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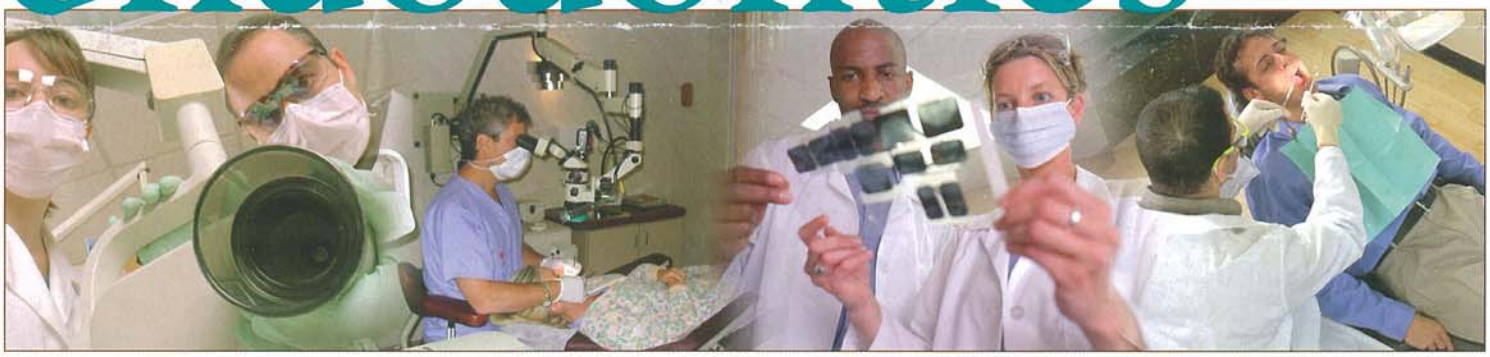

Mineral Trioxide Aggregate for Open Apex Teeth

Apexification, defined as "a method of inducing a calcified barrier in a root with an open apex or the continued apical development of an incompletely formed root in teeth with necrotic pulp," establishes a root-canal space that can be successfully obturated. Numerous procedures have been recommended to facilitate this by inducing root-end barrier formation. Calcium hydroxide ($Ca[OH]_2$) has been the material of choice for inducing the formation of an apical hard-tissue barrier before placing a long-term root filling.

Despite a long history of use in apical closure procedures, the use of $Ca(OH)_2$ for apexification presents several problems, including the long time required for root apices to close, the number of "dressings" necessary to complete closure, the role of infection and the fracture resistance of teeth after the long-term application of $Ca(OH)_2$. Poor patient compliance also has a negative influence on outcomes of traditional apexification procedures.

Mineral trioxide aggregate (MTA) has recently been recommended to create an apical barrier. MTA has the ability to induce cementum-like hard tissue when used adjacent to the periradicular tissues. Advantages of MTA, compared with the combination of $Ca(OH)_2$-induced apical closure followed by compacted gutta-percha, include

- a reduction in treatment time,
- smaller likelihood of fracture and
- fewer visits to the dental office.

In order to report on the clinical outcome when MTA is used to obturate teeth with open apices, Witherspoon, a private practitioner from Texas, et al retrospectively analyzed 116 patients treated in a single private endodontic office from 1999–2006. Treatments on 144 teeth were completed either in 1 visit (92/144) or 2 visits (52/144) with an interim $Ca(OH)_2$ interappointment medication.

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Table 1. *Results for recalled teeth with ≥1-year follow-up*

Treatment	Number of teeth with ≥1-year recall	Healed	Healing	Persistent disease
All teeth	52	48	3	1
1 visit	31	29	2	0
2 visits	21	19	1	1

A total of 54% (78/144) of the teeth were available for recall. The maximum time to recall was 4.87 years; the mean time to recall was 19.4 months. Of the cases recalled for a period of ≥1 year, 93.5% of teeth treated in 1 visit healed, and 90.5% of teeth treated in 2 visits healed (Table 1).

Conclusion

These data show high success rates for 1- and 2-visit treatments. MTA obturation of canals with open apices is a viable alternative to the use of $Ca(OH)_2$ to induce apical closure.

Witherspoon DE, Small JC, Regan JD, Nunn M. Retrospective analysis of open apex teeth obturated with mineral trioxide aggregate. J Endod *2008;34:1171-1176.*

Adhesive Cementation of Endodontic Posts

The retentive effect of adhesive systems for endodontic post cementation has been claimed to improve marginal adaption with better apical seal, increase post retention even with reduced post length, relieve stresses within the root, optimize fracture patterns in re-restoration and, at least for upper incisors, increase failure resistance compared with conventional cementation. To test the influence of nonadhesive, self-adhesive and etch-and-rinse systems, Naumann et al from the University of Leipzig, Germany, tested the following null hypotheses:

- Conventional nonadhesive zinc phosphate cement is as reliable as a self-adhesive and etch-and-rinse adhesive cement during simulated functional force application; and
- There is no difference between the load capability of adhesive and nonadhesive cements.

