

# CLINICAL OUTCOME OF MTA APICAL PLUG AND MTA MONOBLOCK TECHNIQUE FOR APEXIFICATION OF NON-VITAL IMMATURE PERMANENT INCISORS. IN VIVO STUDY

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## ABSTRACT

**OBJECTIVE:** To compare the clinical outcome between mineral trioxide aggregate apical plug and mineral trioxide monoblock technique of endodontic apexification procedure of non vital permanent incisors with open apices.

**STUDY DESIGN:** Clinical in vivo Cross sectional comparative study

**PLACE AND DURATION:** Endodontic department/College of Dentistry Ziauddin University, Karachi. Study duration was from January 2010 to January 2013.

**METHODOLOGY:** Total fifty patients of male or female visited Endodontic department with non vital permanent maxillary incisors with open apices were selected. The selected teeth were divided into 2 groups by simple random method. Group A was treated with MTA apical plug technique and the group B was treated with MTA monoblock technique. The assessment of clinical outcome was carried out at 12 and 24 month follow-up appointments. The presence of signs and symptoms with treated cases were considered as clinical failure, while treated cases without symptoms were considered as clinical successful cases. The treated cases were also checked radiographically according to the published criteria of evaluation and categorized as successful, uncertain outcome and failure cases. The recorded data were analyzed by using the statistical software.

**RESULTS:** The results of the study showed clinical success in both group and radiographic success was found to be 68% and 76% in MTA apical plug group and 84% and 92% in MTA monoblock group at 12 and 24 months intervals.

**CONCLUSION:** This study have showed no significant difference in clinical outcome of MTA apical plug and mineral trioxide monoblock technique for endodontic apexification procedure of non vital permanent incisors with open apices.

**KEY WORDS:** Mineral Trioxide Aggregate, Necrotic Pulp, Apical Plug, Monoblock Obturation

## INTRODUCTION

The full formation of root and closure of root apex normally happens likely to 2 or 3 years following eruption of the tooth.<sup>1</sup> Pulp necrosis of teeth with open apices ceases further root formation and closure of root apex cannot be achieved. The endodontic root canal treatment of non vital teeth with open apices is a significantly challenging task.<sup>2</sup> The large canal size, the thin weak dentine walls of root canal and the wide open apex are difficult aspects for root canal treatment procedures.<sup>2</sup> Apexification technique was introduced and defined as 'a method to incite a calcified barrier in a immature root or the continued apical development of an incomplete root in teeth with necrotic pulp and open apices.<sup>3</sup> The objective of this procedure is to get an apical stop to impede the movement of toxins and bacteria from the root canal in to the periapical area and allow the compaction of the obturation? lling material in

immature teeth with open apex.<sup>4</sup>

There are different treatment options such as apexification technique using calcium hydroxide ,one-visit MTA apical plug Apexification, MTA Monoblock obturation technique, retrograde filling, revascularization to induce the root closure (if the patient is in growing age).<sup>5</sup>

Traditionally calcium hydroxide is documented as the ideal material and material of choice for apexification procedure .6Many authors have reported the efficiency of calcium hydroxide for apexification procedure.<sup>7,8</sup> Despite this high success rate, there are several disadvantages to this technique.<sup>9</sup> Multiple appointments, patient compliance issues<sup>10</sup>, susceptibility of tooth to fracture and coronal microleakage are important negative factors.<sup>11</sup>

Variety of materials have been suggested to obtain artificial apical barriers as an alternative to traditional Ca(OH)<sub>2</sub> apexification.<sup>12,13</sup> The application of mineral trioxide aggregate (MTA) as an artificial apical barrier has been documented in published article by Torabinejad and Chivian in 1999.<sup>14</sup> Now a days it has become the material of choice in artificial apical barrier procedures.<sup>15</sup> The popularity of MTA as an artificial apical barrier can be attributed to several factors. MTA is biocompatible.<sup>16</sup> It can induce the formation of hard tissue.<sup>17</sup> It has good sealing properties.<sup>18</sup>

