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Creating Apical Mineral Trioxide Aggregate (MTA) Plug Using Gutta Percha (GP) Points in Apexification- A Viable Option

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Abstract

Apexification is a method of inducing root end closure of an incompletely formed non vital permanent tooth. The coronal and radicular pulp tissue is removed just short of the root end and the canal is filled with a suitable biocompatible material such as calcium hydroxide or mineral trioxide aggregate (MTA). Calcium hydroxide requires replacement after regular time intervals with a fresh replacement whereas treatment with MTA is a single step procedure. Creation of an MTA plug at the root apex by various methods has been tried and reported in the literature by different authors. In this article, a simple, feasible and inexpensive method to form an apical MTA plug using gutta percha point has been discussed.

Keywords: Apexification; Mineral trioxide aggregate; Gutta percha

Abbreviations: MTA: Mineral Trioxide Aggregate; IRM: Intermediate Restorative Material: GP: Gutta Percha.

Introduction

The completion of root development and closure of the apex occurs at around three years after eruption of the tooth [1]. The treatment of pulpal injury during this period proves to be a significant challenge for the clinician. Depending upon the vitality of the affected pulp, two approaches are possible: apexogenesis or apexification. Apexification is defined as a method to induce a calcified barrier in a root within an open apex or the continued apical development of an incomplete root with necrotic pulp [2].Formation of a physical apical barrier is essential to facilitate obturation of the tooth [3]. Different techniques of apexification have been suggested. The most common being calcium hydroxide for an undetermined period of time [4,5]. Mineral trioxide aggregate (MTA) has been suggested for apexification because it provides an adequate seal in the root canal and it appears to also offer a biological active substrate that stimulates periodontal cell production [6,7]. It is composed of tricalcium silicate, tricalcium aluminate, tetracalcium aluminoferrite, calcium, sulfate, dihydrate and silicate oxide. In a moist environment, the setting time of MTA is approximately 4 hours [8]. Its compressive strength is equal to intermediate restorative material (IRM) and Super-EBA but less than that of amalgam [9]. MTA is commercially available as ProRoot MTA (Dentsply Tulsa Dental, Tulsa, OK). It has been used in the immediate obturation of open apex teeth. MTA has the ability to induce cementum-like hard tissue when used adjacent to the peri-radicular tissues [10]. Moisture contamination at the apex during apexification procedure of the tooth before barrier formation has often been a major problem seen with other materials. As MTA is hydrophilic, the presence of moisture and specifically blood does not affect its sealing ability [11,12]. There are encouraging results reported for MTA when it has been used as a root canal end filling material [13]. Delivery of MTA has been carried out by syringe type devices. In certain complicated situations these devices may be difficult to use. The present article discusses an alternative method with the use of gutta percha (GP) points to form an apical MTA plug.

Materials and Methods

Routine access opening of the root canal and establishment of the exact working length should be carried out first. Working length is established radio graphically by inserting a snugly fitting reamer into the canal. In case the reamer is loose, in wide canals of immature teeth, cotton-fibers are wrapped around the reamer to make it fit in the root canal so that during the radiographic procedure, it does not move from the inserted position. After the radiograph is taken, the exact length of root canal is calculated using routine formula i.e.

$$\text{Exact length of root canal} = \frac{\text{exact length of the reamer x radiographic length of root canal}}{\text{Radio graphic length of reamer}}$$

After due biomechanical preparation and sterilization of root canal, $Ca(OH)_2$ is pushed for 7 days as described by Torabinejad to reduce the bacterial count, this also helps to initiate the osteogenic process on the subsequent appointment. The $Ca(OH)_2$ is washed and reamered off. This is followed by selection of appropriate GP point. The GP point should be inserted into the root canal with the butt end towards the apex to a length of 3 to 4 mm short of its exact working length (Figure 1). It should fit snugly into the canal. In case it is loose, a few GP points, as required, should be rolled on to a heated glass slab and joined together so that the aforementioned criterion of "snuggly fitting" is achieved. On this GP point, a mark is made with a permanent marker 3 to 4mm short of the exact length of the root canal in reference to the incisal edge/point. A silicon stopper is placed at this mark (Figure 2). A freshly prepared granular mix of ProRoot MTA in distilled water is placed at the root canal opening with the help of a plastic filling instrument in small instalments. Each increment of the mix is pushed apically by repeated vertical agitation of the marked GP point previously mentioned, taking care that it does not slip past the silicon stopper. By this method a root end barrier of 3 to 4 mm is expected to be created (Figure 3). After inserting MTA, a moist cotton pellet is left in the canal in close contact with MTA to facilitate its setting and the access opening is sealed with ZOE. The adequacy of MTAs insertion is confirmed with an immediate postoperative radiograph. If needed, the procedure is repeated. After three to four days the wet cotton pellet is taken out and the apical plug of MTA is checked for its set and hardness with the help of reamer. Obturation of the root canal is carried out over the hard setting apical plug.

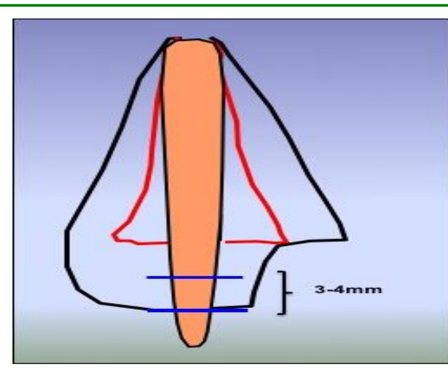

Figure 1: The GP point is inserted into the root canal with the butt end towards the apex, a mark is made with a permanent marker 3 to 4mm short of the exact length of the root canal in reference to the incisal edge/point.

