



ENDODONTIC MANAGEMENT OF THE IMMATURE PERMANENT TOOTH WITH AN OPEN APEX - A REVIEW

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ABSTRACT

The management of immature tooth with an open apex is always a challenge for the endodontist. There is always a difficulty in shaping and cleaning of canals and achieving a proper obturation. Obtaining working length is always difficult in cases of blunderbuss canals. Recently there is a paradigm shift in the management of open apex, There is a possibility of regenerating the pulp tissue in the immature tooth with open apex. Regenerative endodontics is one of the most prospective development in the field of dentistry today.

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INTRODUCTION

In the field of endodontology the most important step is to achieve a proper shaping and cleaning and obturating the canals three dimensionally. The clinician should also have a thorough knowledge on canal anatomy. The morphological variation and configuration of the canal is of utmost necessity in deciding the treatment approach (Anantharaj *et al.*). Trauma to the teeth and dental caries affects the tooth when the tooth matures, both this can be the reason for the non-vitality of the pulp. If trauma occurs during the root development, complete root formation is terminated and there is no apical closure completely. Many reasons are there associated with wide apical foramen (Jain and Rita, 2014).

- In some canals the diameter of the apical foramen is wider than the coronal diameter thus making shaping and cleaning difficult.
- When there is wide apical foramen, it is difficult to three dimensionally obturate the canals as there is a risk of materials being protruding out of the canal to the peri-apical space.

- Since the walls of the root canal is thin, it is more prone to fracture. So surgical treatment is not advised.

The management of immature tooth with an open apex is always a challenge for the endodontist. There is always a difficulty in shaping and cleaning of canals and achieving a proper obturation. Obtaining working length is always difficult in cases of blunderbuss canals (Moodley *et al.*, 2017). Recently there is a paradigm shift in the management of open apex, There is a possibility of regenerating the pulp tissue in the immature tooth with open apex. Regenerative endodontics is one of the most prospective development in the field of dentistry today.

Causes of open apex

- Incomplete development of the root which can be due to trauma and as a result of dental caries before the completion of the root growth and development.
- Apical resorption of the root canal which may be due to trauma or peri-apical pathosis.
- Root end resection
- Over instrumentation which mainly occur during working length determination and shaping and cleaning with rotary instruments.

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Diagnosis

The main cause of the incomplete development of the root is trauma during the development stage. A proper history of the injury occurred is noted for the proper execution of the treatment protocol. A proper radiograph is taken and the interpretation is quite difficult as the radiolucency Endodontic management of the immature permanent tooth with an open apex¹⁶

A proper medical history is taken. A thorough dental history is also taken that should include all the symptoms and signs. Hard and soft tissues are examined clinically to diagnose any swelling or presence of caries and discoloration of the crown. Pulp vitality test are done to check the vitality of the pulp. Electric tests and thermal tests are done. Mobility and periodontal probing can provide information regarding the health of status pulp. To provide more accurate details and condition of the peri-apical tissues, cone beam computed tomography should be used. However it is still difficult to determine if the pulp is reversibly or irreversibly affected. However it is hoped that by combining the result of history, examination and diagnostic tests, an accurate clinical diagnosis of pulp vitality can be made in most cases

Treatment modalities

Two basic types of treatment modalities are

- Surgical methods
- Non-surgical methods

4.a) Surgical methods

In the case of blunderbuss apex, there is presence of peri-apical lesion which was treated surgically for many years. Dawood and pittford (1989) reported that obturation of the root canal with thermoplasticized gutta percha followed by periapical curettage can be clinically successful (Apexification, 2013). Now because of advancements such as surgical operating microscopes, refined microsurgical instruments made the procedures more easy and convenient and will result in less trauma to the patient and faster postsurgical healing.

- Root End Filling-

The objective of apical surgery is to surgically maintain a tooth that primarily has an endodontic lesion that cannot be resolved by conventional endodontic (re)treatment. It is therefore of clinical relevance to perform a thorough clinical and radiographic examination of the tooth before apical surgery (including adjacent and opposing teeth), in order to decide whether surgical or non-surgical endodontics should be considered. Only a tight and persistent apical obturation will allow periapical healing with good long-term prognosis. Thus, fulfillment of this requirement is of paramount importance during the surgical treatment (Meena *et al.*, 2016).

4.b) Non-surgical methods

There are various methods:

- Apexification
- Apexogenesis

- Revascularization.

Apexification (root end closure):

According to American Association of Endodontists- Apexification is defined as a method to induce a calcified barrier in a root with an open apex or the continued apical development of an incomplete root in teeth with necrotic pulp (Torsten *et al.*, 2003).

• Indications of apexification (Abu-Hussein Muhamad *et al.*, 2016)-

- Immature teeth with an infected pulp
- No history of spontaneous pain
- No sensitivity on percussion
- No haemorrhage
- Teeth must be ultimately restorable
- No vertical or horizontal root fracture
- No radiographic evidence of replacement resorption (ankylosis)
- Root length must be approximately half or more established
- Periapical radiolucency

Contraindications of apexification (Abu-Hussein Muhamad *et al.*, 2016)

- Purulent drainage
- History of prolonged pain
- Very short roots
- Marginal periodontal breakdown
- Vital pulp

Advantages of apexification (Abu-Hussein Muhamad *et al.*, 2016)

- It is successful in resolving periapical lesions.
- MTA apexification could be completed in one appointment.
- Avoids surgical treatments as surgical removal of tooth structure further weakens the remaining tooth.
- Induces root end closure in necrotic immature permanent teeth.

