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Apexification in Pediatric Dentistry: A Review

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ABSTRACT

Apexification is a well-established endodontic procedure aimed at inducing a calcified apical barrier in non-vital immature permanent teeth. Management of such teeth poses a clinical challenge due to open apices, thin dentinal walls, and difficulty in achieving an adequate apical seal. Traditionally, long-term calcium hydroxide therapy was considered the gold standard; however, the introduction of bioceramic materials such as mineral trioxide aggregate (MTA) and newer calcium silicate–based cements has significantly improved treatment outcomes. This review discusses the biological basis, materials, techniques, advantages, limitations, and current evidence related to apexification in pediatric dentistry.

INTRODUCTION

Trauma and caries are the most common causes of pulpal necrosis in immature permanent teeth. When pulp necrosis occurs before completion of root development, it results in an open apex and thin dentinal walls, complicating conventional root canal treatment. Apexification was introduced to manage such cases by inducing the formation of a calcified barrier at the root apex, against which obturation can be performed.

Frank first described apexification in 1966 using calcium hydroxide to induce apical closure. Since then, various materials and techniques have been proposed to overcome the drawbacks associated with traditional methods.

Biological Basis of Apexification

Apexification relies on the stimulation of hard tissue formation at the root apex. The exact mechanism is not fully understood; however, it is believed that alkaline materials such as calcium hydroxide and calcium silicate cements induce mineralization by:

- Activating alkaline phosphatase
- Promoting differentiation of hard tissue–forming cells
- Creating a favorable environment for deposition of calcified tissue

The resulting apical barrier may consist of osteodentin, cementum-like tissue, or bone-like tissue.

Indications for Apexification

Apexification is indicated in:

- Non-vital immature permanent teeth
- Teeth with open apices and necrotic pulp
- Cases where regenerative endodontic procedures are contraindicated or have failed

Materials Used for Apexification

1. Calcium Hydroxide

Calcium hydroxide has been used extensively for apexification due to its antibacterial properties and ability to induce hard tissue formation.

Advantages:

- Long history of clinical success
- Antimicrobial action
- Inexpensive and readily available

Disadvantages:

- Long treatment duration (6–24 months)
- Requires multiple visits

- Risk of cervical root fracture due to prolonged exposure
- Unpredictable apical barrier formation

2. Mineral Trioxide Aggregate (MTA)
MTA revolutionized apexification by enabling single-visit or short-term treatment.
Advantages:
- Biocompatible
- Excellent sealing ability
- Induces rapid hard tissue formation
- Reduced treatment time

Disadvantages:
- Difficult handling characteristics
- Long setting time
- Tooth discoloration (especially grey MTA)
- Higher cost

3. Newer Bioceramic Materials
Materials such as **Biodentine**, **EndoSequence Root Repair Material**, and **calcium-enriched mixture (CEM) cement** have been introduced as alternatives to MTA.
Advantages:
- Improved handling
- Faster setting time
- Reduced discoloration potential
- Comparable or superior biocompatibility

Limitations:
- Limited long-term clinical data
- Higher cost

Techniques of Apexification
Traditional Calcium Hydroxide Apexification
After canal disinfection, calcium hydroxide paste is placed in the canal and replaced periodically until radiographic evidence of apical barrier formation is observed, following which obturation is performed.

MTA Apical Plug Technique
Following canal preparation and disinfection, an apical plug (3–5 mm) of MTA is placed at the apex, allowing immediate obturation of the remaining canal space once the material has set.

Comparison with Regenerative Endodontics
While apexification achieves apical closure, it does not allow continued root development. In contrast, regenerative endodontic procedures aim to promote root lengthening and thickening of dentinal walls. However, apexification remains relevant when regeneration is not feasible due to factors such as inadequate stem cell potential, patient compliance issues, or persistent infection.

Clinical Outcomes and Prognosis
Studies report high success rates for MTA apexification, often exceeding those of calcium hydroxide in terms of treatment duration and fracture resistance. However, neither technique strengthens the thin root walls, emphasizing the need for careful long-term follow-up.

Complications
- Root fracture
- Apical leakage
- Material extrusion
- Tooth discoloration

CONCLUSION

Apexification remains a valuable treatment modality in pediatric dentistry for managing non-vital immature permanent teeth. While calcium hydroxide has been largely replaced by MTA and newer bioceramic materials, case selection remains critical. Advances in biomaterials have made apexification more predictable and time-efficient; however, it does not substitute regenerative endodontics where continued root development is possible.

REFERENCES

[1]. Frank AL. Therapy for the divergent pulpless tooth by continued apical formation. *J Am Dent Assoc*. 1966;72:87–93.
[2]. Cvek M. Treatment of non-vital permanent incisors with calcium hydroxide. *Odontol Revy*. 1972;23:27–44.
[3]. Torabinejad M, Watson TF, Pitt Ford TR. Sealing ability of mineral trioxide aggregate. *J Endod*. 1993;19(12):591–595.
[4]. Witherspoon DE, Ham K. One-visit apexification: technique for inducing apical closure. *J Endod*. 2001;27(6):386–388.
[5]. El-Meligy OAS, Avery DR. Comparison of apexification with calcium hydroxide and MTA. *Pediatr Dent*. 2006;28(3):248–253.
[6]. Simon S, Rilliard F, Berdal A, Machtou P. The use of MTA in one-visit apexification. *Int Endod J*. 2007;40(3):186–197.
[7]. American Academy of Pediatric Dentistry. Pulp therapy for primary and immature permanent teeth. *AAPD Reference Manual*. 2023–2024.