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Endodontic Treatment of Cracked Posterior Teeth: Outcome and Survival

Diagnosing cracked teeth is often not a simple decision, and no efficient clinical methods exist to predict their prognosis. This problem is exacerbated in cracked teeth that require root canal treatment before restorative procedures are undertaken, such as the placement of crowns. But little reported evidence-based information exists regarding the prognosis and survival of endodontically treated cracked posterior teeth, a major hindrance to the creation of adequate treatment plans. Olivieri et al from Universitat Internacional de Catalunya, Spain, conducted a systematic review and meta-analysis of the available evidence to determine the success and survival rates of endodontically treated cracked posterior teeth and to assess what, if any, preoperative factors affect tooth survival.

The authors searched 3 large databases, along with gray literature and article reference lists, to find articles reporting survival and success rates for endodontically treated permanent posterior cracked teeth with a follow-up period of ≥ 1 year. After screening 61 publica-

tions, they found 7 studies, all longitudinal cohort studies published between 2006 and 2018, that met the inclusion criteria. Because so few studies included outcome data for >1 year, the only data included in the analyses were those recorded at 1 year.

The survival rate at 1 year for the 674 teeth included in the 7 studies was 88%; the success rate for the 424 teeth in the 3 studies that reported success rates was 82%. These rates are similar to those following primary root canal treatment in noncracked teeth.

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Preoperative variables, including patient sex, tooth type (molar or premolar), number of cracks, presence of a periodontal pocket, pulp status (vital or necrotic) and whether the cracked tooth was a terminal tooth, were also analyzed for their impact on outcomes. Although fatigue resistance decreases in the dentin of older patients, and some studies have found a correlation between age and cracked teeth, the 4 studies in this review that included older patients

failed to uncover any difference in survival rates for patients aged ≥ 50 years. The presence of a periodontal pocket increased the risk of extraction by 11%, while teeth without periodontal pockets had a survival rate of 97%, results parallel to those found in teeth without cracks; no other preoperative variable had any significant impact on outcome.

Conclusion

The results of this meta-analysis suggest that root canal treatment in cracked posterior teeth is a viable treatment option, especially in teeth without periodontal pockets.

Olivieri JG, Elmsmari F, Miró Q, et al. Outcome and survival of endodontically treated cracked posterior permanent teeth: a systematic review and meta-analysis. *J Endod* 2020;46:455-463.

Comparative Effectiveness of Two Endodontic Screening Tools

The frequently used decayed, missing or filled tooth (DMFT) index provides accurate information to epidemiologists about the incidence of caries, tooth loss and tooth restorations. Unfortunately, the DMFT index provides no information on the pulpal and periapical status of teeth, limiting its applicability to endodontic treatment needs.

One index used to categorize the results of untreated caries—the PUFA index—measures

- pulpal involvement (P)

Table 1. Accuracy of the PUFA index and the PAI.

	PUFA	PUFA (decayed)	PUFA (filled)	PAI	PAI (decayed)	PAI (filled)
Sensitivity	67.6%	75.5%	29.4%	41.7%	42.4%	38.5%
Specificity	99.8%	96.8%	99.8%	99.2%	98.2%	97.4%
Positive predictive value	98.3%	98.4%	96.9%	90.6%	98.3%	79.3%
Negative predictive value	94.1%	61.2%	84.7%	89.8%	40.5%	86.1%

- ulceration caused by tooth fragments (U)
- fistula formation (F)
- abscess (A)

While this measure should be an effective screening device to determine which patients need to undergo further clinical and radiographic evaluation, its accuracy has not been established, nor has the PUFA index been used in adult populations. The second methodology evaluates a patient's periapical status via the periapical index (PAI), which is based on a radiographic assessment, usually including panoramic radiographs. The PAI score has been validated, but radiographic assessment comes with its own drawbacks, including low sensitivity (true positive rate) compared with cone beam computed tomography (CBCT), radiation exposure and cost.

Teh et al from Universiti Kebangsaan Malaysia compared the diagnostic accuracy and reliability of the PUFA index and PAI. Their patient sample included 165 patients (4115 teeth) making their first visit to a university primary dental clinic. Consistent with clinic protocol of ordering panoramic radiographs for new patients presenting with multiple dental problems, panoramic radiographs were ordered for all patients. A clinical examination

recorded a subjective assessment of the presenting complaint and pain level; an objective assessment including extraoral and intraoral examinations, pulpal test and periodontal examination, radiographic findings, etiology and prognosis; and a treatment plan. Tests to achieve a definitive diagnosis included electronic pulp testing, cold test, percussion, palpation and probing depth.

