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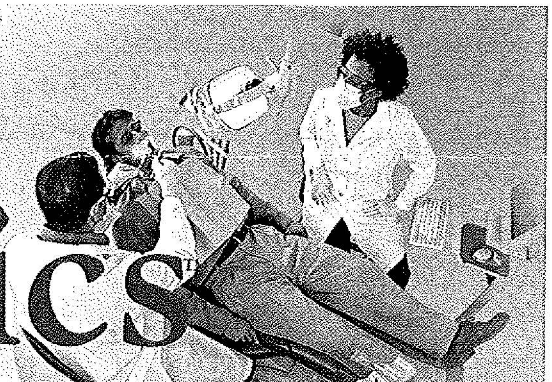

Long-term Prognosis of Horizontal Root Fractures

Root fractures may heal in 1 of 3 ways: hard-tissue fusion, periodontal ligament interposition with and without bone, or nonhealing with interposition of granulation tissue owing to coronal pulp necrosis. Several factors influence these healing modalities, including stage of root development, extent of displacement, type of splinting, use of antibiotics and location of the fracture. The method of healing can be determined by 3 to 6 months after the fracture occurs.

Andreasen et al from University Hospital Rigshospitalet, Denmark, analyzed long-term survival of teeth with root fractures by healing modality and fracture position. The authors studied a series of 534 teeth (470 patients) with root fractures. The teeth were classified by location of fracture: apical, midroot, cervical and oblique fractures located in both the midroot and cervical regions. In the original series,

- a total of 42 teeth (27 cervical fractures, 13 midroot fractures, 2 cervical–midroot fractures) were considered impossible to treat at first examination and were subsequently extracted
- long-term survival analysis was limited to the remaining 492 teeth

The location of the root fracture had a significant impact on 10-year survival rates:

- apical fractures (*n* = 125): 10-year survival rate, 89% (95% confidence interval [CI], 78%–99%); pulp healing complications caused the loss of 5 out of 6 teeth
- midroot fractures (*n* = 272): 10-year survival rate, 78% (95% CI, 64%–92%); pulp healing complications caused the loss of 17 out of 23 teeth
- cervical fractures (*n* = 50): 10-year survival rate, 33% (95% CI, 17%–49%); pulp healing complications caused the loss of 7 out of 27 teeth

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- cervical–midroot fractures ($n = 45$): 10-year survival rate, 67% (95% CI, 50%–85%); pulp healing complications caused the loss of 9 out of 11 teeth

No teeth with hard-tissue healing were lost, regardless of the position of the fracture. For teeth with periodontal ligament interposition, 8-year survival rates varied significantly:

- apical, 95% (95% CI, 86%–100%)
- midroot, 84% (95% CI, 72%–96%)
- cervical, 25% (95% CI, 7%–43%)
- cervical–midroot, 81% (95% CI, 62%–100%)

Teeth with nonhealing fractures demonstrated significantly better survival when the fractures were in the apical or midroot areas than they did when the fractures were in the cervical or cervical–midroot areas.

Conclusion

Traditionally, horizontal root fracture has been an indication for tooth extraction. However, this study suggests that certain root fractures may have a good-to-excellent prognosis, depending on the location of the fracture and the healing modality applied. All teeth with hard-tissue healing, even teeth with cervical fractures, appear to have a positive long-term prognosis. Practitioners and patients might want to wait 3 to 6 months after the trauma occurred to determine the appropriate healing modality before deciding on a long-term treatment plan.

Andreasen JO, Ahrensburg SS, Tsilingaridis G. Root fractures: the influence of type of healing and location of fracture on tooth survival rates—an analysis of 492 cases. Dent Traumatol *2012;doi:10.1111/j.1600-9657.2012.01132.x.*

Treatment of Maxillary Molars With Accessory Roots

Although maxillary molar teeth usually have 3 roots, studies have shown that the number of roots may range from 1 to 5. An accessory root (sometimes called an extra root, supernumerary root or additional root) can be overlooked when treatment begins, which can lead to less-than-successful results. Ahmed from the Universiti Sains Malaysia and Abbott from the University of Western Australia reviewed the literature on accessory roots in maxillary molar teeth and the impact their presence may have on endodontic treatment.

Studies show that 0.9% of maxillary first molars, 1.4% of maxillary second molars and up to 7% of maxillary third molars have 4 roots. These teeth may have an accessory palatal root (the most common), an accessory buccal root, an accessory mesial root or an accessory distal root. The classification systems for teeth with an accessory palatal root can be found in Table 1. Five-rooted maxillary molar teeth are rare and difficult to diagnose on radiographs.

