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Success of Calcium Silicate-based Sealers

Treatment and prevention of apical periodontitis require sealing the entire root canal system to keep microorganisms and fluids from reaching the apical tissues through the canal. Among the more recent innovations to achieve this are calcium silicate-based sealers (CSBSs). These sealers exhibit hydraulic properties that allow them to set and seal in the presence of moisture, along with bioactivity that includes the ability for them to release calcium ions and produce calcium hydroxide apatite. Although many in vitro studies have compared CSBS properties to those of zinc oxide–eugenol-based sealers (ZOESs) and epoxy resin-based sealers, little information exists for CSBS performance in clinical practice.

In 2021, Bardini et al from the University of Cagliari, Italy, reported the 1-year results of a randomized clinical trial that compared teeth instrumented with a standardized protocol and obturated using either the single-cone technique with gutta-percha and a CSBS or warm vertical compaction with gutta-percha and a ZOES. Teeth were evaluated using a periapical index (PAI) score and, based on clinical and radiographical assessments, grouped into 3 outcome categories:

- **healed:** functional and asymptomatic without any sign of apical periodontitis (PAI = 1)
- **healing:** functional and asymptomatic with periapical lesions that have decreased in size (PAI > 1)
- **diseased:** nonfunctional and symptomatic with signs of apical periodontitis (PAI > 1) or asymptomatic teeth with increased periapical lesions

Healed and healing teeth were considered successfully treated using "loose criteria," while only healed teeth were considered successfully treated using "strict criteria." Secondary outcomes included extraction rates, length of filling, presence of voids and sealer extrusion rate.

Now the authors have returned with further results of the trial at 2- and 4-year follow-ups. Of the original study group of 56 patients and 92 randomized treated teeth, 45 patients (67 teeth) returned at the 4-year recall. At 2 years,

Inside this issue:

- Apical Periodontitis and Autoimmune Diseases
- Pulp Sensitivity Testing After Pulpotomy
- Treating Dental Trauma in The Primary Dentition

Table 1. ***Success rate percentages at 4 years using calcium silicate-based sealer (CSBS) with the single-cone technique and zinc oxide–eugenol sealer (ZOES) with warm vertical compaction.***

	Strict criteria	Loose criteria
CSBS	86.8	92.1
ZOES	75.9	86.2
CSBS with preexisting apical periodontitis	81.5	88.9
ZOES with preexisting apical periodontitis	79.2	88.0

the overall success rate using the loose criteria was 88.5%, while the success rate using the strict criteria was 73.1%. Regardless of criteria, no difference between the CSBS and the ZOES groups was seen.

At 4 years, the total success rate was 89.6% using the loose criteria and 83.3% using strict criteria. The 52 teeth with preexisting apical periodontitis were separately analyzed; their success rates were 88.5% (loose criteria) and 80.4% (strict criteria), with both treatments recording similar results. None of the secondary outcomes showed any significant differences between the 2 treatment regimens (Table 1).

Conclusion

Both treatment options studies showed excellent results. The success rate using strict criteria improved at the 2- and 4-year follow-ups compared with that seen at the 1-year follow-up, consistent with previous findings that success rates tend to improve as follow-up time increases. Based on this study, the use of CSBSs and ZOESs results in similar success rates for nonsurgical root canal treatment and retreatment.

Bardini G, Bellido MM, Rossi-Fedele G, et al. A 4-year follow-up of root canal obturation using a calcium silicate-based sealer and a zinc oxide-eugenol sealer: a randomized clinical trial. Int Endod J *2025;58:193-208.*

Apical Periodontitis And Autoimmune Diseases

Practitioners need to be aware of the possible relationship between autoimmune diseases and apical periodontitis. Studies have suggested that patients with rheumatoid arthritis (RA) and inflammatory bowel disease (IBD) may have higher rates of apical periodontitis, which may be related to increased infection susceptibility and impaired healing mechanisms. The immunomodulatory and immunosuppressive therapies that these patients frequently undergo may also have an impact on apical periodontitis prevalence and healing. Mannocci et al from King's College London, United Kingdom, recently reviewed current evidence concerning the relationship between autoimmune diseases and apical periodontitis, along with the clinical implications for endodontic treatment.