The Monoblock obturation technique or packing of the entire root canal system of immature teeth with MTA is the recent treatment option. It is the logical advancement in the evolutionary application of this material for endodontic apexification of non-vital teeth with open apices. The monoblocks created in the root canal spaces are documented in

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the literature, as primary, secondary or tertiary type monoblock.<sup>19</sup> According to this classification, Mineral Trioxide Aggregate Monoblock obturation is categorized an example of the primary monoblock.<sup>19</sup> Previous study found that MTA obturation stimulate the mesenchymal stem cells from the apical papilla in immature non vital teeth and promote apexogenesis.<sup>20</sup> Recent data have reported that MTA monoblock obturated teeth showed higher fracture resistance as compared to untreated counterparts.<sup>21</sup>

Previously only case reports of mineral trioxide aggregate apical plug and mineral trioxide monoblock technique have been documented.<sup>22-24</sup> We didn't find any published clinical study that evaluate and compare the clinical and radiographic outcome of mineral trioxide aggregate apical plug and mineral trioxide monoblock technique for endodontic apexification procedure of non-vital permanent central and lateral incisors with open apexes. So the aim and objective of this study was to determine and compare the clinical outcome of mineral trioxide aggregate apical plug and mineral trioxide monoblock technique for endodontic apexification procedure of non vital permanent central and lateral incisors with open apexes.

## METHODOLOGY

The study was conducted at the Department of Endodontics/College of Dentistry Ziauddin University, Karachi Pakistan from January 2010 to January 2013. It was a cross sectional comparative study. The objective was to determine the clinical and radiographic outcome of mineral trioxide aggregate apical plug and mineral trioxide monoblock technique for apexification procedure of non vital immature permanent central and lateral incisors. The ethical review committee granted ethical consent prior to initiation of the study. The fifty patients were selected as follows. All the patients of either gender presented with non vital permanent maxillary central and lateral incisors with open apexes were selected. The included patients were aged 15 to 20 years. The patients presented with root fracture, internal or external resorption of the teeth were excluded from the study. An informed consent was taken for every patient. First during screening medical and dental history was taken and clinical diagnosis was made on the basis of clinical and radiographic examinations. The patients that did not fulfill the inclusion criteria were excluded. Signs and symptoms of affected teeth were recorded during clinical examination. Clinical signs of pain on percussion, pain on palpation of the apical area and existence of sinus tract were determined. Similarly the use of analgesics to control symptoms and discoloration of one or more permanent incisors were also determined and recorded in data.

The selected patients were randomly divided into two groups: Group A MTA apical plug technique and Group B MTA monoblock technique

Group A: For this group treatment was done in three visits. Standard endodontic procedure was performed. The root canal of teeth was accessed, prepared and irrigated on the first visit. Radiographic method of working length determination was

applied for working length of canal. The canals were dried and filled with calcium hydroxide (Ultradent, USA) and the Cavit (3M ESPE, Asia) was used to fill the access cavity of teeth. The root canal was re-opened on second visit and mixing of MTA was done as per the manufacturer instructions. MTA was placed into the root canal by MTA carrier. Appropriate pluggers were used for gentle condensation of MTA and formation of apical plug. Pre measurement of pluggers was done 4mm short of the working length with the help of rubber stoppers and correct thickness of the MTA was established. Correct placement of material was confirmed by taking periapical radiograph. In case of inadequate placement, the root canal was re-opened and the material was removed and cleaned out by irrigation and material was replaced. After placement of MTA apical plug the pulp chamber was packed with a moist cotton pellet on which dry cotton pellet was placed. After that restorative glass ionomer material (Ketac-fil) was used to pack the access cavity. On the third visit, the obturation of remaining part of root canal was done by using gutta-percha and the composite resin was used for restoration of access cavity. Evaluation of obturation was done by taking post operative periapical radiograph. One case of this technique can be seen in Figure-I

Group B:

