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A Review On Management Of Open Apex In Permanent Teeth.

Management Of Open Apex In Permanent Teeth.

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ABSTRACT: Endodontic management of the permanent tooth with open apices continues to be a challenge for both clinicians and researchers. It is quite difficult to achieve adequate levels of disinfection, instrumentation and obturation in teeth with incomplete root development because of thin radicular walls of such teeth are susceptible to fracture. Various treatment options and materials having osteogenic effect have been introduced in the field of Endodontia.Materials like Calcium hydroxide, MTA and Biodentine have shown promising results in the formation of apical seal. Nowadays, One-step apexification technique has become a popular procedure. Thisinvolves placing an apical barrier to achieve an adequate apical stop. The present article describes the available options so far to treat cases of open apex.

Keywords: Open apex, Apexification, One- step Apexification, MTA, Biodentine, Apexogenesis

1. INTRODUCTION

The anatomy of apical foramen changes with age as root formation has yet to be completed as tooth erupts. It takes up to three years after eruption for completion of root development and closure of the apex to occur [1]. But there are certain instances when the process of apex closure in permanent teeth is disturbed and leads to formation of open apex.
There are two types of open apices; blunderbuss and non-blunderbuss. The root walls are divergent and flaring, apex is funnel shaped and wider than the coronal aspect of the canal in case of blunderbuss canals. The walls of the canal may be parallel to slightly convergentin case of non-blunderbuss apex. Therefore, the apex can be broad shaped or convergent.

Among the two types of open apex the treatment of immature permanent tooth having blunderbuss canal can be an endodontic challenge because of difficulty in obtaining mechanical preparation, canal disinfection, lack of tapered root canal apical seal, and existing thin radicular walls which are susceptible to fracture[2]. Open apices are a problem for the root canal treatment because there are high chances of extravasation of irrigating solution and/or sealer into periradicular tissues, and this can have a negative effect on the apical healing process [3].

Studies have shown that the endodontically treated immature tooth is more prone to fracture than its fully developed root filled counterpart, and as such there is presently an abundance of researchers exploring the notion of continued root development of the immature tooth with a necrotic and infected pulp[4].

Over the years different treatment modalities were applied in open apex cases like custom made guttapercha, apexification, reverse cone guttapercha, thermoplastisized obturation, surgical retrograde filling, creation of immediate apical barrier by biomimitic materials and revascularization[5].

Large open apices have shown challenges in determining the working length, decision on the necessity of root canal preparation, and achieving control during obturation. This article describes the causes of open apex, ways to determine the working length, instrumentation and obturation in tooth with open apices.

CAUSES OF OPEN APICES

Caries or trauma causes pulpal necrosis which can lead to incomplete root development. Studies have revealed that 30% of children are affected by a traumatic dental injury, with the majority occurring before complete formation of the root [6]. Both foraminal and peri-foraminal resorption of the root end may also arise in the presence of a periapical lesion[7]. Poor control of working length and subsequent enlargement with both hand and rotary files can give rise to iatrogenic enlargement of the root end.

DETERMIMING WORKING LENGTH

It is essential to use a file when using an electronic apex locator to measure working length in such cases. The paper point technique can be performed as a supplement to initial apex locator readings for the working length determination of open apices in relatively straight canals[8]. According to an in vivo study,this technique in establishing working length to within 0.5mm of the apical foramen showed 87 per cent accuracy [9]. A tactile method involving the use of a size 25 K-file bent at the tip, with its orientation marked with a silicone ring was proposed by El Ayouti[10]. 95% of cases in the study were accurate to within 0.5mm of the apical foramen.

NEED OF INSTRUMENTION

In the procedure adequate levels of disinfection is compromised as ‘aggressive’ instrumentation is contraindicated. Hence, endodontic irrigants and medicaments play a vital role in the disinfection of teeth with open apex[11].As instrumentation can weaken the thin root walls of teeth with open apex.

Techniques to obturate Open apex:[12]

1. Necrosed pulp:
    a) Calcium hydroxide apexification
    b) One- step apexification

a. With Matrix(Hydroxyapatite matrix, Collagen matrix, PRF matrix) with MTA OR Biodentine barrier and followed by obturation with Guttapercha
b. Without matrix with MTA OR Biodentine barrier and followed by obturation with Guttapercha
c. Tailormadeguttapercha

2. Vital pulp
    a) Apexogenesis

1. Necrosed pulp-

a) Calcium hydroxide apexification:

Atechnique which involves inducing a calcific barrier in a root with an open apex or inducing continued apical development of an incompletely formed root in teeth with necrotic pulps is called Apexification[13].

Frank first described the calcium hydroxide apexification technique in 1966[14]. He suggested placement of calcium hydroxide with CMCP, with the calcium hydroxide to be replaced every 3 months until an apical barrier was formed which could take up to 24 months.The calcium hydroxide apexification technique is simple. Once working length is established radiographically, light filing is donewith copious irrigation using 0.5% sodium hypochlorite (NaOCl) to facilitate the removal of necrotic pulp tissue[15]. Sterile paper point is used to dry the canal. This isfollowed by placement of calcium hydroxide, which can be mixed with saline, sterile or distilled water.

