics *Dentaltown* **10(4)**: 39-43

Dr Nasseh received his dental degree from Northwestern University Dental School in 1994 and his post-doctoral endodontic training at Harvard School of Dental Medicine in 1997, where he also completed a Masters in Medical Sciences degree in the area of bone physiology. Dr Nasseh has been a clinical instructor in the post-doctoral endo department at Harvard School of Dental Medicine since 1997. Dr Nasseh is the clinical director of Real World Endo and the editor of the *Harvard Dental Bulletin*. He has published numerous articles and lectures extensively nationally and internationally in surgical and non-surgical endodontic therapy. Dr Nasseh has a clinical private endodontic practice (Micro-Surgical Endodontics) and an endodontic educational institute in Boston, MA in the Copley Plaza.

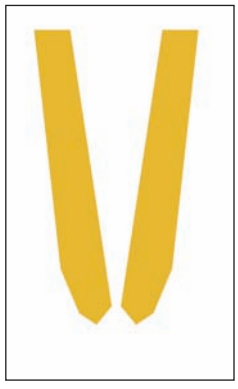

Figure 2a: After final cleaning and shaping, the canal is irrigated with NaClO final rinse and dried with paper points

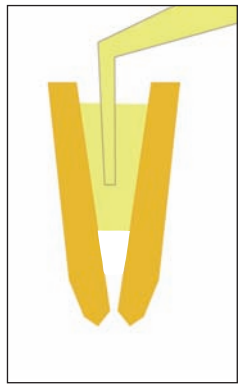

Figure 2b: EndoSequence BC sealer is injected into the coronal half of the canal using the syringe tips in the box

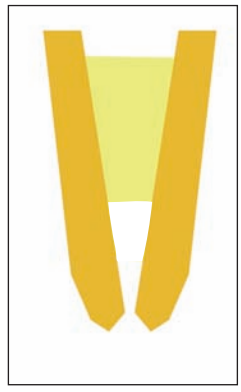

Figure 2c: If the EndoSequence system of matching GP is used, the apical third may be left without any sealer

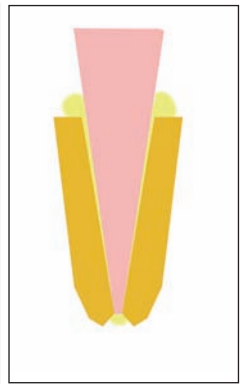

Figure 2d: Placement of the matching cone to the preparation size will push the sealer apically

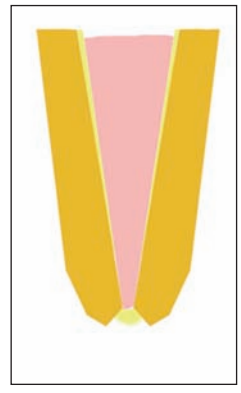

Figure 2e: The gutta percha handle is then severed with heat at the level of the orifice or below for a canal cap or a post space

Case one

Figure 1: Tooth 14 with irreversible pulpitis following a composite restoration

Figure 2: Immediate post operative radiograph using the EndoSequence system including BC sealer and a 3mm thick layer of bonded EndoSequence core material for an immediate seal of the canal orifices. Cotton and Cavit is placed in the orifice

