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## Treating Cracked Teeth with Bidirectional Splinting

**T**eeth cracked with an incomplete longitudinal fracture starting on the occlusal surface and advancing in a subgingival direction present an endodontic treatment challenge. Bacteria may enter the tooth through the crack; if it extends close to the pulp chamber, reversible pulpitis may result, which can develop into irreversible pulpitis or a necrotic state if the crack progresses. Thus, saving a cracked tooth with reversible pulpitis requires arresting the crack progression while improving pulpal health.

Studies have shown that it may be possible to avoid root canal treatment of cracked teeth through the use of internal splinting with a composite restoration or external splinting, typically with crowns. Lee et al from the Yonsei University College of Dentistry, Korea, proposed treating cracked teeth with reversible pulpitis with bidirectional splinting, involving

- immediate splinting with a stainless-steel orthodontic band
- internal splinting with crack line removal and a resin restoration

- external splinting with a crown restoration

To test this hypothesis, they conducted a prospective, cohort study with a 1- to 4-year follow-up.

The study involved 30 teeth in 29 patients. Immediately following diagnosis by clinical and radiographic examination, the cracked teeth were splinted with a stainless steel band. Patients returned 10 to 14 days later. At that time, the teeth underwent internal splinting with the crack line and any old restoration removed; the cavity then was filled with composite resin followed by immediate placement of a temporary crown. One month later, if the patient felt

no discomfort, a definitive crown was placed. If the patient continued to feel discomfort, a diagnosis of irreversible pulpitis was made, and root canal treatment was performed followed by the placement of a permanent crown. Teeth that continued to be symptomatic 1 month after root canal procedure were judged as treatment failures.

Pulpitis resolved in all teeth, and none were judged failures after an observation time of 1 to 4 years. Eight teeth

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**Table 1. Smear layer removal by irrigation technique.**

	17% EDTA + Er:YAG laser			17% EDTA only			Distilled water + Er:YAG laser		
	Coronal	Middle	Apical	Coronal	Middle	Apical	Coronal	Middle	Apical
Score 1	93.9%	76.7%	56.7%	6.7%	0	0	87.9%	68.4%	25.1%
Score 2	6.7%	23.3%	30.0%	53.5%	13.3%	16.7%	12.1%	22.9%	44.3%
Score 3	0	0	10.0%	40.0%	43.4%	16.7%	0	8.7%	22.5%
Score 4	0	0	3.3%	0	30.0%	30.0%	0	0	8.1%
Score 5	0	0	0	0	13.3%	36.6%	0	0	0

required root canal treatment, including 2 after final crown cementation; in all, 8 symptoms resolved. The only significant predictive factor for pulp survival was pain on percussion, which may indicate the presence of irreversible pulpitis or pulp necrosis.

### Conclusion

Bidirectional splinting appears to be an effective protocol to treat cracked teeth with reversible pulpitis. The procedure can preserve vital pulp and obviate the need for preemptive root canal treatment.

Lee J, Kim S, Kim E, et al. *Survival and prognostic factors of managing cracked teeth with reversible pulpitis: a 1- to 4-year prospective cohort study.* Int Endod J 2021; 54:1727-1737.

## Removing the Smear Layer with Laser-activated Irrigation

Removal of the smear layer, which contains microorganisms, necrotic tissue and dentinal remnants, is a critical stage of root canal treatment. Not only is removal necessary for disinfecting the canal but it also eliminates a barrier between the

canal surfaces and the materials used to fill and seal the canal.

Studies have shown that traditional chemical irrigants, such as sodium hypochlorite (NaOCl), ethylenediaminetetraacetic acid (EDTA), citric acid and chlorhexidine, have a limited efficacy in removing the smear layer, especially in the apical third of the root canal. The use of the erbium:yttrium-aluminum-garnet (Er:YAG) laser has shown promise as a tool for cleaning and disinfecting root canals. Razumova et al from the Peoples' Friendship University of Russia tested the efficacy of laser-activated irrigation, pairing the Er:YAG laser with 17% EDTA, in removal of the smear layer.