Disadvantages of apexification (Abu-Hussein Muhamad *et al.*, 2016)

- High incidence of root fractures in teeth after apexification due to thin dentinal walls.
- Restorative efforts should be directed towards strengthening the immature root.
- Teeth to be used as overdenture abutments.
- Although MTA has more benefits, using MTA in teeth with funnel shape apices and large periapical lesions is difficult and it often spreads beyond the apex.

Materials used for apexification

- Calcium hydroxide
- Mineral Trioxide Aggregate
- Biodentin
- Tricalcium Phosphate
- Dentin chips

- Calcium Phosphate Ceramics And Hydroxyapatite
- Bone Morphogenic Proteins
- Bioceramics

Regenerative endodontics

Regeneration is the process of renewal, restoration, and growth that makes genomes, cells, or organisms resilient to natural fluctuations or events that cause disturbance or damage. Every species, from bacteria to humans, is capable of regeneration. Regeneration can either be complete where the new tissue is the same as the lost tissue, or incomplete where fibrosis occurs after the necrotic tissue is removed. In regenerative endodontics, the goal is for the pulp to "revitalize" or "regenerate" new tissue so that root maturation can occur in the absence of disease and the patient's tooth can return to function, form, and aesthetics. The management of immature permanent teeth with pulpal disease can be very challenging for the clinician. For example, it is difficult to properly debride, clean, and shape thin dentinal walls, which can result in cervical fracture. An extraction or fracture will present a restorative and aesthetic problem, especially if the patient is young, due to the fact that the bone is too immature for an implant. According to the American Association of Endodontists (AAE) recommendation for the endodontic management of the permanent immature tooth with an open apex, the patient should fulfil the following criteria:

- Tooth with necrotic pulp and an immature apex.
- Pulp space not needed for post/core, final restoration.
- Compliant patient/parent.
- Patients not allergic to medicaments and antibiotics necessary to complete procedure(31)

Indications (Regenerative Endodontics, 2015)

- Necrotic pulp and immature or open apex
- Young patient
- Very thin dentinal walls
- Cannot achieve a predictable apical seal with conventional endodontics
- Presence of pathology with very large apical foramen

Key Components of Regenerative Endodontics

In order for the regenerative endodontic technique to be effective, the following 3 key components are:

- Stem cells
- Scaffolds
- Growth factors

ADA Code on Regeneration Procedures (Regenerative Endodontics, 2015)

- First Phase of Treatment: D3351(debridement and placement of antibacterial medication)
- Interim Phase (repeat of first phase, if necessary): D3352(interim medication replacement)
- Final Phase: D3354 (pulpal regeneration [completion of regenerative treatment in an immature permanent tooth with a necrotic pulp]; does not include final restoration)

Apexogenesis

Definition

- Apexogenesis refers to a vital pulp therapy procedure performed to encourage physiological development and formation of the root end (Torsten *et al.*, 2003).
- Defined as the physiologic root end development and formation. -According to American Association of Endodontists.

Advantages

- A traumatised immature tooth shows capacity for further root development (Torsten *et al.*, 2003).
- Provides a hard tissue barrier limiting or preventing bacterial contamination (Torsten *et al.*, 2003).
- Preservation of vital pulp tissue (Endodontics, 2009).

Disadvantages

- Discoloration of tooth after apexogenesis can be due to minocycline used in the TPA and can also be due to MTA (grey or white) which is used as a cervical barrier.
- The nature of the tissue formed inside the root canal is uncertain, with most of the animal studies and histological findings in human teeth report that the tissue formed inside is cementum-like, bone-like or PDL like tissue.
- Patient compliance can be a problem as the treatment can take months to years with multiple clinical appointments.
- Revascularization depends on presence of stem cells and growth factors and hence, it is likely to be more successful only in young individuals and not in older patients.
- Calcification of canal space after revascularization is a commonly noticed phenomenon.

Revascularization

Revascularization is a new treatment method for immature necrotic permanent teeth. Indeed, it would provide, after treatment, a vital tooth that would be able to complete its root maturation. Up to now, apexification procedures were applied for these teeth:

- Using calcium dihydroxide to induce the formation of an apical calcified barrier;
- Using mineral trioxide aggregate (MTA) to produce an artificial apical barrier.

Both methods have shown to be effective regarding the narrowing of the apical foramen of an immature tooth. However, the pulp revascularization allows also the stimulation of the apical development and the root maturation of immature teeth (root growth and thickening of dentinal walls and natural apexification). The pulp revascularization also allows the stimulation of the apical development and the root maturation of immature teeth i.e root growth and thickening of dentinal walls and natural apexification. Revascularization technique would allow the growth of root and thus avoiding the remaining of thin and fragile walls. It will reduce the risk of root fracture. This is not the case with apexification treatment. Immature teeth with a large open apex

and short roots seem to be more conducive to the successful treatment of pulp revascularization (Mélanie Namour and Stephanie Theys, 2014).

Advantages of revascularization

- Requires a shorter duration time after control of infection, can be completed in a single visit.
- Cost-effective, the number of visits is reduced and no additional material (such as TCP, MTA) is required.
- Obturation of the canal is not required unlike in calcium hydroxide induced apexification with its inherent danger of splitting the root during lateral condensation.
- Continued root development (root lengthening) and strengthening of the root as a result of re- reinforcement of lateral dentinal walls with deposition of new dentin/hard tissue (Regenerative Endodontics, 2015).

Conclusion

Throughout decades, there have been significant changes in the clinical management of infected immature permanent teeth, dating back to the 1960s in work by Ostby. In the 2000s, Banchs and Trope reported an alternative treatment to revascularization by introducing the use of triple antibiotic pastes. Regenerative endodontics is one of the most exciting developments in dentistry, and endodontics is at the cutting edge of the technology. A working knowledge of biological and mechanical skill is required to attain the highest results in order to make regenerative endodontics a success in clinical practice.

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