

Fate of the Tissue in Lateral Canals and Apical Ramifications in Response to Pathologic Conditions and Treatment Procedures

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Abstract

Introduction: This article reviews and reports on the histopathologic and histobacteriologic status of the tissue in lateral canals and apical ramifications (LC/AR) in diverse clinical conditions as well as in response to endodontic treatment. **Methods:** In total, serial sections from 493 human tooth specimens obtained by extraction or apical surgery were screened for the presence of LC/AR. **Results:** LC/AR were observed in about 75% of the teeth. In clinically vital teeth, vital tissue was consistently found in LC/AR. In teeth with periodontal disease, the whole pulp became necrotic only when the subgingival biofilm reached the main apical foramen. In teeth with pulp exposure by caries, the tissue in LC/AR remained vital as far as the pulp tissue in the main canal did so. When pulp necrosis reached the level of the LC/AR, the tissue therein was either partially or completely necrotic. Chemomechanical preparation partially removed necrotic tissue from the entrance of LC/AR, whereas the adjacent tissue remained inflamed, sometimes infected, and associated with periradicular disease. Vital tissue in LC/AR was not removed by preparation. In cases in which lateral canals appeared radiographically “filled,” they were actually not obturated, and the remaining tissue in the ramification was inflamed and enmeshed with the filling material. **Conclusions:** Overall, the belief that lateral canals must be injected with filling material to enhance treatment outcome was not supported by literature review or by our histopathologic observations. It appears that strategies other than finding a technique that better squeezes sealer or gutta-percha within LC/AR should be pursued to effectively disinfect these regions. (*J Endod* 2010;36:1–15)

Key Words

Apical periodontitis, apical ramification, endodontic treatment, lateral canal, periodontal disease, pulpitis

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Lateral and apical ramifications of the main root canal are formed after a localized fragmentation of the epithelial root sheath develops, leaving a small gap, or when blood vessels running from the dental sac through the dental papilla persist. Dentinogenesis does not occur in this specific area, giving rise to a canal containing small blood vessels and sometimes nerves. Although ramifications contain connective tissue and blood vessels, this is not usually regarded as collateral blood supply and consequently provides little contribution, if any, to pulp function, except possibly for the ramifications located in the apical 1–2 mm of the canal (1, 2). Ramifications can be observed anywhere along the length of the root, but they occur more commonly in the apical portion and in posterior teeth (3). In 73.5% of the cases, ramifications are found in the apical third of the root, in 11% in the middle third, and in 15% in the coronal third (4). For consistency, we refer to ramifications as furcation canals, lateral canals, and apical ramifications. This article deals with the latter two.

Ramifications comprise potential pathways through which bacteria and/or their products from the necrotic root canal might reach the periodontal ligament and cause disease, and likewise, bacteria from periodontal pockets might reach the pulp. Lateral canals and apical ramifications are arguably difficult to reach, clean, disinfect, and fill during treatment. Their possible clinical significance has long called the attention of clinicians and researchers as to how and whether these ramifications should be approached and what is the fate of the tissue present therein after treatment. The present study reviews and reports on the histopathologic and histobacteriologic status of the tissue in lateral canals and apical ramifications in diverse clinical conditions as well as in response to endodontic treatment. In light of these observations, the influence of lateral canals and apical ramifications on treatment outcome is discussed.

To Fill or Not to Fill: Is This the Question?

The actual need to fill lateral canals has been a bone of contention among endodontists. Schilder (5–7) postulated that the main objective of endodontic treatment procedures should be the cleaning and filling of the root canal in its entire extent, also including all lateral canals and apical ramifications. After him, some advocated that “those who do 3-D obturation techniques have historically claimed technical and even moral superiority over those who do techniques that only fill primary canals” (8). Thus, clinician’s skill or the technical ability of filling lateral canals has been considered by many as a measure of endodontic excellence. Personal opinions based on impression left aside, it has been reported that “unfilled lateral canals” might be associated with post-treatment disease (9). It has also been claimed that lateral canals harboring inflamed and/or infected material might cause pain during endodontic treatment (10).

On the basis of these assumptions, the idea that lateral canals and apical ramifications should be filled for successful endodontic therapy has been accepted by many clinicians and researchers in an almost dogmatic manner. In this context, a myriad of in vitro studies have aimed at evaluating the ability of different obturation techniques of filling lateral canals (11–17). Curiously, most of these studies reported that no significant differences were observed for the efficacy of different techniques in forcing sealer into the lateral canal, even though thermoplasticized techniques obviously also tended to force gutta-percha in many specimens. It has also been found that lateral canals are filled less frequently after use of calcium hydroxide medication (18).