Forty human maxillary central incisors were divided into 4 groups ($n = 10$). Teeth were endodontically treated and restored using glass fiber posts luted with 4 different cement/composite resin combinations:

- RelyX Unicem (3M ESPE, Seefeld, Germany)/Clearfil Core (Kuraray Europe, Duesseldorf, Germany),
- RelyX Unicem/LuxaCore-Dual (DMG, Hamburg, Germany),
- Zinc phosphate cement/Clearfil Core and
- LuxaCore-Dual/Clearfil Core.

A 2-mm ferrule preparation was performed. All specimens received adhesively luted all-ceramic crowns and were exposed to thermal cycling and mechanical loading (TCML) before subsequent static loading. Then, the specimens were loaded into a universal testing machine (v = 1 mm/minute) until failure. Failure detection was set at a 10% loss of the maximum applied force. To reduce excessive stress concentrations, a 0.3-mm-thick tin foil was positioned between the steel piston and the palatal crown surface.

The results of this study did not support either of the 2 hypotheses. Significant differences between the experimental groups regarding load capability and fracture patterns were observed. Six specimens of the zinc phosphate-Clearfil cement group failed early during TCML.

In the Unicem–Clearfil group, all specimens survived TCML. In the Unicem/LuxaCore and LuxaCore/Clearfil groups, 3 and 2 specimens, respectively, failed early during TCML. The highest median fracture load value was observed for the group in which RelyX Unicem was used for post cementation in combination with Clearfil Core as buildup composite resin. The combinations of Unicem with LuxaCore-Dual and LuxaCore-Dual with Clearfil Core revealed similar load values; however, these combinations performed less reliably.

Conclusion

Conventional nonadhesive post cementation failed to withstand simulated functional forces as well as a self-adhesive composite resin or an etch-and-rinse–based bonding system. Therefore, nonadhesive post cementation may not be recommended for clinical application. However, the reliability of adhesive cementation of endodontic posts appears to be material-specific.

Naumann M, Sterzenbach G, Rosentritt M, et al. Is adhesive cementation of endodontic posts necessary? J Endod *2008;34:1006-1010.*

Gutta-percha vs Resilon Penetration Into Lateral Canals

The root-canal system has a complex anatomy with irregularities that may contain bacteria and necrotic tissue. Lateral canals exist predominately in the middle and apical thirds. Although several reports have shown developing or persistent periapical disease around untreated and unfilled lateral canals, other studies have shown no correlation between untreated, unfilled lateral canals and failed endodontic treatment. However, it has been speculated that open and large lateral canals could create a 2-way passage of bacteria and tissue degradation products between the root-canal space and periodontal tissue.

The goal of a root filling is to confine or entomb microorganisms, their toxins and the necrotic tissue remaining after cleaning and shaping procedures. The capacity of an endodontic filling material and technique to seal the canal irregularities is an important clinical parameter. Better adaptation of material to irregular dentinal walls is a favorable characteristic of a filling material and technique. Warm gutta-percha compaction provides superior adaptation to canal walls and into lateral canals when compared with cold lateral compaction.

Resilon (Resilon Research, LLC, North Branford, Conn.) is a polyester polymer-based obturation system that was introduced with a new concept of monoblock formation between the dentinal wall and the filling material. When a resin composite sealer is used with a Resilon core material, a bond is formed with the dentin wall, making the filling more resistant to bacterial penetration. Resilon can be softened with heat and used with thermoplastic gutta-percha delivery systems.

Karabucak et al from the University of Pennsylvania evaluated the ability of Obtura II (Obtura Spartan, Fenton, Mo.) and Calamus (Densply, Tulsa, Okla.) delivery systems to fill artificially created lateral canals in simulated plastic teeth using standard gutta-percha, Flow 150 gutta-percha (Obtura Spartan) and Resilon.

Lateral canals were created at 2, 4, 6, 8, 10 and 12 mm from the apex in plastic teeth. The teeth were divided into 8 groups:

- Group 1—teeth were filled with Calamus Singles in a single increment;
- Group 2—teeth were filled with Calamus Singles in 3 increments;
- Group 3—teeth were filled with standard gutta-percha in a single increment using Obtura II with a 23-G needle;
- Group 4—teeth were filled with standard gutta-percha in 3 increments using Obtura II with a 23-G needle;
- Group 5—teeth were filled with Flow 150 gutta-percha in a single increment using Obtura II with a 25-G needle;
- Group 6—teeth were filled with Flow 150 gutta-percha in 3 increments using Obtura II with a 25-G needle;
- Group 7—teeth were filled with Resilon pellets in a single increment using Obtura II with a 25-G needle; and
- Group 8—teeth were filled with Resilon pellets in 3 increments using Obtura II with a 25-G needle.