A 2002 study (Hoen and Pink, *J Endod* 2002) reported a 42% incidence of missed roots and root canals in endodontic treatment. A thorough

Table 1. *Classifications of 4-rooted maxillary molar teeth with accessory palatal roots*

Classification 1

Type I: Maxillary molars with 2 widely divergent palatal roots that are often long and tortuous. The buccal roots are often "cow horn" shaped and less divergent.

Type II: Maxillary molars with 4 separate roots but the roots are often shorter, run parallel, have buccal and palatal root morphology, and have blunt root apices.

Type III: Maxillary molar with 4 roots, but it is constricted in root morphology with the mesiobuccal, mesiopalatal and distopalatal canals encaged in a web of root dentin.

Type IV: Maxillary molar with 4 roots, but the accessory palatal root is fused with the mesiobuccal root up to the apical level.

Classification 2

Radix mesiolingualis: An accessory root that has direct affinity to the mesiopalatal part of the maxillary molar crown, which is very pronounced. It can be separate, nonseparate or separate/nonseparate.

Radix distolingualis: An accessory root that has direct affinity to the disto-palatal part of the maxillary molar crown, which is very pronounced. It can be separate, nonseparate or separate/nonseparate.

Radix mesiolingualis/distolingualis: Both mesiopalatal and distopalatal roots have direct affinity to the very pronounced mesiopalatal and distopalatal parts of the maxillary molar crown, respectively. They can be separate, nonseparate or separate/nonseparate.

clinical examination noting coronal and radicular landmarks is necessary to detect accessory roots. Maxillary molars with accessory roots usually present with a larger-than-normal crown size because of a prominent or extra cusp or cusps. Cervical root probing may reveal cervical root bifurcations or radicular grooves, especially if accompanied by gingival recession.

Periapical radiographs with >1 horizontal projection can help the practitioner detect periodontal ligament outlines. Two periodontal ligament spaces on 1 side of a root and the periodontal ligament space crossing over roots can indicate the existence of accessory roots. The 3-dimensional imaging available with cone-beam computed tomography eliminates the superimposition of roots with surrounding anatomical structures. Once the roof of the pulp chamber has been removed during access cavity preparation, visualization and exploration of the pulp chamber floor and walls may lead to detection of accessory roots.

Morphological features of accessory roots must be identified and evaluated before mechanical instrumentation begins. Because some accessory roots in maxillary molars are quite small and have thin dentin walls, the practitioner must exercise caution to avoid overenlarging the canals. The authors suggested that the lack of dentin thickness must also be considered when contemplating warm root filling compaction techniques that require the removal of more dentin to accommodate heat carriers, delivery needles and pluggers.

Conclusion

Treatment of maxillary molar teeth with accessory roots requires extra planning and care. Although these teeth are uncommon, the prognosis for root canal treatment of maxillary molar teeth with accessory roots should be favorable as long as all of the root canals are located and adequately treated.

Ahmed HMA, Abbott PV. Accessory roots in maxillary molar teeth: a review and endodontic considerations. Aust Dent J *2012; 57:123-131.*

Retrospective Analysis of Radiolucent Jaw Lesions

Although >90% of radiolucent lesions associated with the teeth are benign cysts, granulomas or abscesses, some lesions with severe pathological processes, such as keratocystic odontogenic tumors (KOT), central giant cell lesions (CGCL), ameloblastomas and metastatic lesions, may present in the jaw, especially in the mandible. Koivisto et al from the University of Minnesota undertook a retrospective analysis of biopsies performed on radiolucent jaw lesions over a 15-year period at the university's school of dentistry.

Approximately three-quarters of the 9723 lesions that underwent biopsy were either apical cysts (3215) or apical granulomas (3931; Figure 1). Other diagnoses included

- 857 KOTs
- 129 CGCLs
- 114 ameloblastomas

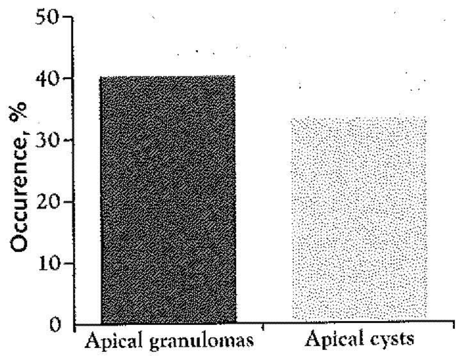

Figure 1. Apical granulomas and cysts composed 73% of the considered jaw lesions.