There is possibility of delayed healing due to washing out of single application of Calcium hydroxide medicament. Hence, it is recommended to replace calcium hydroxide every 2 to 3 months for over 5 to 6 appointments[16].

Apexification does not promote continued root development with calcium hydroxide. Achieving complete apical seal in teeth with open apices using Calcium hydroxide is still debatable due to the formation of porous callus bridge with “Swiss cheese” appearance. The formation of apical barrier can take long time and depends on the size of the lesion and patient's age [17].It is reported that long-term calcium hydroxide dressings could increase the risk of root fracture[2].

Although multiple visit calcium hydroxide apexification technique shows some disadvantages, the clinician should keep in mind that this method is a reliable and simple technique to carry out and therefore should not be eliminated as newer materials or techniques are proposed.

b) One- step apexification

With traditional treatment procedures it takes at least 3–4 months with multiple appointments, poor patient compliance and fail to return for scheduled appointments, temporary seal may fail resulting in reinfection and prolongation or failure of treatment. Hence, one-visit apexification has been suggested to treat open apices. The nonsurgical condensation of a biocompatible material into the apical end of the root canal is defined as One-visit apexification[18].The aim of this procedure is to establish an apical stop. This will enable the root canal to be filled immediately. Numerous materials have been proposed including tricalcium phosphate, calcium hydroxide, freeze-dried bone and freeze-dried dentine, MTA, and biodentine for this purpose.

a. With Matrix(Hydroxyapatite matrix, Collagen matrix, PRF matrix) with MTA or Biodentine barrier and followed by obturation with Guttapercha.

MTA among many other materials for root-end closure, has become material of choice for Apexification. MTA has a range of advantages such as biocompatibility, hard tissue formation, sealing ability, and antibacterial property [19].

An article comparing MTA and calcium hydroxide for apexification in dogs and found that MTA has maximum ability to form an apical barrier [20].It also concluded that it reduces root fracture. It shows certain disadvantages which includes long-setting time, poor handling characteristics, low resistance to washout before setting, possibility of staining tooth structure, properties and strength. Biodentine shows better handling propertypresence and release of arsenic, and its high cost [21].

These disadvantages lead to the introduction of various new materials. One among them is Biodentine. It has composition similar to MTA with the addition of setting accelerators like calcium chloride. It results in fast setting of the material but also improves handling, does not require a two-step obturation as setting time is faster and shows lower risk of bacterial contamination when compared to MTA[22].

A variety of synthetic and autogenous materials such as calcium sulfate, resorbable collagen, hydroxyapatite, dentin chips and collagen membranes have been tried as an internal matrix [23].Autogenous materials are usually used than synthetic materials. As there is minimal possibility of allergic reactions with Autogenous materials, and aids in wound healing, unlike their synthetic counterparts.

PRF is an autologous, biocompatible, immune fibrin biomaterial which causes optimal wound healing [24]. It has the ability to cause rapid angiogenesis, quicker remodelling of fibrin network, stimulates osteoblasts, fibroblasts, periodontal ligament cells and also activates stem cells from the dental pulp and periodontal ligament [25].This occurs due to the release of growth factors like platelet-derived growth factor, transforming growth factor-beta, platelet-derived growth factor and vascular endothelial growth factor from PRF. Moreover, this does not offer pressure – resistant support which is necessary for the application of freshly mixed MTA.

b. Without matrix with MTA or Biodentine barrier and followed by obturation with Guttapercha

Apexification with Biodentine requires significantly less time. A study evaluated the pH and calcium ion release of MTA and Biodentine and concluded that Biodentine presented alkaline pH and released calcium ions similar to that of MTA [26].

c. Tailor made guttapercha

Gutta-percha obturation with lateral compaction is not the technique of choice for open apices. It is due to lack of resistance of the thin fragile dentinal walls to lateral pressure, as the procedure involves a greater force for compaction of Gutta-percha[27]. Henceforth, customization of an obturator to match the canal volume without lateral compaction will be attempted using PMMA, and shows excellent biocompatibility with tissues [28]. Furthermore, the inherent ability of these acrylic resins to be custom formulated has enabled to tailor-make a heat polymerized acrylic resin, as an endodontic obturating material.

2.Vital pulp

a) Apexogenesis

Recently, regenerative endodontic procedures have drawn much attention. The advantage of this treatment option over apexification is that it allows root maturation to continue by generating vital tissue [29].

Regeneration should occur in the presence of a suitable scaffold therefore, the blood clot in the apical part of the canal can act as a scaffold and might also contain growth and

differentiation factors which might be crucial for successful proliferation and differentiation of stem cells [30].

In the case of apexogenesis, one day after the pulpotomy procedure, the tooth is restored by using dentin-bonding composite resin. In the revascularization case, a double seal over the blood clot, MTA and a resin-bonding restoration, recommended in several studies is used[30].

2. CONCLUSION

Despite different treatment modalities the treatment outcome depends on diameter of open apex, thickness of root dentin, disinfection, shape of root canal, periapical tissue response to obturating material and duration of treatment.Hence, the clinician should evaluate all the parameters to determine suitable treatment option of cases presenting teeth with open apices.

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