A multiple comparison analysis of variance test, followed by a Tukey post-hoc test, was used to compare filling material penetration into the lateral canals and the experimental groups.

Mean values of gutta-percha and Resilon penetration into lateral canals are presented in Table 2. Among all obturation categories, Flow 150 gutta-percha (groups 5 and 6) and Resilon (groups 7 and 8) showed significantly deeper penetration into all lateral canals, compared with Calamus and Obtura II with standard gutta-percha

Table 2. *Group distribution and mean penetration into lateral canals in all groups*

	Group	Backfill technique	Mean penetration
Calamus	Group 1	Single	1.48[a]
	Group 2	Multiple	1.16[a]
Obtura II with standard gutta-percha	Group 3	Single	1.26[a]
	Group 4	Multiple	1.41[a]
Obtura II with Flow 150	Group 5	Single	4.27[b]
	Group 6	Multiple	4.37[b]
Obtura II with Resilon	Group 7	Single	3.81[c]
	Group 8	Multiple	3.28[d]

Means followed by different letters present statistically significant difference ($p < .05$).

regardless of single or multiple backfill techniques ($p < .05$). The Flow 150 group had significantly better penetration into lateral canals when compared with other groups ($p < .05$).

Conclusion

The results indicated that the flow of the filling material into lateral canals is a function of the viscoelastic properties of the filling material, rather than the mechanical properties of the delivery systems. The data also suggest that the Resilon filling material flows better into lateral canals when a single backfill technique is used.

Karabucak B, Kim A, Chen V, Iqbal MK. The comparison of gutta-percha and Resilon penetration into lateral canals with different thermoplastic delivery systems. J Endod *2008;34:847-849.*

Survival of Root-fractured Teeth

Horizontal or transverse root fractures pass across the entire root and involve the cementum, dentin and pulp. They can present with or without clinical signs of luxation of the coronal fragment. However, the most common clinical sign is an extruded and lingually displaced crown. The fracture can appear radiographically as a single line or multiple lines across the root.

Cvek et al from Eastman Dental Institute, Sweden, performed a survival analysis of root-fractured teeth in patients aged 7–17 years, according to the following parameters:

- Long-term survival and its relation to healing types;
- Location of fracture in the root and stage of root development;
- Outcome of endodontic treatment in teeth primarily showing no fracture healing;
- Consequences of a new injury; and
- Frequency of looseness of the coronal fragment requiring extraction of the tooth.

The study included all 534 teeth with an intra-alveolar root fracture treated at the Eastman Institute's Department of Paediatric Dentistry in Stockholm between 1959 and 1995.

Survival or healing of the fracture was observed in 80% of the teeth. In 348 teeth, the fracture healed spontaneously, and in 78 teeth it healed after endodontic therapy subsequent to initial or new injury.

The 325 teeth in which no complication occurred after healing were followed for 12–124 months after the injury. In more than half of these teeth, the fracture was located in the middle part of the root and healed with interposition of soft tissue between the fragments.

During the observation time, a post-healing complication occurred in 58 teeth. In 47 of the teeth it was a new luxation of the coronal fragment. In the other 11 teeth, the mobility of coronal fragment increased after fracture healing to such an extent that the tooth had to be extracted.

Two types of hard-tissue formation were observed in the pulp. In 45% of the 383 teeth, progressive apposition of hard tissue on the dentinal walls slowly obliterated the pulpal lumen. The pulpal lumen was diminished to some degree in only the coronal fragment of 15 teeth, in only the apical fragment of 57 teeth and in both fragments in 119 teeth. Obliteration of the pulpal lumen had no adverse effect on the survival of these teeth.

No healing, as evidenced by pulp necrosis and the appearance of radiolucency in the periradicular bone next to the root fracture, occurred in 20% of the 534 root-fractured teeth. Healing after endodontic treatment, as evidenced by resolved periradicular radiolucency and reestablished periodontal space bordered by lamina dura, occurred in 79% of the cases.

Conclusion

At the final assessment of 534 root-fractured teeth, 80% survived and 20% were extracted during the observation period. It was concluded that the survival frequency of root-fractured teeth was high for ≤10 years of observation. The highest frequency of tooth loss (70%) was found in teeth with horizontal fractures restricted to the cervical part of the root. When these teeth were excluded, the frequency of survival in remaining teeth rose to 88%.

Cvek M, Tsilingaridis G, Andreasen JO. Survival of 534 incisors after intra-alveolar root fracture in patients aged 7–17 years. Dent Traumatol *2008;24:379-387.*

In the next issue:

- Implants vs endodontics
- Cone-beam CT for identification of periapical lesions
- Comparing irrigation techniques

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