For this group, the same procedures were followed for first visit but in the second visit MTA was mixed, as recommended by the manufacturer, and the whole canal was filled with MTA by using MTA monoblock obturation technique as used previously.<sup>23</sup> MTA was mixed in a dappen dish and transferred into the pulp chamber with the help of amalgam gun. K-file, 1 size smaller than the MAF was attached to an apex locator and moved along the canal glide path with an apical pumping motion. The apex locator was removed once the apical barrier was formed and the depth of the canal glide path was reduced. The MTA can thereafter be circumferentially pumped more aggressively without risk of extrusion. After MTA placement into the whole the canal orifice and pulp chamber was packed with a sterile sponge pellet moistened with sterile water and the access cavity was filled temporarily. Correct placement of MTA was confirmed by taking periapical radiograph. At the next appointment, the access cavity was filled and the teeth were restored with composite restoration. One case of this technique can be seen in figure II.

Cases were reviewed post operatively at the 12 and 24 month recall appointments and clinical outcome was determined by clinical and radiographic assessment. Preoperative radiographs and post operative radiographs at the follow-up appointment were assessed. The following clinical criteria were determined:

- Pain reported by the patient immediately after or since the root canal obturation.
- Any use of Analgesics for the relief of pain
- Tenderness on palpation felt by the patient and findings of abscess formation
- Tenderness on percussion felt by the patient

The presence of above signs and symptoms in treated cases were considered as clinical failure, while absence of above signs and symptoms were considered as clinical successful.

Radiographs were also used to assess the treated cases

radiographically according to the published criteria of evaluation<sup>25</sup> and categorized as successful cases, uncertain outcome cases and failure cases.

The following criteria are used for radiographic assessment:

**a) Successful cases:**

- Presence of normal periodontal ligament space,
- The periapical lesion reduced in size as compared with preoperative radiographs,
- No evidence of inflammatory root resorption.

**b) Uncertain outcome cases:**

- The periapical radiolucent area had remained the same and had not reduced in size.

**c) Failure cases:**

- The periapical lesion had increased in size,
- New lesion that had evolved after the placement of the root filling
- Evidence of continuing root resorption.

The recorded data were analyzed by using the statistical software (SPSS, Version 20, SPSS Inc., Chicago, IL, USA). Descriptive statistical analysis of all variable recorded in the data were obtained.

## RESULTS

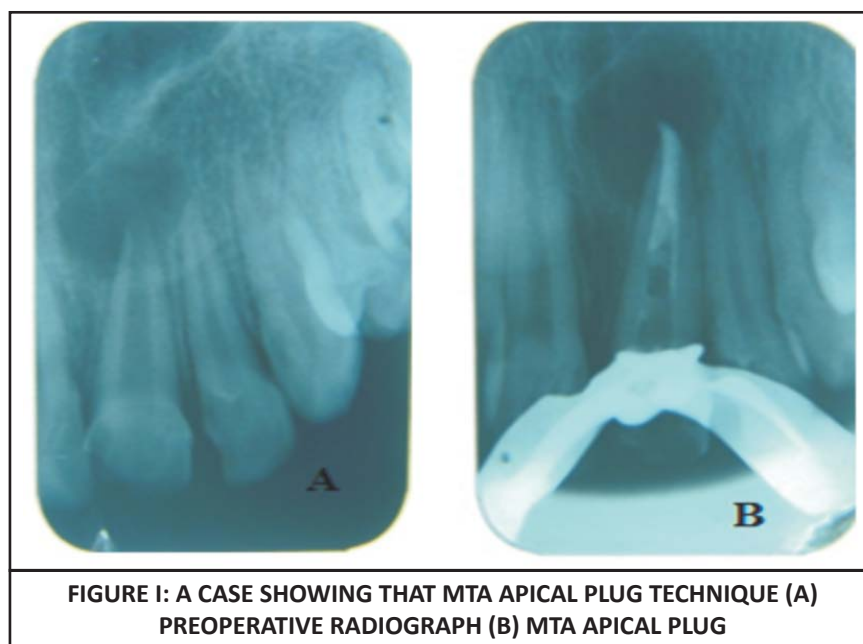
Fifty patients were selected for this study. Fifty patients comprised of 26 male (52%) and 24 (48%) females. The mean age was  $15 \pm 2.49$  ( $X \pm SD$ ) years. Total 50 permanent incisors were treated in this study in which 30 teeth (60%) were upper central incisors and 20 (40%) were upper laterals (Fig-III).