Two independent, trained dentists, blinded to clinical diagnoses and PAI scores, examined the participants' teeth, recording caries experience using the DMFT score, and the progression of caries in each tooth using the PUFA index. An endodontist, blinded to clinical diagnoses, DMFT scores and PUFA index, assessed the panoramic radiographs for periapical status. For the purpose of analyzing the data, PUFA index scores were classified as negative (0) or positive (>0); PAI scores were classified as negative (<3) or positive (≥ 3).

Both the PUFA index and the PAI showed extremely high specificity (true negative rate) for all 4115 teeth and for teeth recorded as decayed or filled. Sensitivity levels were lower, with the PUFA index outperforming the PAI. This relationship held when applied only to decayed teeth; however, both indices demonstrated a low level of

sensitivity in filled teeth. Positive predictive value for pulpal disease was >90% for both the PUFA index and the PAI; only the PAI in filled teeth fell below 80% (Table 1). The PUFA index was significantly more accurate in diagnosing both pulpal and periapical disease than was the PAI.

Conclusion

Given its reliability and its greater accuracy than the PAI, the PUFA index, when used in conjunction with the DMFT index score, can be a helpful tool to screen for pulpal and periapical disease. Following this path could reduce the need for panoramic radiographs as a preliminary screening tool, reducing patients' radiation exposure and costs incurred by the health care system.

Teh LA, Abdullah D, Liew AKC, Soo E. Evaluation of pulpal involvement, ulceration, fistula, and abscess index and periapical index in screening for endodontic disease: reliability and accuracy. J Endod 2020;46:748-755.

Percussion Test Responses in Adjacent and Contralateral Teeth

Forming a proper endodontic diagnosis requires taking a patient's medical and dental history, a thorough inspection and the use of clinical examination methods, such as pulp vitality and mobility testing, along with palpation and percussion. In this process, no indicator is as valuable as the results of percussion testing. Eliciting a response from a patient by using a gloved finger or the blunt end of a dental instrument to

tap a tooth usually indicates the presence of disease in the tooth pulp and the periradicular tissue.

Sensitivity to percussion suggests mechanical allodynia—a reduction in the neuron excitability threshold that creates pain as a response to mechanical stimuli that would not normally provoke pain. Along with hyperalgesia (increased pain in response to stimuli that normally provoke pain), allodynia is hypothesized to be an adaptation that allows for better protection of vulnerable tissues.

Kayaoglu et al from Gazi University, Turkey, undertook a clinical study to investigate the occurrence of mechanical allodynia on the ipsilateral side of first and second molars requiring primary root canal treatment; additionally, they observed results in the contralateral side of the jaw. From each member of a cohort of 348 patients who met the inclusion criteria, the researchers recorded demographic and health information, use of analgesia within the previous 12 hours, current pain status, length of time of the pain and pulpal diagnosis. Level of pain, regardless of type, in response to percussion testing was classified as none, slight, moderate or severe; the first 2 levels of pain were grouped together as absent, while the

second 2 levels were grouped together as present.

A significant number of patients who reported moderate or severe pain on percussion of their diseased tooth (pain present) also reported pain upon percussion in teeth ipsilateral to their diseased tooth. The level of painful associations increased with the severity of pain in the diseased tooth (Figure 1). Several patients reported pain on the contralateral side, although this group was smaller than that of patients who reported pain on the ipsilateral side. Patients reported more pain in teeth located distally to the diseased tooth and its contralateral mate than in teeth located mesially.

Conclusion

The authors entered 10 different variables into their univariate and multivariate logistic regressions, including demography, diagnosis, arch and tooth type. Their final analysis found that the presence of pain on percussion of the diseased tooth was the only significant association with pain in an ipsilateral tooth; location of the diseased tooth in the mandible was the only significant association with pain in a contralateral tooth.

A possible hypothesis for the greater incidence of mechanical allodynia in distal teeth than in mesial teeth

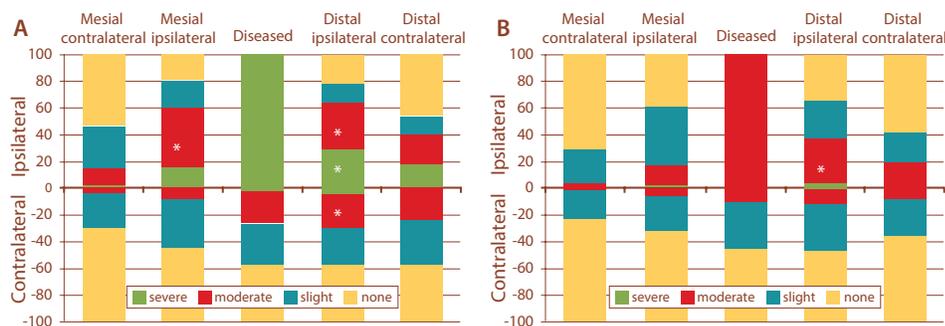


Figure 1. Frequency of pain in teeth ipsilateral and contralateral to endodontically diseased teeth in patients whose pain is severe (A) and moderate (B). Confidence values >0.1 are marked with asterisks (*).

