

# **Apexification with Mineral Trioxide Aggregate followed by Complex Aesthetic Treatment on Maxillary Central Incisors: A Case Report**

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## **Abstract**

**Background:** Dental trauma on young permanent teeth can cause necrosis of the pulp so that the closure of the apex is stalled. Mineral Trioxide Aggregate or MTA is a biocompatible material that is used for apexification treatment to create adequate apical stop. Complex aesthetic issues that often occur due to dental trauma are fractured tooth crowns, changes in inclination and tooth position, as well as asymmetric gingival zenith. **Objective:** To overview the multidisciplinary planning and treatment of open apex and complex aesthetic dental problem caused by dental trauma. **Case:** A 20-year-old male came with chief complaint of fractured maxillary incisors with one of the incisor was not in normal tooth alignment. The patient experienced dental trauma when he was 8 years old. There were apical radiolucency on both teeth. The maxillary central incisors were diagnosed with WHO fracture class I.3. Gingival zenith of tooth 11 was more incisal than tooth 21, and the tooth color was darker. Tooth 21 was in labioversion position. Root canal sterilization were done using  $\text{Ca(OH)}_2$ . The apexification were performed using mineral trioxide aggregate. Treatment of tooth 11 was followed by an obturation using thermoplasticized gutta-percha, intracoronal bleaching with 35% of hydrogen peroxide, aesthetic crown lengthening, and direct composite resin veneers. Treatment of tooth 21 followed by the manufacture of e.max custom post with the change of inclination, and continued with indirect composite crown restoration. **Conclusion:** Trauma in the young permanent dentition requires specific treatments associated with immature apex and aesthetic problems.

**Keywords:** apexification, mineral trioxide aggregate, complex aesthetic

## **Introduction**

In teeth with incomplete root development caused by trauma, caries and other pulpal pathosis, the formation of dentine stops, and root development ceases. Consequently, the canal remains large, with thin and fragile walls, and the apex remains open. These features make instrumentation of the canal difficult and hinder the formation of an adequate apical stop. In such cases, in order to allow the condensation of the root filling material and to promote an apical seal, it is imperative to create an artificial apical barrier or induce the closure of the apical foramen with calcified tissue<sup>2,4</sup>. Mineral trioxide aggregate (MTA) has been suggested for apexification because it provides an adequate seal in the root canal, and it appears to offer a biological active substrate that stimulates periodontal cell production<sup>5,17</sup>.

Dental trauma not only causes incomplete root development, but also causes several aesthetic issues, including fractured tooth crowns, changes in inclination and tooth position, and asymmetric gingival zenith. There are several classification of tooth fracture. WHO classified oral structures injuries using code numbers while considering both primary and permanent teeth. While Andreasen modified WHO classification by including terms uncomplicated or complicated crown-root fracture and concussion, subluxation, lateral luxation<sup>11</sup>.

Anterior teeth with extensive loss of coronal tooth structure usually need a post because the pulp chamber and single canal are generally not adequate to retain a core. The chief function of the post is to retain the core. Ceramic, glass and zirconium posts have gained popularity because they are tooth-colored and avoid esthetic problems in the anterior teeth. Customized cast posts are especially versatile and can often be fabricated with the minimum of additional canal preparation. Besides, customized post allows the changing of tooth inclination. Such posts have a strong history of clinical success, especially when a coronal ferrule is provided<sup>1,18</sup>.

As patients and dentists become increasingly aware of the importance of gingival health and architecture to a pleasant smile, soft periodontal tissues have become a focus of attention. To achieve symmetry gingiva and gingival zenith, aesthetic crown lengthening could be the treatment of choice, but it is needed to

understand the concept of biological width. Gingival biological width (biologic membrane, dentogingival attachment) is the area of gingiva attached to the surface of the tooth coronary from the alveolar bone<sup>14,15</sup>.

Non vital teeth may become discolored<sup>8</sup>. Treating discolored anterior teeth with indirect restorations presents a unique dilemma; the requisite tooth preparation diminishes and severely weakens the restricted mesial-distal substance of the previously intact tooth. Tooth bleaching can avoid more invasive dental treatment, preserving tooth structure<sup>10,16</sup>. Although tooth bleaching presents satisfactory esthetic results, some investigations have shown a deleterious effect of peroxide bleaching on the adhesion of composite resins to tooth structure. It has been shown that exposure to hydrogen peroxide causes a substantial reduction in the adhesiveness of composite resin to the enamel<sup>16</sup>.