Case two

Figure 1: Tooth 3 with irreversible pulpitis

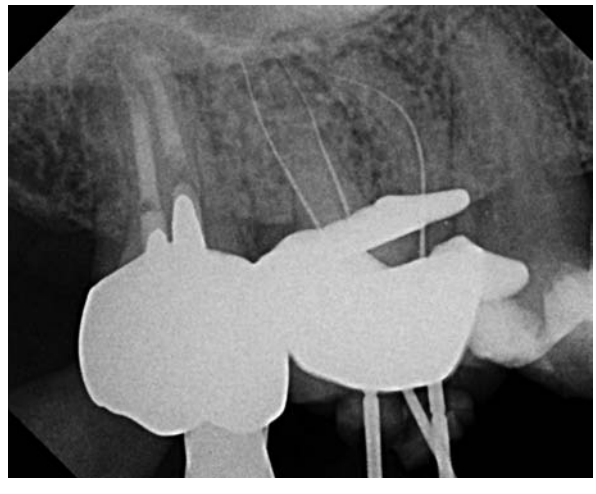

Figure 2: Initial working length determination shows sharp mesial root curvature

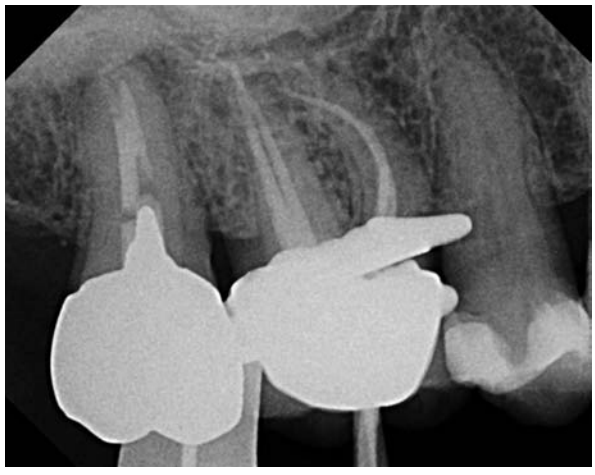

Figure 3: Mid-obturation radiograph showing single .04 taper EndoSequence gutta percha cones with BioCeramic sealer in all four canals

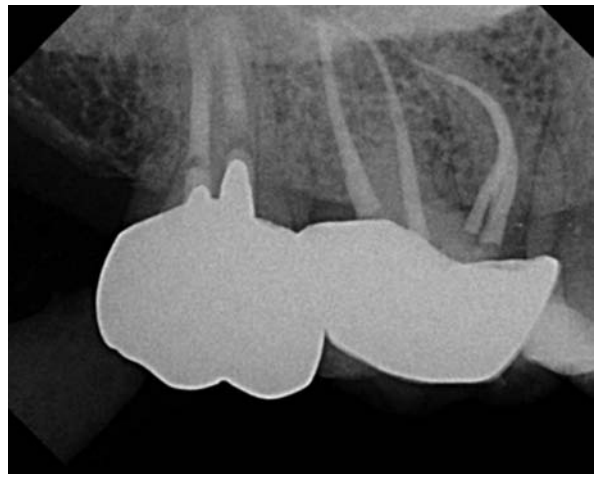

Figure 4: Post obturation distal angle radiograph of the sealer showing all four canals obturated using the EndoSequence BC sealer and bonded EndoSequence core material in the access opening

Case three

Figure 1: Necrotic tooth 3 with a large coronal restoration and apical lesions of endodontic origin

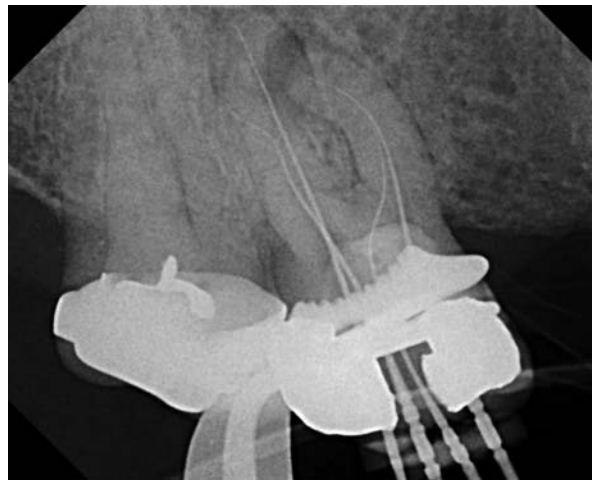

Figure 2: Working length radiograph identifying all four canals

Figure 3: Mid-obturation radiograph with (matching) EndoSequence single cones and BC sealer

