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Traumatic Injuries in Immature Teeth

Traumatic dental injuries require prompt management to increase the odds of successful treatment. For severe traumatic dental injuries in fully developed permanent teeth—typically uncomplicated crown fractures—the International Association of Dental Traumatology recommends a preventive endodontic approach along with early or immediate pulp intervention. However, these recommendations may not comprise the best methodology for treating immature teeth that have suffered traumatic dental injuries.

Shahmohammadi et al from Birjand University of Medical Sciences, Iran, reviewed the outcomes of patients treated for trauma to immature permanent teeth. All 72 patients (aged from 6 to 12 years) included in the study presented over an 11-year period at the dental trauma center of an academic institution with a crown fracture, and were followed for ≥6 months. The patients had 58 maxillary incisors with complicated crown fractures and 41 maxillary incisors with uncomplicated fractures. The 99 teeth underwent 1 of 3 different primary treatments at their first visit:

- **restoration only** (n = 36)**:** exposed dentinal tubules were covered with a calcium hydroxide liner and restored with enamel and dentin-bonded composite resin
- **vital pulp therapy** (n = 55)**:** 21 teeth underwent cervical pulpotomy capped with zinc oxide–eugenol paste; 34 teeth underwent partial pulpotomy with zinc oxide–eugenol paste (n = 27) or mineral trioxide aggregate (MTA; n = 7)
- **endodontic procedures** (n = 8)**:** 5 teeth received an MTA apical barrier; 3 teeth underwent nonsurgical root canal treatment

Outcomes were dichotomized as favorable (absence of any clinical or radiographic signs of symptoms) or unfavorable (presence of any clinical or radiographic signs of symptoms requiring retreatment).

Vital pulp therapy resulted in the highest success rate, with a favorable outcome in 87.3% of teeth, followed by endodontic procedures. More than half the teeth that underwent only restoration had unfavorable outcomes (Table 1). Of the 28 teeth with complications, 25 required secondary interven-

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tions, mostly endodontic procedures; the outcomes for this group remained unfavorable in only 3 teeth. In the end, 93 of the 99 traumatized teeth had favorable outcomes.

A statistical analysis showed that teeth with concomitant luxation injuries were more susceptible to complications than were teeth without concomitant injuries, as were teeth that underwent only restoration when compared with teeth that received vital pulp therapy. Surprisingly, teeth with pulpal exposure were less prone to complications than were teeth without pulpal exposure; however, this appeared to be a result of the choice of primary treatment intervention in these cases rather than an outcome based on the injury.

The authors proposed 3 clinical findings that can help guide the practitioner when treating these injuries in immature teeth:

- Traumatic dental injuries should be treated promptly. Early treatment, along with close examination and frequent follow-ups, leads to better outcomes.
- A fracture with wide-open dentinal tubules should be considered as direct communication with the pulp and treated accordingly. It is critical to discover any mechanical microexposures of the pulp, which can be easily overlooked.
- Preventing coronal microleakage after restoration of deeply fractured teeth without pulpal exposure is critical.

Conclusion

The study's findings showed that prompt treatment using cervical or partial pulpotomy for crown fractures in immature permanent teeth leads to a high success rate.

Shahmohammadi R, Sheikhnezami M, Moradi S, et al. Treatment outcomes of permanent immature teeth with crown fracture: a retrospective cohort study. J Endod *2021;47: 1715-1723.*

Table 1. ***Success rate of primary intervention by type of crown fracture.***

	Complicated crown fracture (*n* = 58)	Uncomplicated crown fracture (*n* = 41)	Total (*n* = 99)
Restoration only	NA	47.2% (17/36)	47.2% (17/36)
Vital pulp therapy	90.2% (46/51)	50.0% (2/4)	87.3% (48/55)
Cervical pulpotomy	90.4% (19/21)	NA	90.4% (19/21)
Partial pulpotomy	90.0% (27/30)	50.0% (2/4)	85.2% (29/34)
Endodontic intervention	71.4% (5/7)	100.0% (1/1)	75.0% (6/8)
MTA apical barrier	75.0% (3/4)	100.0% (1/1)	80.0% (4/5
Root canal treatment	66.6% (2/3)	NA	66.6% (2/3)

NA, not applicable.