The descriptive statistics of recorded data for follow up clinical signs and symptoms and radiographic outcome were tabulated and statistical calculations were performed. The absence of signs and symptoms associated with treated teeth determined the Clinical success after treatment. Radiographic criteria were

used for determination of successful cases as described in the beginning of the study. This study was found no teeth with any pain before treatment. None of the patients were reported used of analgesics before obturation of the root canal and similarly none of the included patients reported tenderness to palpation or percussion before obturation. This study was found that 8 of 25 teeth (32%) reported pain after the final obturation in MTA apical plug group and 3 of 25 teeth (12%) reported pain in MTA monoblock group on the first postoperative visit and analgesics was required to relief the pain. In this study 7 of 25 teeth (28%) showed tenderness to palpation in MTA apical plug group and 1 of 25 teeth (4%) showed tenderness to palpation in MTA monoblock group. Similarly in this study 8 of 25 teeth (32%) showed Tenderness to percussion in MTA apical plug group and 4 of 25 teeth (16%) showed Tenderness to percussion in MTA monoblock group. Table I showed teeth distribution presenting with signs and symptoms after obturation of canal

Radiographic assessment was also done in all treated cases after MTA placement and final obturation. Patients were recalled for follow up at 12 months and 24 months intervals. The results of this study showed that seventeen cases (68%) were rated as successful, five cases (20%) uncertain outcome and three cases (12%) unsuccessful in MTA apical plug group at 12 months, (Fig-IV). Similarly, this study showed that twenty-one cases (84%) were rated as successful, three cases (12%) uncertain outcome and one case (4%) unsuccessful in MTA monoblock group at 12 months (Fig-IV)

Radiographic outcome of cases in both groups were also assessed at 24 months. The results showed that nineteen cases (76%) in MTA apical plug group were rated as successful, while two cases were determined with an uncertain outcome (8%). Four cases were unsuccessful (16%) (Fig-V). In MTA monoblock group twenty-three cases (92%) the treatment was rated as successful, while two cases were unsuccessful (4%). (Fig-V)