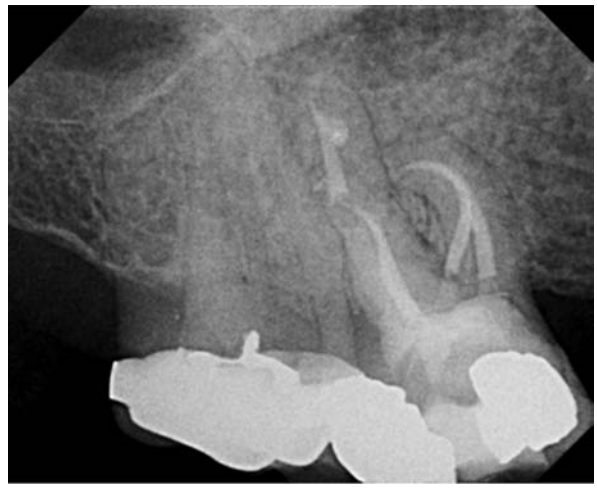

Figure 4: Four months post-operative radiograph showing healing of apical radiolucencies. The post space has been filled with a fiber post

Case four

Figure 1: Carious tooth 18 under an old composite restoration with irreversible pulpitis and acute pain. Tooth 19 also has an old, poorly treated root canal with a chronic apical abscess around the mesial root

Figure 2: Proper isolation, using a rubber dam and Opal Dam light curable resin to seal the crevices and the rubber dam, completely sealing it against leakage of saliva into the working field or leakage of sodium hypochlorite into the mouth

Figure 3: Working length determination of all three canals

Figure 4: Radiographic confirmation of root lengths

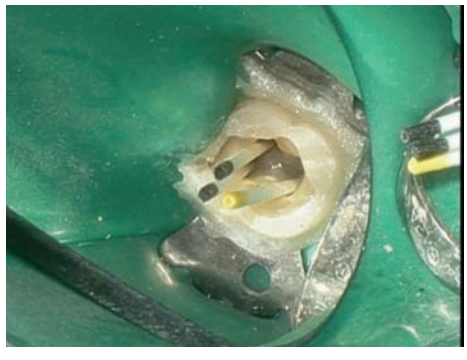

Figure 5: Complete instrumentation of the canals using EndoSequence files, finishing at 40/.04 in the two mesial roots and 50/.04 in the distal root

Figure 6: After removal of the smear layer and a final rinse with sodium hypochlorite, the canals are dried with the matching size EndoSequence paper points

Figure 7: The EndoSequence BC sealer syringe tip is inserted in each canal and a small quantity of the sealer is inserted into each canal, coating and filling the canals with sealer

Figure 8: Injection in the mesiobuccal canal

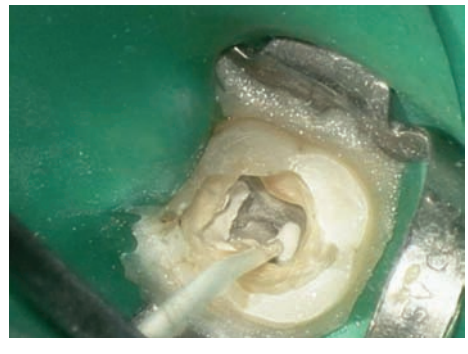

Figure 9: Injection in the distal canal

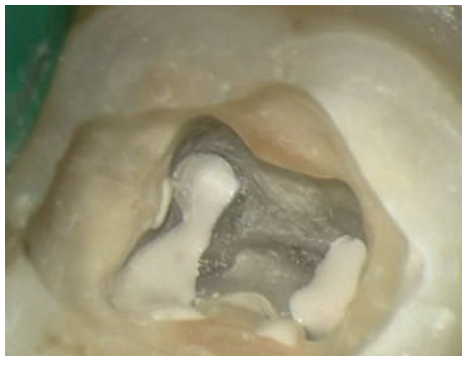

Figure 10: Higher magnification image of canals filled with the bioceramic sealer from the syringe

Figure 11: A confirmation radiograph shows that the sealer has fully filled the coronal 2/3 of the canal, leaving the apical 1/3 free of sealer. This space will be filled after the introduction of the matching gutta percha cone into the canal, which like a piston, pushes the coronal sealer apically

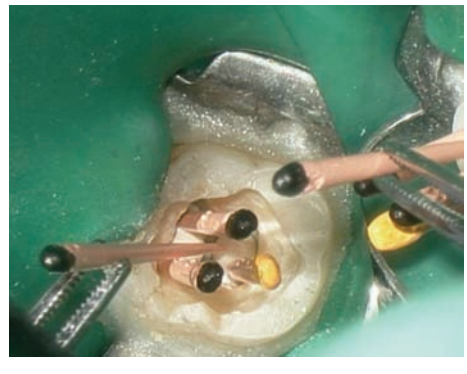

Figure 12: The corresponding cone for each canal is gently inserted. If additional space is available (e.g. an oval shaped canal), an additional cone may be placed in that space

