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CASE REPORT

Apexification: An Interesting Case

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This case of total pulpal necrosis and infection illustrates a relatively unexpected apexification outcome that morphologically closely resembled normal root end formation.

Apexification with calcium hydroxide [$Ca(OH)_2$] has proven to be a reliable and most welcome addition to the therapeutic armamentarium since Frank (1) described it in 1966. Before 1966 the clinical management of a "blunderbuss" canal usually required a surgical approach for the placement of an apical seal into the often fragile and flaring apex. Treatment was complicated when patient management required conscious sedation or general anesthesia, especially with children.

Apexification therapy is initiated when clinical and radiographic evidence of pulpal necrosis has been unequivocally established, and the incompletely formed root has an apical diameter greater than the coronal diameter. Pulpal necrosis with odontoblastic disintegration results in the preclusion of dentin deposition in the apexification "cap."

Apexogenesis in contrast refers to vital pulp therapy to encourage continued physiological root and apex formation, with its normal dentin and cementum composition.

Through the years many published reports have examined both the radiographic appearance and histological content of the apexification-induced calcified "cap." Although the radiographic shape of the "cap" is variable, the most frequently seen closure seems to be a horizontal bridge spanning the tips of the flared apex (Fig. 1). This typical example shows a thin apexification "cap" that closed the "blunderbuss" canal, but did not form a mature apex. The histological studies of the "cap" generally describe a cementum-like material with underlying inclusions of various mineral and organic composition (2–6).

This case report illustrates a relatively unexpected apexification outcome that morphologically closely resembled normal root end formation despite the evidence of total pulpal necrosis and infection.

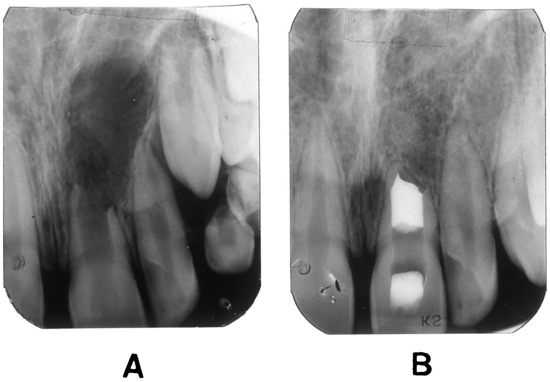

FIG. 1. A typical case of $Ca(OH)_2$ apexification. (*A*) Radiograph at initial examination. Tooth #9 has a nonvital pulp, a "blunderbuss" immature apex, and a large periradicular area of rarefaction. (*B*) Radiograph ~2 yr later at obturation visit with soft gutta-percha and sealer. There has been complete periradicular repair with restitution of normal thickness ligament space and lamina dura. Note how the obturation material adapts to the apexification "cap," outlining its irregular inner surface. The rather thin "cap" has apparently sealed the canal preventing any extrusion of sealer or soft gutta-percha. The "cap" has spanned the gap between the tips of the flared apex, adding very little to the length of the root.

CASE REPORT

The patient was a 12-yr-old male with a noncontributory medical history. It was reported that ~4 months ago he had swelling and pain in the left mandible after a blow to the area. He was now taking penicillin, recently prescribed by his referring dentist. There was no current evidence of swelling or tooth mobility, but a draining sinus tract was seen in the mucolabial fold near the apex of the left cuspid (tooth #22). Thermal and electric pulp tests confirmed that tooth #22 was nonvital, whereas all adjacent teeth contained vital pulps. The radiograph showed that tooth #22 had an incompletely formed root with a "blunderbuss" apex, surrounded by a periradicular rarefaction ~5 × 6 mm in size (Fig. 2*A*). With the parents' concurrence nonsurgical root canal therapy with $Ca(OH)_2$ apexification was initiated.