The chronic systemic inflammation typical of RA, IBD and systemic lupus erythematosus (SLE) results from persistently elevated proinflammatory cytokine levels, the same cause of periapical tissue destruction in apical periodontitis. Overproduction of proinflammatory cytokines in RA not only contributes to joint destruction but also promotes periapical bone resorption and delayed healing in apical periodontitis; in patients with IBD and SLE, the dysregulated immune responses retard the effective resolution of apical periodontitis lesions.

Systemic immunosuppressant and anti-inflammatory therapies used to manage autoimmune diseases have a mixed impact on apical periodontitis outcomes; corticosteroids may worsen apical periodontitis outcomes by impairing microbial defense mechanisms, while the effects of biologic disease-modifying antirheumatic drugs (DMARDs) have been inconsistent, with improvement seen in short-term (≤6 months) studies but not in longer-term studies. Moreover, any improvement in periodontal condition seen with biologic DMARDs may not be repeatable in apical periodontitis. While the progress of periodontal disease may alternate periods of slow progress and accelerated destructive processes, inflammatory destruction of the periodontium progresses steadily over time.

Although it might appear that long-term systemic immunomodulatory therapy might affect apical periodontitis and tooth loss during periods of no detectible progression, these patients do not show an increased tooth retention rate compared with controls. Unlike periodontal medications, which can be repetitively applied to affected tissues, endodontic medications and sealers containing immunomodulators remain active for a short time following application in the root-canal space and have a limited effect. As a group, patients with autoimmune diseases have a higher level of caries; however, it remains unclear whether apical periodontitis in patients

with autoimmune disease is caused by their immune conditions or by caries. Many of these patients have comorbidities, such as diabetes, which can further complicate treatment.

Conclusion

Patients with autoimmune diseases should be monitored frequently; earlier intervention to prevent the progression of lesions may prove beneficial. Patients on long-term corticosteroid or biologic DMARD therapy may require lengthy follow-up periods. Because of the complex interplay between systemic health, medication regimens and endodontic outcomes, a multidisciplinary approach involving close collaboration with other specialists is strongly recommended.

Mannocci F, Koller G, Ravindran S. The prevalence and healing of apical periodontitis in patients with autoimmune diseases. Int Endod J *2025;doi:10.1111/iej.14214.*

Pulp Sensitivity Testing After Pulpotomy

Evaluating pulpal viability after vital pulp therapy can be accomplished by pulp sensibility tests, vascularity tests, direct clinical evaluation by reentering the pulp chamber, histological examination and evidence of hard tissue barrier formation. For teeth with symptomatic irreversible pulpitis, complete pulpotomy (removal of pulp tissue up to the canal orifices) and partial pulpotomy (removal of only the superficial 2 mm to 3 mm of the coronal pulp) are considered minimally invasive alternatives to full endodontic treatment.

To shed some light on whether the choice of pulpotomy procedure affects response to pulp sensibility tests, Sangwan et al from the Post Graduate Institute of Dental Sciences, India, retrospectively analyzed pulp sensibility responses to electronic pulp tests and cold tests in mature permanent molars that had undergone either complete or partial pulpotomy for carious pulpal exposure and symptomatic irreversible pulpitis after a 12-month follow-up. The authors combined the results from 3 studies (1 of complete pulpotomy, 2 of partial pulpotomy) that assessed clinical and radiographic outcomes. These included patients aged 18 to 45 years who had restorable mandibular molars with extremely deep caries and clinical diagnoses of symptomatic irreversible pulpitis with positive but heightened and lingering response to pulp sensibility testing. All studies used mineral trioxide aggregate as the pulpotomy agent, followed by a base of resin-modified glass ionomer cement and a composite resin definitive restoration.

At 12 months, the teeth underwent electronic pulp testing and cold testing. For electronic pulp testing, the electrode was placed over the mesiobuccal cusp of the contralateral, untreated tooth, with patients instructed to raise their hand when they felt any sensation. The test was then repeated on the treated tooth. A similar protocol was followed for cold testing, with the cold agent placed on the buccal surface of the tooth. Pulp sensibility responses were analyzed with reference to the following variables:

- age and sex of the patient
- number of tooth surfaces restored
- preoperative pain intensity
- evidence of hard tissue formation

Of the 220 teeth enrolled in the studies, 209 had successful clinical and radiographic outcomes. Teeth that had undergone partial pulpotomies were significantly more likely than teeth with complete pulpotomies to show predictable response to the electronic pulp testing, although there was no significant difference in results between the groups for the cold test (Table 2). Significantly higher positive responses were seen in the partial pulpotomy group for the electronic test as compared with the cold test, but the 2 tests yielded comparable results in the complete pulpotomy group. The most accurate results were obtained from a combined analysis of both tests.

