Apexification

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ABSTRACT

Apexification is a method to induce a calcific barrier across an open apex of an immature, pulpless tooth. Apical closure occurs approximately three years after eruption. Traumatic injuries to young permanent teeth before root formation is complete commonly occur in children resulting in open apex. This can be treated by Surgical or Non - Surgical treatment modalities. Non surgical treatment modalities include various methods such as Customized cone, Short fill technique, Apexification with various materials and One visit apexification. Various materials that can be used for apexification include Calcium hydroxide, MTA, Tricalcium phosphate, Dentin chips, Calcium phosphate ceramics and hydroxyapatite and bone morphogenetic proteins. Calcium hydroxide is the most common and traditional material employed for inducing apexification. This is a multivisit technique requiring six months to four years to complete.

Key words: *Apexification, Calcium hydroxide, Open apex.*

INTRODUCTION

Apexification is a method to induce a calcific barrier across an open apex of an immature, pulpless tooth.1 It is the process in which an environment is created within the root canal and periapical tissues after death of pulp, which allows a calcified barrier formation to occur on an open apex. An open apex due to the absence of sufficient root development to provide a conical taper to the canal is called Blunder Buss canal. Apexogenesis can also be defined as the treatment of a vital pulp by pulp capping or pulpotomy in order to permit continued physiological closure of open apex and growth of root.

ETIOLOGY OF OPEN APEX

Hertwigs epithelial root sheath responsible for determining the shape of the root surrounds the apical opening to the pulp and eventually becomes the apical foramen. Apical closure occurs approximately 3 years after eruption. Traumatic injuries to young permanent teeth before root formation is complete commonly occur in children.

DIAGNOSIS & CASE SELECTION

The usual cause of endodontic involvement in a tooth with an incompletely developed root is trauma. A detailed history and documentation of any injury is of prime importance from both diagnostic and treatment point of view. Radiographic interpretation is difficult because a radiolucent area normally surrounds the developing open apex of an immature tooth with a healthy pulp.

TREATMENT OPTIONS:

Two basic types of treatment modalities are:

1. Surgical Methods
2. Non - Surgical methods

Surgical methods:

For many years, the problem of blunderbuss apex; particularly if the pulp was necrotic or a periapical lesion was present; was treated surgically. Dawood and Pittford (1989)2 reported that obturation of the root canal with thermoplasticed Gutta Percha followed by periapical curettage can be clinically successful.

Non - surgical methods:

There are various methods:

1. Customized cone (blunt - end, rolled cone).
2. Short fill technique.
3. Apexefication with various materials.
4. One - visit apexification.

Apexification with various materials for establishment of an apical barrier was first proposed by Kaiser (1960)3. However, opinions differ on the use of medication. Nygaard – Ostby4 hypothesized that laceration of periapical tissue until bleeding occured might produce new vital vasularized tissue in the canal. Mc Cormick and Moller5 suggested that removal of the infected pulp tissue should create an environmental conducive to apical closure without use of a medication.

Although a variety of materials have been proposed for induction of apical barrier formation, Calcium Hydroxide has gained the widest acceptance. Kaiser (1964)3 first introduced Calcium Hydroxide in apexification mixed with CMCP which was later popularized by frank. Klein & Levy (1974)5 used Calcium Hydroxide and Cresatin.

Other materials used are MTA, Biphasic calcium phosphate, Hydroxyapatite and dentin chips. Nevins (1978) suggested use of collagen-calcium phosphate gel.

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MATERIALS USED FOR APEXIFICATION

A) CALCIUM - HYDROXIDE

It was introduced to dentistry by Hermann in 1920. Use of Calcium Hydroxide for apical closure was reported first by Granath (1959) and later by Frank (1966)6. Usual time required for apexification is 6 to 24 months. During this time the patient is recalled at 3 month intervals for monitoring of the tooth. A calcium hydroxide paste for use in endodontics is composed of the powder, a vehicle and a radiopacifier. According to Fava (1991)7 ideal vehicle should 1) Allow a gradual and slow Ca++ and OH- ionic release, 2) Allow slow diffusion in the tissues with low solubility in tissue fluids and 3) Have no adverse affect in the induction of hard tissue deposition.

