APEXIFICATION: A BRIEF REVIEW

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***Abstract*- This article examines the justification for and methods of treating the non-vital immature tooth. Three years following the tooth's eruption, the root development and apex closure are complete. A major problem for the clinician during this time is how to treat pulpal injury. One cannot overstate how crucial meticulous case assessment and precise pulpal diagnosis are when treating developing teeth with pulpal injury. Apexification is a treatment and preservation method for developing permanent teeth that have lost pulp vitality. For many years, a common procedure for such teeth has been apexification. A number of substances, including calcium hydroxide and mineral trioxide aggregate, have been advocated for use in the construction of apical barriers (MTA). MTA continues to be the most often used substance for apexification. The application of mineral trioxide aggregate has resulted in an incredibly high success rate.**

***Keywords*- Apexification; endodontic treatment; non-vital pulp; revascularization; immature teeth; permanent teeth; MTA; mineral trioxide aggregate**

INTRODUCTION

A procedure called apexification involves cleaning the root canal, filling it with a temporary drug that encourages the development of a calcified barrier at the apex, and then obturating it permanently with gutta-percha. (1) The tissue that has undergone mineralization may be composed of bone, osteocementum, osteodentin, or any mix of the three. (2) Materials with the ability to create a calcium barrier at the apex of the tooth, allowing for apexification and aiding in the conservative treatment of the developing tooth, include calcium hydroxide and mineral trioxide aggregate. It is done to apexify a tooth if it is determined to be non-vital and it is made plain that the root's length and width won't be able to grow longer or wider. The vitality of the pulp plays a major role in the distinction between the apexogenesis and apexification processes; teeth with vital pulp undergo apexogenesis, whereas those with non-vital pulp undergo apexification. (3)

MATERIALS AND METHODS FOR APEXIFICATION

-Materials: (4) (5)

Materials that can be in cooperated for the purpose of apexification include mineral trioxide aggregate, mineral trioxide aggregate with platelet rich fibrin membrane, mineralized tissue barrier, biodentine, C.E.M, biodentine with collagen membrane calcium hydroxide plug, mineral trioxide aggregate with demineralized freeze-dried bone allograft, mineral trioxide aggregate with calcium sulphate matrix, mineral trioxide aggregate with absorbable collagen sponge, white portland cement with resorbable collagen sponge, tricalcium phosphate and osteogenic protein.

-Methods traditionally used:

- For the management of non-vital immature teeth in the past, methods like custom – fitting the filling material, paste fills, and apical surgery were employed. Subsequent research focused on employing antibacterial and antiseptic pastes to induce apical closure. (6)
- calcium hydroxide is traditionally applied as part of the apexification process to complete root-end closure. The drawbacks of this long term approach, however, include postponed treatment, a challenge in patient follow-up, an unpredictable seal, and a danger of root fractures due to the presence of thin walls. (7) With its tendency to develop calcified tissue that would inhibit the pulp from regenerating, calcium hydroxide was recommended as a possible intra canal medication that would not be appropriate in regenerative operations. (8)

-Recent advancements:

- MTA for one-visit apexification
- Biodentine(new calcium silicate based material) as an apical barrier and a synthetic collagen material as an internal matrix (9)
- Platelet rich fibrin- Sometimes a matrix should be inserted before the implantation of the filling material to lessen the likelihood of apical extrusion of the filling material. Leukocyte matrix, which
- is present in PRF and contains stem cells, platelets, and cytokines, is biodegradable and aids in the migration of epithelial cells. Within one to four weeks, PRF detects growth factors. (10)
- Bioaggregate-Bioaggregate is a tricalcium cement that is also referred to as DiaRoot. Deionized water is combined with aluminium nanoparticles in this product. It is extremely bioinductive, more fracture resistant than MTA, and less dislodging than that material. (11)

-**Mineral trioxide aggregate (MTA)**

- **Advantages**
  - Biocompatibility (12)
  - Hard tissue formation (13)
  - Sealing ability
  - Anti-microbial property (14)

-Bio dentine

- **Advantages**
  - Requires significantly less time (15)
  - Exhibits least microleakage (16)
  - Has alkaline pH and exhibits ability to release calcium ions similar to that of MTA (17)

Types of root apex closure seen after apexification: (18)

- Usual root end advancement
- Clinically obvious radiographic closure and hard tissue stoppage
- Hard halt that is clinically discernible but does not show radiographic bridge development
- construction of a calcific bridge from the corona to the apex

DISCUSSION

Since children are at different stages of growth and development, there has been a continuous evolution of novel materials and innovation in treatment choices, particularly in the field of paediatric dentistry. (19) Calcium hydroxide has been a common substance utilised in apexification for a very long time. The most widespread acceptance was given to calcium hydroxide. It has an alkaline pH and is antibacterial in nature, which may be what stimulates apical calcification. Despite its acceptance, it has certain drawbacks, such as unpredictable treatment times, challenges with patient follow-up, sluggish healing, the necessity for multiple visits to complete the induction of calcific barrier creation, and weakening of the root's dentin.Hence, the need to offer new materials and processes that would aid in the rapid resolution of the apical barrier and apical radiolucency.
Apexification is successfully treated with a recently introduced substance called MTA (mineral trioxide aggregate) (20) MTA revolutionized multivisit apexification to a single-visit apexification due to its setting duration of 3 to 4 hours and allowing a proper hermetic seal at the apex. (21) Moreover, MTA encourages the regeneration of periodontal tissue and aids in the constant development of cementum. (22) Even in situations where there is an open apex, MTA offers a practical alternative to establish root closure in developing teeth or to treat root fracture. With teeth treated with MTA as opposed to teeth treated with Ca(OH)2, a smaller amount of time is needed for the barrier to form. (23)

It is understood that the extrusion of MTA via an open apex is a rather uncommon complication during the apexification process, and the extruded material has no negative effects on the periapical tissues' ability to recover. (24) When the endodontic material is sandwiched between the bone and the mucosa, another possibility is physical irritation of the oral mucosa after the extrusion of MTA. As a result, the outcome of the treatment after the extrusion of MTA in the periradicular tissues cannot be limited and is therefore unpredictable. (25) Moreover, a gradual and ongoing rise in cytokine levels is linked to PRF. Leukocytes in the PRF have anti-inflammatory, anti-infective, immune response-regulating, and vascular endothelial growth factor functions that support angiogenesis. (26)
The shortcomings of MTA, such as its prolonged setting time, discolouration, and challenging handling characteristics, were addressed with the introduction of biodentine. Silicate components in the powder content set more quickly, while calcium chloride-containing liquid content sets in 10 minutes. Zirconium oxide is changed as an opacifier, which lessens discolouration and enhances handling characteristics. (27)
The following are a few of the suggested processes for CaOH: (28)

- The activity of calcium dependent pyrophosphatase is increased when there is a high calcium concentration.
- Direct impact on the soft tissue at the apex and around it
- A high pH could cause alkaline phosphatase activity to be active.
- Antibacterial activity

CONCLUSION

Apexification by Ca(OH)2 has been used as a legitimate therapy to execute an apexification treatment for many years.The MTA barrier is used as an alternative to Ca(OH)2 apexification since it does not require many appointments and the development of the barrier's conformation is not dependent on an external factor, unlike in the case of apexification with Ca(OH)2, which also applies to pulp regeneration. (29)

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