Periapical Surgery In Molars

The introduction of the surgical microscope and endoscope contemporaneously to highly biocompatible root-end filling materials revolutionized periapical surgery, more than doubling the success rate for surgical endodontic treatment. High-power magnification devices increase the likelihood of identifying isthmuses, accessory canals, missed canals and obturation gaps, along with cracks and microfractures of resected root surfaces. Given the high frequency of isthmuses in molars, these advances should have an even greater impact on those teeth. Yet, studies conducted over the past 2 decades have reported a wide range of healing rates and confounding factors in molars treated with periapical microsurgery.

Bliggenstorfer et al from the University of Bern, Switzerland, reviewed the outcomes of 424 molars treated by periapical microsurgery at their school by 1 experienced oral surgeon over a 20-year period. Two surgical protocols were followed. In one, a shallow concavity was prepared in the root end and obturated with a dentin-bonded resin composite (Retroplast) bonded with Gluma. In the other, a cavity was created in the root end, which was then filled with 1 of 3 different materials:

- **zinc oxide–eugenol cement reinforced with ethoxy benzoic acid** (SuperEBA)
- **mineral trioxide aggregate** (MTA)
- **bioceramic root repair material** (BCRRM)

Results of both clinical and radiographic outcomes were divided into 2 groups:

- **"healed"**—success, defined as a radiographic classification of complete or incomplete healing and an absence of clinical signs and/or symptoms
- **"nonhealed"**—doubtful, defined as a radiographic classification of uncertain healing and an absence

Table 2. *Healed and nonhealed cases by root-end filling material.*

	n (%)	Healed (%)	Nonhealed (%)
MTA	234 (55.2%)	202 (86.3%)	32 (13.7%)
SuperEBA	17 (4.0%)	12 (70.6%)	5 (29.4%)
Retroplast	75 (17.7%)	63 (84.0%)	12 (16.0%)
BCRRM	97 (22.9%)	94 (96.9%)	3 (3.1%)

The root-end filling material used in 1 additional tooth was unknown.

of clinical signs and/or symptoms, or failure, defined as radiographic classification of unsatisfactory healing or the presence of any clinical signs and/or symptoms.

Variables analyzed for their potential impact on outcomes included a wide variety of patient and treatment characteristics, including demographics, tooth location, type of preoperative radiograph used (conventional 2-dimensional radiography vs cone-beam computed tomography [CBCT]), root-end filling material used, type of restoration placed and antibiotic administration.

The success rate for all molars was 87.7%, with no significant difference found between teeth whose root ends were prepared using the concave or the cavity preparation. Patient sex and age (<45 years vs ≥45 years) had no impact on success, nor did the location or type of the molar, the type of restoration, attachment level, presence of a post, quality of root canal filling or the use of antibiotics. Significant successful treatment factors included the use of preoperative CBCT imaging, the use of BCRRM as the root-end filling material (Table 2) and a shorter follow-up period.

Conclusion

Several issues must be kept in mind when looking at these results. Long-term studies, including this one, have indicated that the success rate of teeth following periapical surgery tends to decline over time. Previous short-term studies have shown comparable results for BCRRM and MTA, which have similar biological properties; both have excellent biocompatibility and promote cell proliferation. Shorter follow-up times associated with better outcomes may account for the differing results for BCRRM and MTA; follow-up over comparable periods needs to be evaluated before a final conclusion can be reached. One takeaway from this study was the superiority of CBCT as a preoperative imaging modality.

Bliggenstorfer S, Chappuis V, von Arx T. Outcome of periapical surgery in molars: a retrospective analysis of 424 teeth. J Endod *2021;47:1703-1714.*

Osteosarcoma of The Jaw

Many different types of tumors can occur in the head and neck. Osteosarcomas, primary malignant tumors made up of bone or osteoid tissue, typically affect the long bones of the skeleton; they occur infrequently in the head and neck regions, and are particularly rare in the jaw, accounting for <1% of all head and neck malignancies. Osteosarcoma of the jaw has no known etiology, although some have suggested that Paget's disease, congenital retinoblastoma, a history of trauma, fibrous dysplasia and radiation therapy may be predisposing factors.

Because early diagnosis directly correlates with better outcomes, dental practitioners play a vital role in discovering this rare condition. The low incidence of osteosarcoma of the jaw makes literature on this condition scarce, mostly limited to small retrospective studies, making it difficult to establish prognostic factors. Pires et al from Universidade de Lisboa, Portugal, recently reported on the diagnosis and treatment of a patient with an osteosarcoma in the anterior maxilla.