involves the observation that the bite force of individual teeth increases from the incisors to the molars. Thus, a greater percussion sensitivity may reflect a protective mechanism of the body's attempt to minimize the force on the diseased tooth. The practitioner needs to be aware that a healthy tooth adjacent or contralateral to an endodontically diseased tooth may nevertheless demonstrate pain in response to a percussion test.

Kayaoglu G, Ekici M, Altunkaynak B. Mechanical allodynia in healthy teeth adjacent and contralateral to endodontically diseased teeth: a clinical study. J Endod 2020;46:611-618.

Ibuprofen and Irreversible Pulpitis Treatment

When caries reaches within 0.5 mm of the pulp, the immune system responds to the bacterial advance by recruiting inflammatory cells. These inflammatory cells migrate to the dental pulp, typically resulting in irreversible pulpitis, at which point nonsurgical endodontic therapy is the preferred treatment. But achieving an acceptable level of anesthesia in these cases is difficult.

Several studies have recommended the presurgical administration of various drugs, including dexamethasone, indomethacin and ketorolac, in addition to the usual local agents to achieve more profound anesthesia. The most popular proposed strategy involves the use of nonsteroidal anti-inflammatory drugs (NSAIDs)—in particular, ibuprofen. NSAIDs inhibit the synthesis of prostaglandins, which

theoretically should increase the efficacy of local anesthetics. Not all studies have supported this hypothesis; however, these results have been based solely on clinical assessments of pain when accessing the teeth or in response to pulpal vitality tests.

Nguyen et al from the University of Washington attempted to determine the mechanism of ibuprofen on various inflammatory markers at the tooth site. They believed that identifying how ibuprofen worked in these contexts, rather than relying merely on patient feedback, would allow endodontists to make better treatment decisions in patients with irreversible pulpitis.

Their study included 38 patients (aged 21–65 years) with a diagnosis of symptomatic irreversible pulpitis in a maxillary or mandibular premolar or molar. A control group was created from 4 patients with normal, vital pulp who required endodontic treatment solely for restorative purposes. The remaining 34 patients were randomly allocated into 1 of 2 groups:

- patients who took 600 mg of ibuprofen 1 hour before the initial treatment
- patients who refrained from taking any NSAIDs the day of the procedure

After all caries was removed and the pulp exposed, blood from the exposed surface of the pulp was collected and assayed for levels of 6 inflammatory cytokines: prostaglandin E2 (PGE-2), interleukin-1 β (IL-1 β), IL-2, IL-6, tumor necrosis factor alpha (TNF- α) and interferon gamma (IFN- γ). The authors requested that patients record their level of postoperative pain (0–4 hours after anesthesia wore off) on a scale of 0 (no pain) to 10 (severe pain).

Patients who took preoperative ibuprofen had significantly lower levels of PGE-2, IL-6, TNF- α and IFN- γ than did patients who did not take preoperative NSAIDs. In some cases, levels were lower in the treatment group than in the control group. However, the 2 test groups did not demonstrate any significant difference in the level of postoperative pain.

Conclusion

The fact that preoperative ibuprofen reduced levels of inflammatory markers but did not affect the patients' postoperative pain level seems curious. The study did not control for the amount of local anesthetic and the type of needle used, which may have influenced the amount of pain felt by individual patients. These results demonstrating the effect of ibuprofen on inflammatory cytokines, however, may prove valuable to practitioners in treatment planning for patients with symptomatic irreversible pulpitis.

Nguyen V, Chen Y-W, Johnson JD, Paranjpe A. In vivo evaluation of effect of preoperative ibuprofen on proinflammatory mediators in irreversible pulpitis cases. J Endod 2020;46:1210-1216.

In the next issue:

- Impact of pulp sensibility testing in patients with symptomatic irreversible pulpitis
- Survival of replanted permanent teeth after traumatic avulsion

Do you or your staff have any questions or comments about **Update on Endodontics**? Please call or write our office. We would be happy to hear from you.

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