Porcelain veneers have long been considered the gold standard in terms of appearance in the provision of a long-term aesthetic restoration in the correct clinical circumstances. This is because each veneer is crafted by hand, entirely customised and individualised. However, this comes at a price, both financial and, sometimes, in terms of tooth tissue<sup>6</sup>. Direct composite veneers have often been heralded as a more conservative alternative to porcelain. The developing of microhybrid and nano-hybrid composites, makes the finishing and polishing of veneer restorations can rival the veneer porcelain<sup>13</sup>.

## **Objectives**

To overview the multidisciplinary planning and treatment of open apex and complex aesthetic dental problem caused by dental trauma.

## **Case Report**

A 20-year-old male came with chief complaint of fractured maxillary incisors with one of the incisor was not in normal tooth alignment. The patient experienced dental trauma when he was 8 years old. There were apical radiolucency on both teeth. The maxillary central incisors were diagnosed with WHO fracture class I.3. Gingival zenith of tooth 11 was more incisal than tooth 21, and the tooth color was darker. Tooth 21 was in labioversion position (Figure 1).

There were no complaint on percussion test, palpation test, and mobility test. Tooth 11 had a 2.5 mm overjet and overbite of 3 mm. Tooth 21 had 5 mm overjet and overbite -2 mm. Non stimulated saliva test showed a poor level of acidity (pH = 6.0).

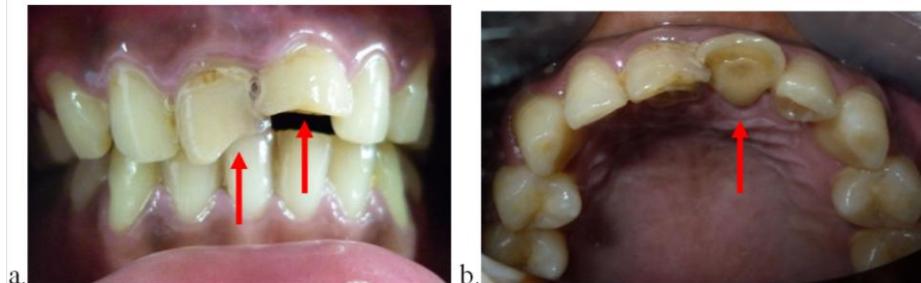


Figure 1. a) Tooth 11 had fracture from mesial part to the incisal part, involving enamel and dentin but not the pulp, with caries on mesial part. Tooth 21 had horizontal fracture at the third incisal, the fracture didn't reach the pulp, with the labioversion tooth inclination, there was caries on mesial part. b) Tooth 21 was out of the tooth alignment.

On radiographic examination, tooth 11 and 21 had open apex with apical radiolucency. There was dental caries on mesial part of tooth 11 that had already penetrated the pulp. There was dental caries on mesial part of tooth 21 but didn't penetrate to the pulp (Figure 2).



Figure 2. Dental radiographic of tooth 11 and 21 showed open apex and apical radiolucency. There was mesial caries of tooth 11 that had already penetrated the pulp. There was mesial caries of tooth 21 that had not already penetrated the pulp

## Treatment

At the first visit, a full examination was done, followed by the informed consent signing and dental health education. Then after making an artificial wall with light cured glass ionomer cement (Fuji II LC, GC), the opening access of tooth 11 and 21 was done, followed by the rubber dam isolation. Measurement of

working length tooth 11 and 21 were done radiographically, and the working length of tooth 11 was 22 mm and tooth 21 was 19 mm (Figure 3).



Figure 3. Radiographic working length measurements obtained confirmation of working length for tooth 11 was 22 mm and tooth 21 was 19 mm

Biomechanical preparation of tooth 11 and 21 were done with circumferential filing motion using K-file #80. Furthermore, the root canals were irrigated with 0.5% NaOCl solution (Dakin's solution). Root canal medicaments was done using  $\text{Ca}(\text{OH})_2$  (Ultradent, Ultracal), followed with temporary restoration (Cavit-G).

At the second visit, 1 week after sterilization, the apexification procedure was done using Mineral Trioxide Aggregate (BioMTA). The MTA was inserted into the root canal with MAP (micro apical placement) and hand plunger to the root canal of tooth 11 and 21, 4 mm at the apical part. Cotton pellets which had been moistened with distilled water were inserted into the root canal and then the cavity were closed with a temporary restoration (Cavit G). At the third visit, 1 week after apexification, the wax for post and core of tooth 21 is marginated, sprued, and invested for casting. The post and core inclination was changed for  $17^\circ$  (Figure 5).



Figure 4. Radiographic confirmation of apexification with MTA (BioMTA) on tooth 11 and 21.