Figure 13: Image showing all canals filled with an additional cone in the distal canal due to its oval shape. The heated instrument is used in the mesiobuccal canal orifice, preparing to sear off the handle

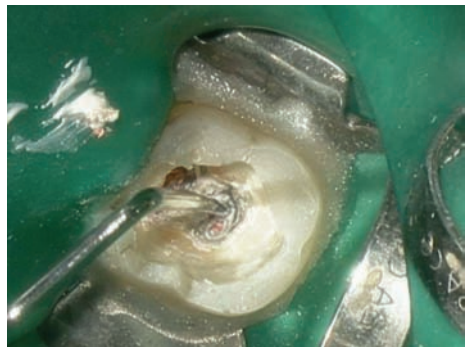

Figure 14: The gutta percha is then seared off using heat at the orifice level and a plugger is used to condense the gutta percha apically at the level of the orifice. Use the correct size plugger, one that matches the gutta perchas cross sectional diameter at that specific level and does not put pressure on the dentin. Apical pressure will transfer the condensation force along the length of the EndoSequence gutta percha (which has a higher molecular density and does not deform as readily). This property allows the gutta percha cone to act as an extension of the plugger

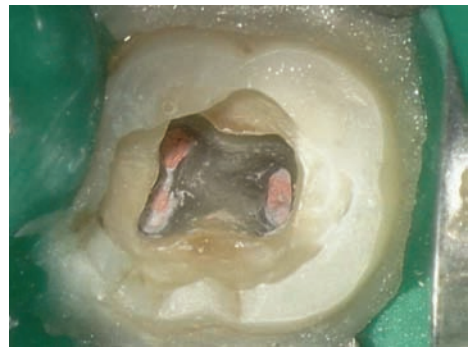

Figure 15: After condensation, the excess sealer is best cleaned using an ultrasonic tip with water for about 10 seconds in the chamber

Figure 16: Following obturation, it is best to seal the orifices immediately, no matter what sealer you use (non-eugenol based sealers). After Phosphoric acid etching, a later generation bonding agent is used

Figure 17: A 2-3mm thick layer of EndoSequence dual cure, reinforced composite is placed and cured in place

Figure 18: Cotton and Cavit are then inserted in the chamber

Figure 19: The angled final radiograph shows an adequately prepared and obturated root canals with a definitive seal in the chamber. The patient will then see the restorative dentist for the ensuing core and crown. Tooth #19 also requires retreatment next

Case five

Figure 1: Necrotic tooth 19 with a large periapical radiolucency

Figure 2: Immediate post-operative radiograph of the tooth obturated with the EndoSequence BioCeramic sealer

Figure 3: Six months follow-up of the tooth showing restoration of the access and healing in the periapex

Figure 4: Another angle showing complete periapical healing six months post-operatively

Case six

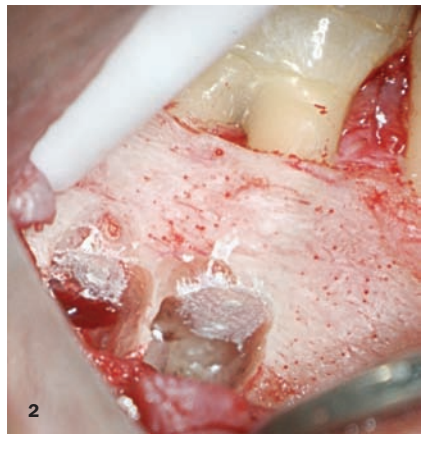

Figure 1: Pre-operative radiograph showing failed root canal
Figure 2: Bioceramic paste retrofills injected into retropreparations
Figure 3: Immediate post-operative radiograph (three BC paste retrofills at the apecies)
Figure 4: Four months and 21 day recall of the case. Further healing in progress and no clinical symptoms present