The sinus tract closed shortly after the start of treatment, and the patient was instructed to stop taking the penicillin. Attempts to schedule treatments at 3-month intervals were unsuccessful because of patient lack of cooperation. Nonetheless when reexamined 1 yr after the start of treatment the radiograph showed marked resolution of the area of rarefaction, and satisfactory apexification progression. The canal was retreated and a fresh $Ca(OH)_2$ paste applied. Once again the patient failed to return until 1 yr later. The

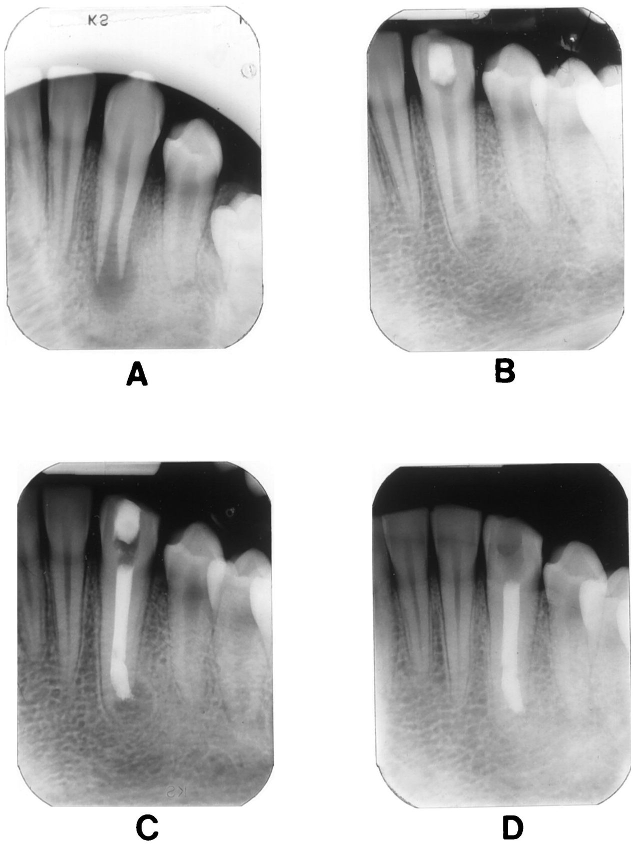

FIG. 2. A case of $Ca(OH)_2$ apexification that formed a mature- looking apex. (*A*) Radiograph at initial examination. Pulp tests did not elicit any response from tooth #22, and clinically a labial sinus tract was present. A "blunderbuss" apex and periradicular rarefaction are seen. (*B*) Radiograph 2 yr after the start of treatment. Only one additional $Ca(OH)_2$ treatment had been performed at the 1-yr visit. (*C*) Radiograph at obturation 2 yr after the start of treatment. Some extrusion of sealer and gutta-percha is seen. (*D*) Final follow-up radiograph 2 yr 6 months after canal obturation. A morphologically mature apex has formed that seems to have enclosed the gutta-percha within the canal.

radiograph at that time (2 yr since the start of treatment) showed advanced apexification with calcific deposition within the apical root canal (Fig. 2*B*). Obturation was accomplished with soft gutta-percha and sealer. The fill radiograph (Fig. 2*C*) showed some gutta-percha and sealer extruded beyond the apex, despite paper point tests that gave the impression that the apex was solidly closed.

The final follow-up radiograph taken 2 yr 6 months after root canal filling (Fig. 2*D*) disclosed regeneration of the periradicular tissues, including a normal thickness ligament space and lamina dura, and a fully formed apex that seemed to enclose the gutta-percha within the root. In addition the tooth was free of any symptoms and the sinus tract remained healed.

DISCUSSION

This case has yielded a measure of instructive but not conclusive results about apexification. The unexpected formation of a mature apex served to demonstrate its possibility, but not its predictability. In addition successful treatment occurred with only two applications of $Ca(OH)_2$ paste spaced 1 yr apart, whereas the widely accepted protocol recommended changing the paste every 3 to 6 months.

The underlying mechanisms involved in controlling not only the apexification process but also the shape of the "cap" remains unresolved. In addition the most efficacious frequency of $Ca(OH)_2$ treatments is still controversial. Furthermore the time required to effectively close the open apex is hard to predict.

Although it is reassuring that apexification offers an adequately reliable treatment, clarification of the obscure parameters would be welcome. This is especially relevant from a clinical point of view where enhanced confidence is most critical in the predictability of a procedure's outcome.

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