- 25 metastatic lesions
- 2 incidences of squamous odontogenic tumor
- 2 cases of chondrogenic sarcoma

Cysts and granulomas appeared most frequently in the anterior maxilla. Granulomas appeared more often in the posterior maxilla than did cysts, while cysts outnumbered granulomas in the posterior mandible. The least common location for both granulomas and cysts was the anterior mandible.

More than half (57%) of the KOTs were located in the posterior mandible, as were 43% of the CGCLs, 59% of the ameloblastomas and 80% of the metastatic lesions. Cysts, ameloblastomas, KOTs and metastatic tumors occurred slightly more often in men; CGCLs occurred slightly more often in women.

The age of patients with more serious pathologies varied widely:

- KOT patients averaged 46 years of age (age range, 5–100 years).
- CGCL patients averaged 35 years of age (age range, 7–97 years).
- Ameloblastoma patients averaged 46 years of age (age range, 13–94 years).

- Metastatic tumor patients averaged 63 years of age (age range, 17–98 years).

Conclusion

Dentists need to investigate abnormal radiolucent areas in the jaws. Patient age should not be a determining factor when deciding whether to biopsy a lesion. Although most of these lesions will be determined to be benign, many nonhealing radiolucent areas may be serious pathologic conditions, especially when they appear in the posterior mandible.

Koivisto T, Bowles WR, Rohrer M. Frequency and distribution of radiolucent jaw lesions: a retrospective analysis of 9,723 cases. J Endod *2012;38:729-732.*

Mandibular First Molars with Distolingual Roots

The primary anatomical anomaly in mandibular first molar teeth is an accessory distolingual (DL) root. Abella et al from the Universitat Internacional de Catalunya, Spain, conducted a literature review on the prevalence and morphologic classification of accessory DL roots in mandibular first molar teeth and discussed the clinical approach to these teeth.

The authors conducted a search of the MEDLINE, PubMed and Cochrane databases for articles published between 1970 and 2011 about additional DL roots in mandibular first molar teeth. The search yielded 45 articles (19,056 teeth) that met their criteria. The frequency of teeth with DL roots was 14.4%, with significant variation among ethnic groups. Several studies reported a frequency >20% among East Asian and Native American populations. However, African populations showed a maximum frequency of 3.1%, Indian populations showed a frequency of between 4.5% and 13.3%, and European populations showed a frequency of <5%.

No significant difference in incidence of DL roots appears to exist between males and females. Evidence for the predominance of left or right side for the appearance of the accessory root is contradictory, as is evidence for a bilateral consistency. The DL root is typically shorter than are the distobuccal and mesial roots and has a greater angle and smaller radius of curvature in a buccolingual orientation. This suggests a greater possibility for instrument fracture at any level during root canal therapy.

Identification of a DL root is necessary before and during endodontic treatment of a mandibular first molar. Periodontal examination may facilitate the discovery of a DL root. Radiographs taken at a 25° mesial angle can provide additional confirmation of a DL root. However, whenever possible, 3-dimensional imaging should be used to overcome the inherent limitation of 2-dimensional radiographs.

DL roots exhibit severe curvature distributed over a large area or the entire length of the canal. The average thickness of the mesial wall at 4 mm from the apical foramen is only 1.15 mm, with an average mesiodistal diameter of 0.33 mm. Therefore, instrument fracture is possible during canal preparation at any level. A trapezoid-shaped access cavity is preferred for locating the orifice of this canal. Excessive flaring or coronal enlargement should be avoided to prevent furcal/strip perforations and a weakening of the root.

Conclusion

An accessory DL root in a mandibular first molar can complicate endodontic treatment. This extra root is considered a normal morphological variation in people of East Asian and Native American descent. Studies indicate that a chemomechanical preparation with 0.04 taper should be sufficient to debride and fill accessory DL roots.

Abella F, Patel S, Durán-Sindreu F, et al. Mandibular first molars with disto-lingual roots: review and clinical management. Int Endod J *2012;doi:10.1111/j.1365-2591.2012.02075.x.*

In the next issue:

- Cytotoxicity of soy milk for storing avulsed teeth
- Revascularization procedures for immature permanent teeth

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