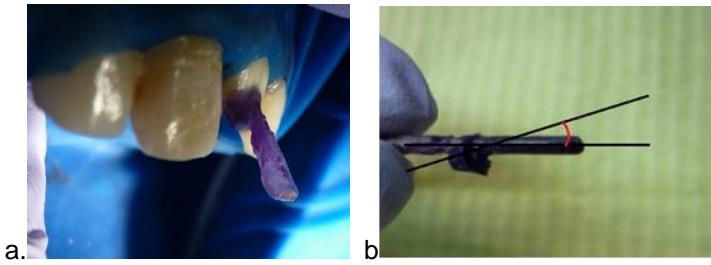


Figure 5. a) The wax for post and core of tooth 21 is marginated, sprued, and invested for casting, b) The post and core inclination was changed for  $17^{\circ}$

At the fourth visit, 2 weeks after apexification, the post was tried to the root canal, and then was confirmed by radiograph (Figure 7). Cementation of the post using the dual-cured resin cement (Calibra, Dentsply).

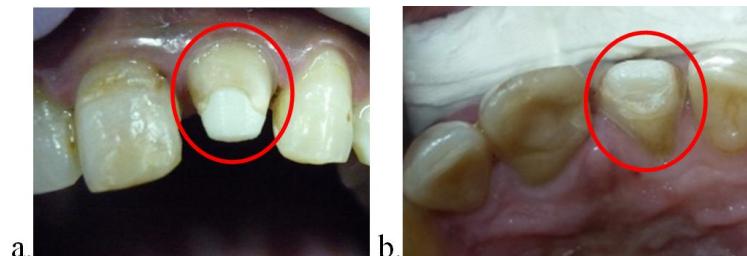


Figure 6. a) E.max post core had been cemented on tooth 21, b) Palatal view after E.max post core had been cemented on tooth 21



Figure 7. Radiographic confirmation E.max post core cementation on tooth 21.

At the fifth visit, 3 weeks after apexification, the crown was cemented on tooth 21 using a dual-cured resin cement (Calibra, Dentsply). Radiographic confirmation was done after composite resin crown had been cemented.



Figure 8. Composite resin crowns on teeth 21 had been cemented,



Figure 9. Radiographic confirmation of composite resin crown cementation on tooth 21.

Tooth 11 looked darker than the other teeth, the intracoronal bleaching was done before the direct composite veneer restoration, so that the direct composite veneer can achieve the optimal aesthetic result. Determination of initial tooth color with vitapan shade guide showed the tooth color was A3,5 (Figure 10).



Figure 10. Determination of initial tooth color with vitapan shade guide showed the tooth color was A3,5

Before the intracoronal bleaching, the wing barrier was made on tooth 11 with glass ionomer cement (Fuji I, GC), and then was confirmed by radiograph (Figure 13). After that, the 35% hydrogen peroxide paste was applied in the pulpal room (Opalescence Endo, Ultradent). Tooth cavity 11 was closed with a double seal using Cavit-G, then coated with glass ionomer cement. At the sixth visit to-six,

3,5 weeks after apexification and 5 days after intracoronal bleaching, tooth 11 had increased color from A3, 5 to A3 (Figure 12).



Figure 11. Radiographic confirmation of wing barrier made with glass ionomer cement (Fuji I, GC) on tooth 11



Figure 12. Tooth 11 had increased color from A3, 5 to A3 color. Examination of the color using vitapan shade guide

Before the crown lengthening was done, the anesthetic infiltration on labial gingival margin area around the tooth 11 was done and then followed by bone sounding with WHO probe. The dentogingival complex of tooth 11 was 4 mm. Gingival tissue margins on labial area of tooth 11 was reduced 1 mm using a surgical scalpel blade no.15. Bleeding was stopped with a hemostatic agent (ViscoStat, Ultradent) (Figure 13). Gingival margin of tooth 11 area was applied with Stabilized Chlorine Dioxide Gel (Oxyfresh Dental Gel) to accelerate the healing process. Patient was instructed to return 1 week later for direct composite veneer restoration.



Figure 13. Bleeding was stopped with a hemostatic agent (ViscoStat, Ultradent).