**FIGURE I: A CASE SHOWING THAT MTA APICAL PLUG TECHNIQUE (A) PREOPERATIVE RADIOGRAPH (B) MTA APICAL PLUG**

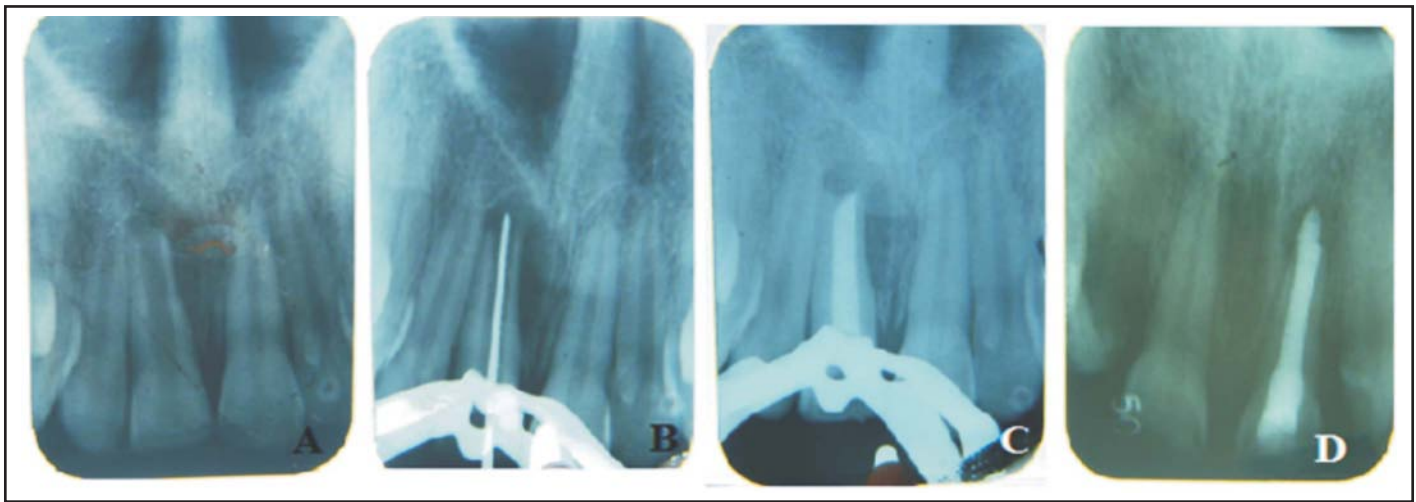


FIGURE-II: A CASE SHOWING MTA MONOBLOCK TECHNIQUE (A) PRETREATMENT RADIOGRAPH (B) WORKING LENGTH RADIOGRAPH (C) ONE YEAR FOLLOW-UP (D) TWO YEAR FOLLOWUP.

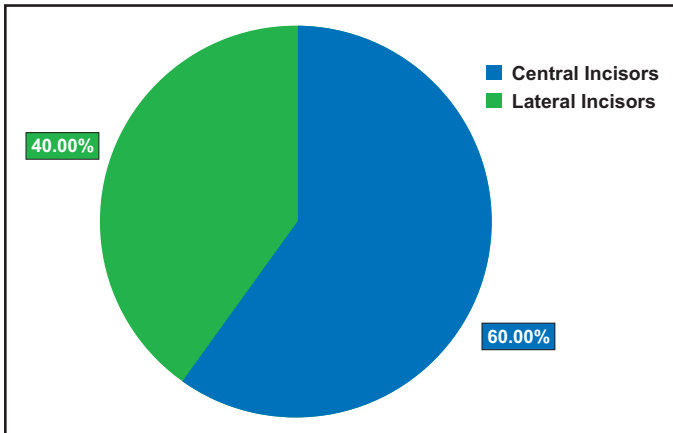


FIGURE- III: TOOTH DISTRIBUTION OF CASES (n=50)

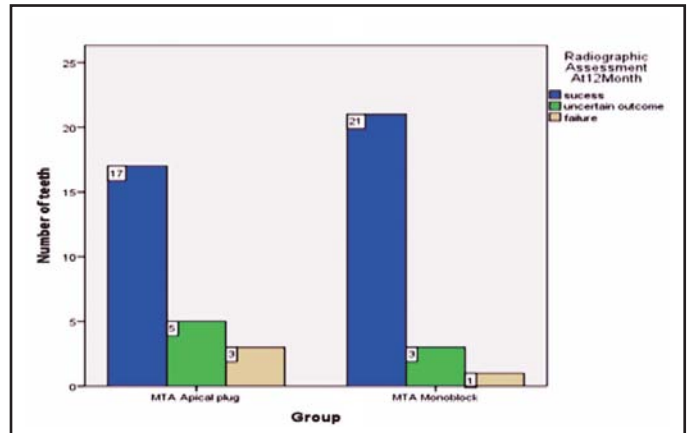


FIGURE-IV: RADIOGRAPHIC ASSESSMENT AT 12 MONTH (n=50)