Histology of apexification with calcium hydroxide Calcified material that forms over the apical foramen has been histologically identified as an osteoid and cementoid. Histologically there appears differentiation of adjacent connective tissue cells into specialize cells; there is also deposition of calcified tissue adjacent to filling material. The closure of apex may be partial or complete, but consistently has minute communications with the periapical tissues. The root development after apexification procedures generally results in a somewhat different shape then the configuration of the root after normal development.

B) M.T.A. It was first introduced in 1993 by Torabinejad et al8 and received food and drug administration approval in 1998. MTA provides scaffolding for the formation of hard tissue and the potential of a better biological seal. The material consists of Tricalcium silicate, Tricalcium aluminate, Tricalcium Oxide, Silicate Oxide. It is a hydrophillic material that has three hour setting time in presence of moisture. MTA advantage includes excellent sealing ability, good compressive strength and a good biocompatibility and cementum and PDL regeneration.

C) TRICALCIUM PHOSPHATE - Coviello and Brilliant (1979)9 reported use of tricalcium phosphate as an apical barrier. The material was packed into the apical 2mm of canal against which Gutta percha was condensed and treatment is achieved in one appointment.

D) DENTIN CHIPS - It was used to create an apical stop or matrix for the purpose of obtaining a biologic apical seal.

E) CALCIUM PHOSPHATE CERAMICS AND HYDROXYAPATITE: Higashi and Okamoto (1996)10 reviewed the use of calcium phosphate ceramics and hydroxyapatite as potential agents. They studied the particle size affects of hydroxyapatite and - tricalcium phosphate in the success of hard tissue formation. Ostodentin and tubular dentin formation occured around large particles in contrast to small particles.

F) BONE MORPHOGENETIC PROTEINS - Bone morphogenetic proteins 2 to 8 belong to TGF - that are signalling proteins that regulate cell differentation. BMP 2 and 4 have been implicated in odontoblastic differentiation.

ONE VISIT APEXIFICATION

It is the non - surgical condensation of a biocompatible material into the apical end of the root canal. The rationale is to establish an apical stop that would enable the root canal to be filled immediately. There is no attempt at root end closure. Rather an artificial stop is created.

A number of materials have been proposed for this purpose. They include

1) Tri Calcium Phosphate
2) Freeze dried bone
3) Freeze dried dentin
4) MTA

Fig.1
Pre-Operative radiograph showing periapical radiolucency along with open apex with respect to maxillary left central incisor

Fig.2
Radiograph showing working length determination.

Fig.3
Radiograph showing Ca(OH)2 dressing.

Fig.4
Six months follow up.

Fig.5
Post obturation radiograph.

CASE REPORT

A 9 year-old boy was brought to the department with the chief complaint of pain in the maxillary anterior region. He had suffered dental trauma one year back. Intraoral examination revealed Ellis class II fracture with respect to maxillary left central incisor. The tooth exhibited tenderness on percussion. An intraoral periapical radiograph revealed

an open apex along with periapical radiolucency(Fig 1). Apexification was planned. After isolation, conventional access cavity was prepared and the necrotic tissue was removed with the help of barbed broach. Working length was determined slightly short of the radiographic apex (Fig 2). Instrumentation was performed with circumferential filing motion aided with copious irrigation. Large sterile paper points were used to dry the canal .The canal was then filled with calcium hydroxide paste in a pre mixed syringe and sealed temporarily with IRM (Fig.3). Immediate post operative radiograph was taken to confirm the presence of calcium hydroxide in the canals .The patient was kept on 3 months recall and on every visit the radiograph was taken (Fig.4). It took 9-12 months for the complete apical barrier to be formed. Once the apex was formed obturation was done (Fig 5).

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