The researchers studied 90 single-rooted, extracted human teeth, dividing them into 3 treatment groups:

- **Group 1:** teeth were irrigated with 10 ml of 17% EDTA while an Er:YAG laser was applied for 60 seconds
- **Group 2:** teeth were irrigated with 10 ml of 17% EDTA for 60 seconds without any laser application
- **Group 3 (control):** teeth were irrigated with distilled water while an Er:YAG laser was applied for 60 seconds

The teeth were then sectioned into coronal, middle and apical thirds and analyzed using a scanning electron microscope (SEM). Smear layer removal was assessed based on a 5-point scale:

1. No smear layer; dentinal tubules open.
2. Small amount of smear layer covering the canal wall; many dentinal tubules open.
3. Smear layer partially covering the canal wall; a few dentinal tubules open.
4. Smear layer completely covering the canal wall; no dentinal tubules open.
5. Heavy smear layer covering the canal wall.

The combination of EDTA and laser (Group 1) removed significantly more of the smear layer in the coronal, middle and apical sections than did EDTA alone (Group 2). Interestingly, the use of the laser with distilled water in the control group also significantly outperformed EDTA alone and was nearly as effective as EDTA and laser in the coronal and middle sections (Table 1).

### Conclusion

The results of this study suggest that the use of an Er:YAG laser to activate irrigation significantly enhances root

canal disinfection, regardless of the chemical agent used. Further studies are needed to determine what chemical irrigant is most efficacious when combined with laser activation.

Razumova S, Brago A, Kozlova Y, et al. Evaluation [sic] the efficacy of Er:YAG laser in removing the smear layer during endodontic treatment. J Int Dent Med Res 2021;14:933-937.

## Managing Endodontic Pain With Valacyclovir

An acute apical abscess is an inflammatory response to pulpal infection and necrosis defined by rapid onset, spontaneous pain, percussion sensitivity, pus formation and swelling of associated tissues. When treating pain from acute apical abscesses, nearly all endodontists prescribe antibiotics, typically amoxicillin.

While bacterial infections are a critical part of chronic apical infections, they may not be the only factor that needs to be addressed. Studies have shown that herpesviruses, such as human cytomegalovirus and Epstein-Barr virus, are strongly associated with symptomatic periapical pathosis, particularly in symptomatic lesions harboring major bacterial pathogens and accompanied by extensive radiographic bone destruction.

Sabeti et al from the University of California, San Francisco, investigated the possibility that adding valacyclovir, which has proven effective against various herpesviruses, might reduce pain and the need for analgesics in

patients with acute apical abscesses. They designed a randomized, placebo-controlled, double-blind pilot study to test their thesis.

Enrolled patients exhibited clinical evidence of pulp necrosis and acute apical abscess, along with radiographic evidence of apical disease, and suffered from persistent pain of moderate or higher level, defined as >4 on the 0-to-10 Numerical Rating Scale. All patients received a 7-day course of amoxicillin; those in the experimental group also received an immediate dose of 2 g of valacyclovir followed by 500 mg twice daily for 3 days, while the control group received a placebo in addition to the amoxicillin.

Twenty patients were randomized to each group. All but 2 patients used analgesics at entry to the trial; all but 1 reported pain levels of >4. At the end of day 1, 80% of patients in the valacyclovir group reported pain scores of ≤4, compared with only 20% in the placebo group. By day 3, all patients in the valacyclovir group reported pain scores of ≤4; by day 5, 60% of the patients in this group reported a pain score of 0.

In contrast, only 30% of patients in the placebo group reported a pain

score of 0 on day 6 (Table 2). Analgesic use in the placebo group declined from 90% of patients at baseline to 10% of patients after 1 day and to 0 on day 5, while 50% of patients in the placebo group continued to use analgesics on the last day of the trial. The rapid pain relief by valacyclovir treatment points to herpesviruses as main causes of pain from acute abscesses.

### Conclusion

Although this was a small pilot study, the results lend credence to the major pathologic role of active herpesviruses in endodontic pathosis. They also suggest that valacyclovir treatment may provide almost immediate relief from pain caused by acute apical abscesses and cast doubt on the efficacy of treating endodontic pain with amoxicillin alone.

Larger trials are needed to confirm these findings, along with determining the optimal dosage of valacyclovir or similar chemotherapeutic interventions that work against herpesviruses.