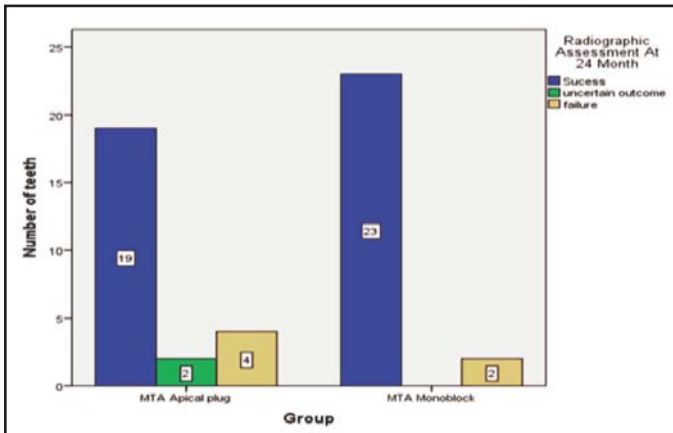


FIGURE-V: RADIOGRAPHIC ASSESSMENT AT 24 MONTH (n=50)

TABLE I: DISTRIBUTION OF TREATED TEETH PRESENTED WITH SIGNS AND SYMPTOMS AFTER THE OBTURATION OF CANAL n = 50

Symptoms	MTA Apical Plug		MTA Monoblock	
	n	%	n	%
<b>Pain after obturation</b>				
Yes	8	32%	3	12%
No	17	68%	22	88%
<b>Analgesics/obturation</b>				
Yes	8	32%	3	12%
No	17	68%	22	88%
<b>TT palp ¥/obturation</b>				
Yes	7	28%	1	4%
No	18	72%	24	96%
<b>TTP €/obturation</b>				
Yes	8	32%	4	16%
No	17	68%	21	84%

¥ TT Palp =Tender to Palpation € TTP = Tender to Percussion

## DISCUSSION

The evaluation of clinical outcome of endodontic treatment is an integral component of evidence based practice in endodontics. The objective of this present study was to determine and compare the clinical outcome of mineral trioxide aggregate apical plug and mineral trioxide monoblock technique for endodontic apexification procedure of non vital permanent incisors with open apices after a sufficient period of follow-up.

Historically, two technique Ca(OH)<sub>2</sub> and mineral trioxide aggregate apical plug apexification were compared by many studies.<sup>26, 27</sup> Their results indicated that MTA and Ca(OH)<sub>2</sub> treatment modalities showed similar healing times (4.6 ± 1.5 months vs 4.4 ± 1.3 months, respectively), again confirming that both techniques are comparable in resolving periapical radiolucencies. In addition, there was a statistically significant shorter treatment time for the MTA group versus the Ca(OH)<sub>2</sub> group (0.75 ± 0.49 months vs 7 ± 2.5 months, respectively).

Several case reports of MTA apical plug and MTA monoblock technique for endodontic apexification of non vital permanent teeth with open apices have been published.<sup>15, 22, 23, 24</sup> It was found that comparison of clinical outcome of apexification procedure with MTA in both techniques has not been published. In this study the follow-up (clinical and radiographic) for the both technique were 12 and 24 months. The review time in any clinical trial can be considered an advantage for determining the success of an endodontic procedure. Two studies looking at MTA root-end barriers<sup>28, 29</sup> evaluated radiographic success by the standard criteria mentioned by the European Society of Endodontology (ESE)<sup>25</sup> or by a modified version of this standard.. This study showed radiographic success in 76% of the cases in both groups at 12 months and 84% of the cases in both groups at 24 months. However, because of the limited number of teeth included in this study, the results of this study should be interpreted with caution.

The results of this study cannot be considered as conclusive due to limited number of patients. So multi-centre randomized clinical trials should be conducted to compare the outcome of both techniques for apexification in larger number of subjects. As there are not only some case reports were documented in the literature, a thorough comparison cannot be made with the present study. MTA apexification technique provides some benefit as compared to the traditional calcium hydroxide apexification. However, its wide use for the monoblock apexification is restricted due to expensive cost of the material and the handling difficulties of the material.

## CONCLUSION

This study have showed no significant difference in clinical outcome of MTA apical plug and mineral trioxide monoblock technique for endodontic apexification procedure of non vital permanent incisors with open apices. Further research studies are required to investigate about the biological process of MTA apexification procedure and long term prognosis of the treated teeth.

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