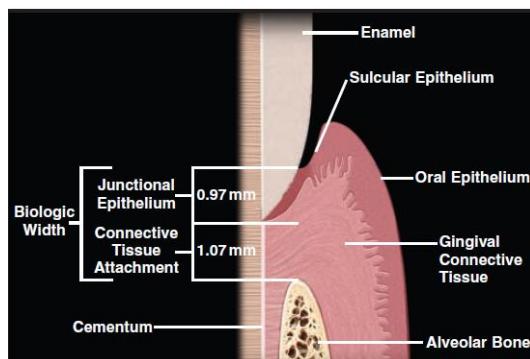


Figure 14. Schematic drawing of the structures comprising the periodontium and the biologic width space (Lee E.A., 2004)

At the seventh visit, 4.5 weeks after apexification and 1.5 weeks after intracoronal bleaching, direct composite veneer restoration was done on tooth 11. Previously, guiding groove on the third cervical, middle part, and the third incisal were done using a depth-cutting bur with cutting depth of 0.5 mm, then the labial part of tooth 11 was reducted with fissure bur (Figure 15). Examination using a labial index made from double impression putty material that was molded to study model (Figure 16).

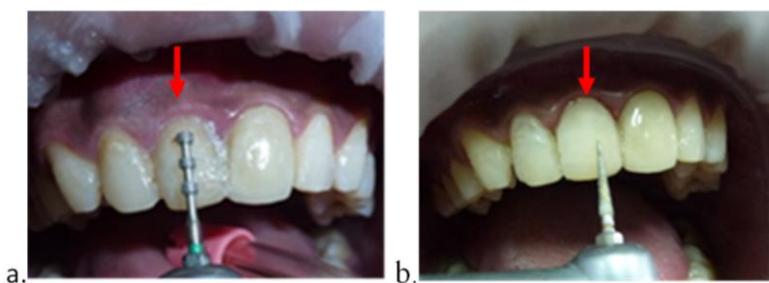


Figure 15. a) The making of guiding groove on tooth 11 using depth-cutting bur, b) Labial part of tooth 11 was reducted using fissure bur



Figure 16. Labial reduction examination of tooth 11 by using labial index that was made from the double impression putty material

The restoration on tooth 11 using composite with color of E3 and D3 (Ceram X duo, Dentsply), the same color as C3 and A3, 5 of vitapan shade guide. The dentin color was used first, and followed with translucent color to make the email and incisal parts. Contouring was done using yellow ribbon fissure polishing bur, enhance (Dentsply), and polishing strips (Figure 17).



Figure 17. a) Contouring using a yellow ribbon fissure polishing bur, b) Enhance (Dentsply,) and c) polishing strips

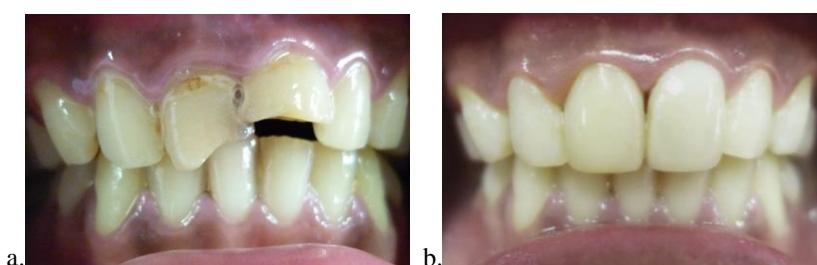


Figure 18. a) Tooth 11 and 21 before the treatment. Tooth 11 had fracture from mesial part to the incisal part. Tooth 21 had horizontal fracture at the third incisal, with the labioversion inclination, b) After treatment, tooth 11 and 21 had received new aesthetic appearance, with the tooth inclination of tooth 21 had already on the right alignment

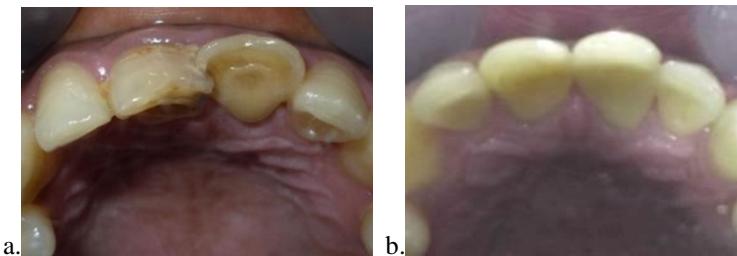


Figure 19. a) Palatal view of tooth 11 and 21 before treatment. The tooth 21 was out of the tooth alignment with labioversion position, b) Palatal view of tooth 11 and 21 after treatment, tooth 11 had already on the right alignment

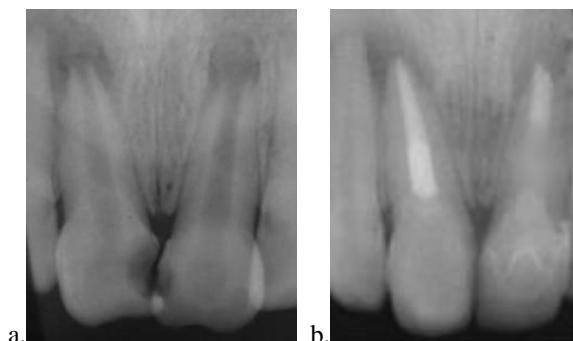


Figure 20. a) Radiographic of tooth 11 and 21 before treatment, showed open apex and apical radiolucency, b) Radiographic of tooth 11 and 21 after treatment. Apexification using MTA (BioMTA) had been done on both central maxillary incisors. Healing process happened on apical part of tooth 11 and 21.