Conclusion

The difference in the amount and depth of tissue excision has led to the belief that pulp sensibility responses are more unpredictable in teeth that have undergone complete pulpotomy than in teeth that have undergone partial pulpotomy. The results of this

Table 2. ***Pulp sensibility responses after 12 months.***

	Positive response		
Pulp sensibility test	**Complete pulpotomy (*n* = 44)**	**Partial pulpotomy (*n* = 165)**	***p* value**
Electronic pulp test	36 (81.8%)	158 (95.8%)	.001[a]
Cold test	37 (84.1%)	149 (90.3%)	.242
Either electronic or cold test	41 (93.2%)	161 (97.6%)	.150

[a]*Significant at <.05.*

analysis support that hypothesis—at least as it applies to the use of electronic pulp testing.

Sangwan P, Ramani A, Mishra S, et al. Pulp sensibility responses following complete and partial pulpotomy in mature permanent molars with carious pulpal exposure and symptomatic irreversible pulpitis: analysis of pooled data from three randomized clinical trials. Int Endod J *2025;58:420-433.*

Treating Dental Trauma in the Primary Dentition

In children under 6 years of age, dental trauma is the second-most common injury, accounting for 17% of all injuries suffered. Worldwide, traumatic dental injuries in the primary dentition have a reported prevalence of >20%; children with >3 mm overjet, a frequent sequela to pacifier and digit sucking habits, have even higher likelihood of injury. O'Connell from Trinity College Dublin, Ireland, recently published a review outlining the management of traumatic dental injuries in the primary dentition.

Although the anatomy, structure and physiology of primary teeth and permanent teeth are similar, 2 major differences influence the management of injuries to anterior primary teeth:

- physiological resorption and exfoliation
- the presence of the permanent successor tooth

Resorption of the primary tooth's roots accompanies the eruptive movement of the permanent tooth; as the permanent tooth progresses toward eruption, the primary tooth's root becomes shorter. The life expectancy of the traumatized primary incisor depends on the extent of resorption and the apical anatomy of the tooth.

Four major factors have an impact on the management of the child and the oral injury in both the primary and permanent dentition:

- injuries to hard tissue and pulp
- luxation injuries
- soft tissue injuries
- apical status

To limit the child's exposure, radiographs should be taken only in situations with a reasonable expectation of achieving a readable image that will have an impact on management decisions. Challenges include the difficulty of positioning the child and distinguishing physiological resorption from possible trauma. Photographs may document soft and hard tissue changes over time, and may help avoid the use of radiographs.

Intra- and extraoral soft tissue injuries should be stabilized, which may require sutures; hygienic care facilitates rapid healing. International Association of Dental Traumatology (IADT) guidelines do not recommend replantation of avulsed primary incisors, because that increases the need for future intervention without any real benefit for the child. However, intruded primary teeth may reemerge over time and should therefore be monitored without intervention. Luxated teeth can be stabilized with splint types used in the permanent dentition. The likelihood of healing complications varies depending on the type and extent of the initial injury. Teeth with concussion or subluxation have a low risk of pulp necrosis or premature tooth loss; teeth with lateral luxation that were not repositioned have a high healing potential. Extruded teeth may be extracted if they interfere with the occlusion; pulp therapy may allow teeth to survive until exfoliation.

Traumatic injury to the primary dentition can cause sequelae in the permanent dentition, including discoloration of enamel, arrested tooth formation, hypoplasia and dilaceration. More frequent and more severe damage to the permanent dentition is more likely in younger children.

Conclusion

When deciding how to manage dental trauma in young children, IADT guidelines should be followed. The practitioner should be alert to the possibility that the injury may not have been accidental, and all management decisions need to prioritize the well-being of the child.

O'Connell AC. Contemporary approach for traumatic dental injuries in the primary dentition. Dent Traumatol *2025;41(suppl. 1):17-26.*

In the next issue:

- Regenerative endodontic procedures in immature permanent teeth
- Bacteremia associated with apical periodontitis

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