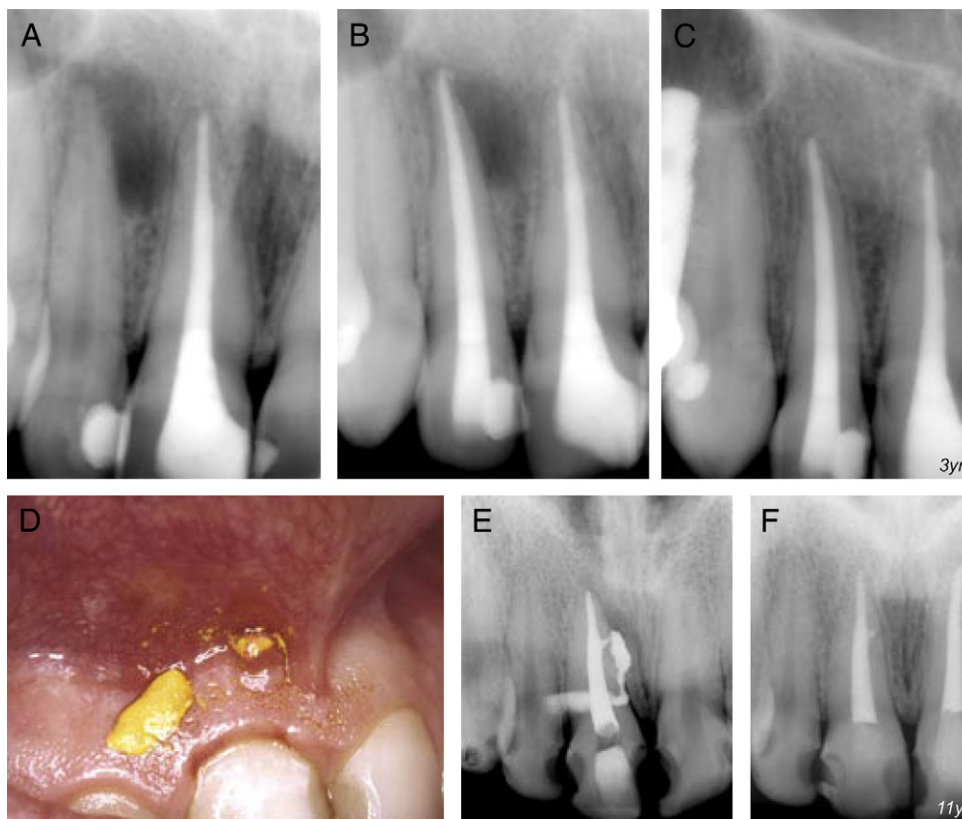


Figure 1. (A) Maxillary lateral incisor with necrotic pulp and a large radiolucency involving the apex and the mesial aspect of the root. Patient presented with spontaneous pain. Tooth was tender to percussion. Presence of lateral canals, although not visible in the radiograph, is likely under this circumstance. (B) After instrumentation and 1-week calcium hydroxide medication, the canal was obturated with laterally compacted cold gutta-percha and a sealer. Note that no lateral canal/ramifications were injected with filling material. (C) Three-year follow-up radiograph. The lateral lesion appears completely healed. (D) This is a case in which the canal of a maxillary central incisor with necrotic pulp was instrumented and medicated with an iodoformic paste. After rubber dam removal, some medicament pushed through the sinus tract was seen on the buccal mucosa. (E) The material penetrated into a lateral lesion through a large lateral canal and followed the course of the sinus tract. Because of its high radiopacity, it permitted to obtain sort of a “fistulography”. The canal was then obturated after 40 days, when the sinus tract appeared clinically healed, with chloroform modified lateral compaction technique and sealer. Postoperative radiograph revealed that the filling material penetrated into the large lateral canal (not shown). No symptoms emerged in the postoperative period. (F) Eleven-year follow-up radiograph showing that the lateral lesion healed completely, with the radiographic image of a lamina dura following the entire root outline.

Nevertheless, there is no consensus as to the need to fill lateral canals to optimize the treatment outcome. Weine (10) admitted that although the frequency of lateral canals has been demonstrated to be high, they are not so frequently revealed radiographically after root canal filling. Even so, failure to fill lateral canals has been assumed not to lead to endodontic treatment failure characterized by a post-treatment lateral lesion in the huge majority of cases.

Admittedly, filling ramifications would be a desirable objective of treatment only when there is a chance for bacterial traffic from the canal to the periodontal ligament, ie, in previously necrotic infected cases in which bacteria were left undisturbed in the main canal or in the ramification. However, clinical experience reveals that lateral lesions might heal after endodontic treatment, even when the lateral canals are not filled (Fig. 1A–C). Indeed, Camps and Lambruschini (19) stated that filling of lateral canals is not always necessary for a successful root canal treatment. A study examining root canal-treated teeth from human cadavers reported no relationship between unfilled lateral canals and the status of inflammation at the periradicular tissues (20).

However, it must be stated that lateral canals and apical ramifications have been implicated with endodontic treatment failure when they are sufficiently large to harbor significant numbers of bacteria and to

provide these bacteria with frank access to the periradicular tissues (21–26). Therefore, disinfection of lateral canals and apical ramifications in cases of pulp necrosis and apical and/or lateral periodontitis should be considered an important goal of the treatment, although difficult to achieve with current treatment procedures. What remains to be determined is whether forcing the filling material into ramifications exerts any significant influence on the outcome by killing bacteria in these ramifications as a result of the antibacterial effects of the material or by promoting an effective lateral antibacterial (bacteria-tight) seal. It is important to point out that the antibacterial effects of filling materials are usually weak and only transient, reaching a peak of effectiveness before setting (27–33). Moreover, attainment of a predictable antibacterial seal provided by the material injected into the small and usually tortuous ramification is highly unlikely and has not been demonstrated.

As one can infer from this discussion, although the influence of filling lateral canals on treatment outcome has been subject of debate and personal opinion (34), there is no clear scientific evidence as to this matter. Because bacteria located in lateral canals and in apical ramifications can certainly influence the treatment outcome, it seems advisable that efforts should be made to apply therapeutic strategies to reach and incorporate these areas in the disinfection process.

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