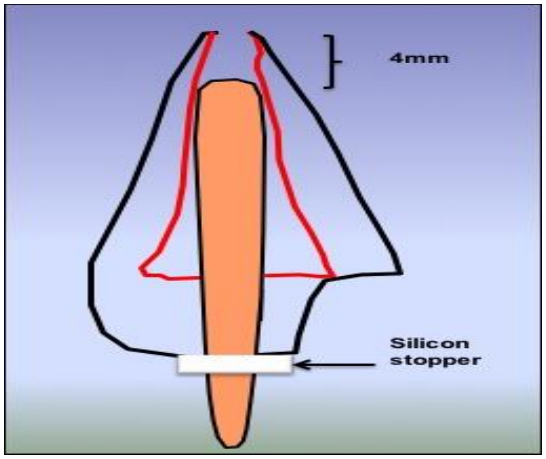

Figure 2: A silicon stopper is placed at the mark, 3 to 4mm short of the exact length of the root canal in reference to the incisal edge/point.

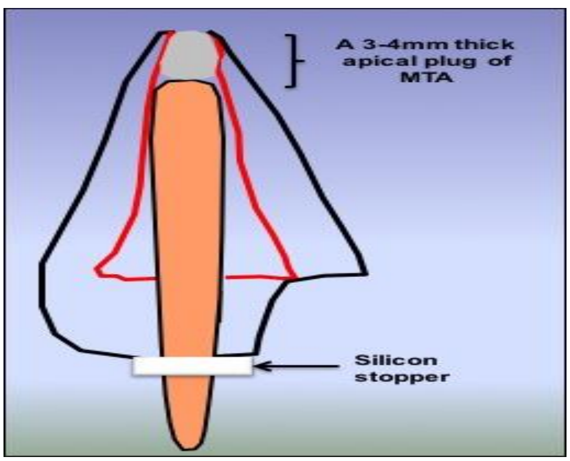

Figure 3: Root end barrier of 3 to 4 mm thick MTA plug is created.

Results

The method described in this article uses a GP point to condense MTA at the apical end. The butt end of the GP point can be used in case of blunderbuss canals. MTA is carried to the root canal with the help of a plastic filling instrument in small instalments. This is an easy and cost effective method as it does not require any special armamentarium and can be mastered with minimal practice. Moreover, this technique gives the operator an enhanced tactile perception and precise thickness of the MTA plug.

Discussion

Successful outcome of endodontic therapy is dependent on hermetic sealing of the canals. This is achieved by the introduction of an obturating material into the root canal which is then thoroughly compacted. The first requisite for proper root canal obturation is the development continuously tapering conical form, with cross sectional diameter progressively diminishing in the corono-apical direction. This can be easily achieved in mature permanent teeth in which there is an apical constriction and the canal tends to be wider coronally than apically. In contrast, teeth with immature apices do not have this apical constriction; instead the apex is very wide. The canal walls may be parallel or even diverge corono-apically, depending on the degree of maturity. In the latter, so called blunderbuss canal, the apex is even wider than the widest portion of the canal, such that its shape is exactly the opposite of the required shape.

In such cases, it is not possible to compact any type of obturating material into the root canal without an excess of obturating material being expressed beyond the apex [3]. Therefore, prior to undertaking routine endodontic therapy, apical barrier needs to be created. The clinician must stimulate the maturation of the apex or the formation of a matrix against which the obturating material can be compacted in the traditional manner.

In the case of an immature apex and necrotic pulp, the treatment is referred to as apexification with the objective being induction of a calcific barrier at the open apex against conventional obturating materials. After the calcific barrier is formed the obturating material may be condensed without overfilling. MTA is Endodontic cement that is extremely biocompatible, hydrophilic material, capable of stimulating root healing and osteogenesis [10]. MTA has an ability to facilitate normal periradicular architecture by inducing hard tissue barriers. Formation of cementum surrounding MTA was observed even after the extrusion of MTA into furcation [14]. On the basis of these findings, MTA is considered to be an appropriate material for sealing immature root canals with open apices which otherwise impose many technical challenges in obtaining an adequate obturation.

A successful prognosis from conservative, nonsurgical treatment with MTA for such difficult cases can be of great benefit to the patient. Due to the slow setting time, the initial looseness of the MTA after mixing can make the material difficult to manage. Delivery of MTA has focused mainly on the carrier and syringe type devices such as the Retro Amalgam Carrier, the Messing Root Canal Gun, the Centrix syringe and ultrasonic methods [15-18]. In certain situations these devices may be difficult to use. There is also a need to have additional armamentarium while using these techniques.

Amainoshariae et al examined the adaptability of MTA to the walls of plastic tubes by simulating root canal walls using hand placement and ultrasonic methods [19]. Samples were evaluated with a light microscope and radiograph for the degree of adaptability of MTA to the tube wall and for the presence of voids within the MTA material itself. They found that hand condensation resulted in better adaptation to the tube walls and fewer voids than the ultrasonic method. Pradhan et al have used this technique to form the MTA plug in many cases. They have also compared MTA and calcium hydroxide for its efficacies, time taken for formation of apical biological calcific barriers, resolution of periapical radiolucencies in teeth with unformed apices and have reported favorable results [20].

Conclusion

The technique for formation of MTA plug using GP points in apexification can be considered as a viable option in routine clinical practice as it does not require any special armamentarium. This also makes it cost effective. The technique gives the operator an enhanced tactile sense and can be easily mastered by the operator.

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