Sabeti M, Zhong J, Hildebrandt K, Slots J. Valacyclovir in pain management of acute apical abscesses: a randomized placebo-controlled double-blind pilot study. J Endod 2021;47:1724-1728.

**Table 2. Patients' reported pain level.**

	Valacyclovir + amoxicillin group (n = 10)		Placebo + amoxicillin group (n = 10)	
	Pain ≤4	Pain = 0	Pain ≤4	Pain = 0
Baseline (Day 0)	0	0	1	0
Day 1	8	2	2	1
Day 2	9	3	4	1
Day 3	10	4	5	2
Day 4	10	4	7	3
Day 5	10	6	7	3
Day 6	10	6	9	3

## Single-visit vs Two-visit Root Canal Retreatment

Ideally, an endodontically treated tooth will function asymptotically, with any presurgical periapical lesions resolving over time. Unfortunately, even in well-treated teeth, some periapical lesions will not resolve, leading to the need for root canal retreatment. Studies have shown that the vast majority of treatment failures can be identified after 2 years.

While single-visit root canal treatment has achieved acceptance as a treatment protocol, no consensus exists as to whether a single- or multiple-visit protocol is preferable for patients requiring root canal retreatment. To evaluate the use of different retreatment protocols, Karaođlan et al from Ege University, Türkiye, conducted a prospective randomized clinical trial to compare the results of single-visit and 2-visit root canal retreatment.

The authors studied patients who had undergone root canal treatment ≥4 years previously and who required retreatment for periapical lesions with diameters between 2 mm and 10 mm on preoperative digital radiographs. Enrolled in this clinical trial were 100 single-rooted teeth that had been treated previously for root canal from patients referred for retreatment because the lesion had not been reduced by the initial treatment. Patients were randomly allocated to

receive treatment in either 1 or 2 visits (n = 50). Root canal instrumentation was the same for both groups.

Upon completion of instrumentation, the single-visit group underwent root canal irrigation, first with manually agitated 5% ethylenediaminetetraacetic acid (EDTA) and 2.5% sodium hypochlorite (NaOCl), and then with 2% chlorhexidine (CHX). After obturation with laterally compressed gutta-percha cones and sealer, the access cavities were restored with a composite restoration.

In the 2-visit group, a calcium hydroxide (CH) paste was placed into the root canals, and the tooth received a temporary restoration. After 7 to 10 days, the CH paste was removed with 17% EDTA and 2.5% NaOCl. After a final irrigation of 17% EDTA and 2.5% NaOCl, root canal obturation and coronal restoration was performed using the same materials and techniques as were used for the single-visit group.

At 6-, 12- and 24-month follow-up, teeth were examined clinically for presence of pain, swelling of sinus tract, tenderness on percussion and palpation, tooth mobility and quality of coronal restoration, as well as radiographically for the presence or absence of periapical lesions. Teeth were scored according to the following radiographic healing criteria:

- **Healed:** The tooth was clinically asymptomatic, and the periapical lesion was no longer present.

### In the next issue:

- Assessment of bone quality of apical periodontitis
- Systemic medications on endodontic outcomes
- Occlusal loading conditions in roots of molar teeth

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- **Healing:** The tooth was clinically asymptomatic, and the size of the periapical lesion had decreased from the previous examination.
- **Not healed:** The tooth was clinically symptomatic or the tooth was clinically asymptomatic, but the size of the periapical lesion had not decreased.

Of the 89 teeth available for evaluation at 24 months, 88% were classified as healed, 6% were classified as healing and 7% were classified as not healed. The rate of success, defined as healed and healing teeth, showed no significant difference between the 2 treatment groups (Table 3).

### Conclusion

The findings of this study indicated that single-visit endodontic nonsurgical retreatment of asymptomatic teeth with periapical lesions had results comparable to those obtained using a 2-visit protocol.

Karaođlan F, Miçoođulları Kurt S, Çalıřkan MK. Outcome of single- versus two-visit root canal retreatment in teeth with periapical lesions: a randomized clinical trial. *Int Endod J* 2022;55:833-843.

**Table 3. Results of retreatment in each group.**

	Healed	Healing	Failure
Single visit	39 (88.6%)	3 (6.8%)	2 (4.5%)
2 visits	39 (86.7%)	2 (4.4%)	4 (8.9%)