The 25-year-old woman presented for an endodontic consultation after reporting a "pressure-like" discomfort in the upper right quadrant. No ulceration, carious lesions or previous restorations were present. The maxillary anterior right area showed facial edema, and a firm, nonmobile mass was found near the apex of maxillary right lateral incisor. Cone-beam computed tomography revealed radiolucent alterations in the apical area of maxillary right lateral incisor, which was diagnosed with symptomatic apical periodontitis of non-endodontic origin.

The patient returned 2 months later with continued pain and edema; a mass was found over maxillary right first premolar. An oral surgeon excised an osteoid-like lesion; the subsequent biopsy suggested the presence of an osteosarcoma. After the patient was referred to an oncology facility, she received a diagnosis of osteosarcoma of the jaw. The oncologists performed radical excision surgery through a hemimaxillectomy; treatment planning

included subsequent complementary chemotherapy.

Conclusion

Diagnosing this rare form of cancer represents a challenge to the practitioner. This patient showed signs and symptoms of periapical pathology, but a normal response to pulp sensitivity testing eliminated the possibility of endodontic pathology. Radiographic appearance of osteosarcomas varies depending on tumor stage. Diagnostic imaging beyond radiographs can better assess lesions. While diagnosing osteosarcoma of the jaw requires both clinical and radiographic findings, only a biopsy can provide histopathological confirmation. Treatment of this condition requires coordination between dental practitioners and oncology specialists.

Pires MD, Martins JNR, Dias GS, et al. Osteosarcoma of the anterior maxilla mimicking a periapical pathology: a case report. Aust Endod J *2021;doi:10.1111/aej.12491.*

Lingual Canals In Mandibular Premolars

Successful endodontic treatment requires the discovery of all root canals in the tooth. Double canals, the presence of a second root canal on the lingual side, is an additional variation found most frequently in mandibular premolars. Martins et al from Universidade de Lisboa, Portugal, led a worldwide analysis that used cone-beam computed tomography images to determine the influence of ethnicity, geographic region, age and sex on the prevalence of lingual canals in mandibular premolars.

The study included results from 23 endodontic practitioners in 23 different geographic regions (8 in Europe, 6 in the Americas, 5 in Asia, 2 in Africa and 2 in Australia/New Zealand). Each practitioner reported on 300 mandibular first premolars and 300 mandibular second premolars, resulting in an overall sample of 6900 mandibular first premolars in 4274 patients and 6900 mandibular second premolars in 4367 patients.

Each tooth was classified by the number of roots and the presence of a lingual canal. In addition, teeth were further classified as having a single canal, 2 independent canals from the pulp chamber to the apex, 2 confluent canals merging into a single canal at the apex or >2 canals.

Nearly one-quarter of mandibular first premolars studied showed the presence of a lingual canal. The lowest percentage of lingual canals was found in China and Australia, while the highest rate was found in Egypt and India; however, none of the differences were significant. In contrast, only 5% of mandibular second premolars showed a lingual canal; again, the lowest percentage was found in China. These patients, along with those from Australia/New Zealand, had a significantly lower incidence of lingual canals in second mandibular premolars compared with patients from Europe, Africa and West Asia. Patients aged >60 years were statistically less likely to have a lingual canal in their first premolars but not in their second premolars, while men were more likely than women to have lingual canals in both first and second premolars.

Conclusion

Several demographic factors appear to influence the probability of a lingual canal in mandibular premolars. The authors noted that the lower incidence of lingual canals in East Asian patients may be related to the typically smaller tooth size in this population. Similar reasoning could apply to the finding that women showed lingual canals less frequently than did men, while the lower likelihood in the older population may be the result of physiological deposition of secondary dentin over time. Based on the high prevalence of lingual canals in mandibular first premolars, practitioners must take extra care with these teeth to ensure a positive outcome.

Martins JNR, Zhang Y, von Zuben M, et al. Worldwide prevalence of a lingual canal in mandibular premolars: a multicenter cross-sectional study with meta-analysis. J Endod *2021;47:1253-1264.*

In the next issue:

- Healing after surgical retreatment
- Survival and success of cracked teeth
- Pulp diagnosis in patients with diabetes mellitus

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