## Discussion

MTA offers the option of a two-visit apexification procedure, which must have the benefit of better compliance and reduced number of radiographs over the multiple visit calcium hydroxide apexification, particularly in younger patients. MTA has been used as a suitable alternative to achieve a periradicular seal<sup>4</sup>.

It is believed that the deposition of hard tissue over the MTA material is related to features such as good sealing ability, biocompatibility, alkaline pH, the presence of calcium and phosphate ions in its formulation, the capacity to attract blastic cells and to promote a favourable environment for cementum formation, osseous and cementum-conductive effect, the stimulus to adhesion and cell proliferation, stimulus to expression of alkaline phosphatase by fibroblasts and osteocalcin and other interleukins by osteoblasts<sup>3</sup>.

In consideration of restoration, it is important to note the coronal destruction, the tooth type (anterior or posterior), position in the arch, morphology, force to the teeth, and periodontal support. Every case is different and requires proper treatment plan according to the indication. Anterior teeth will receive a lateral force, in contrast to the posterior teeth that receive vertical force<sup>7</sup>. Customized post core can be a treatment option when tooth were not on the right position and need to be returned to the dental arch according to the other teeth. Even that ceramic, glass, and zirconia post provide the good aesthetic result, but the use of these materials should be followed with detail analysis of many factors that supporting or not supporting the treatment success. It is noteworthy to know other important factor before making a decision to do the inclination change, including the bad habit such as bruxism and clenching that become the contraindication for this kind of customized post<sup>18</sup>.

The normal connective tissue attachment (CTA) is 1.07 mm, epithelial attachment (EA) is 0.97 mm, dental sulcus is 0.69 mm. Gingival biological width (GBW) was calculated by adding widths of connective tissue attachment and epithelial attachment:  $GBW = CTA + EA = 2.04 \text{ mm}^{14}$ . Tooth 11 had gingival margin more incisal than tooth 21 and 12. To get a more aesthetic result, crown lengthening procedures was done before the direct composite veneer restoration was done. The measurement of tooth 11 region showed there was 4 mm of dento gingival complex (DGC), so it was possible to reduce gingiva for 1 mm. Crown lengthening procedure was done without damaging the biological width.

Intrinsic discolorations are caused by deeper internal stains or enamel defects. Intracoronal bleaching of pulpless discolored teeth is a valuable treatment modality, provided that the procedures are administered with due regard for the relative risks involved<sup>10,16</sup>. Given the appropriate indication, the bleaching of nonvital teeth is a relatively low-risk intervention to improve the esthetics of endodontically treated teeth. Sufficient cervical sealing and avoidance of the thermocatalytic method can minimize the risk of resorptions<sup>19</sup>.

Intracoronal bleaching was done on tooth 11 before the direct composite veneer restoration, in order to achieve the best veneer results. The veneer restoration was very thin with the width range of 0,5 mm until 1 mm. Therefore, if

the tooth color is dark, the direct veneer restoration will be difficult especially in achieving the best translucent color. Even though the opaque could be used, but it is better to show the natural tooth color behind the veneer restoration<sup>10</sup>.

Direct composite veneer was selected for tooth 11 because the tooth still had enough structure, therefore it didn't need more invasive restoration to preserve the normal and aesthetic appearance. Besides, direct composite veneer enables modification of length and contour<sup>13</sup>. The direct composite veneer restoration was postponed for one week after intracoronal bleaching, to avoid the interruption of dentin bonding because exposure to hydrogen peroxide causes a substantial reduction in the adhesiveness of composite resin to the enamel<sup>16</sup>. Obtaining optimal results with direct composite restorations can provide a technical challenge in certain circumstances, particularly when being compared to indirect veneer or crown restoration that already exists<sup>6</sup>.

## Conclusion

Trauma in the young permanent dentition requires specific treatments associated with immature apex and aesthetic problems. Mineral trioxide aggregate used after root canal preparation favored the occurrence of the apexification and periapical healing. Optimal restorations results after apexification can be achieved by understanding all factors affecting the restoration function and the aesthetic appearance. Technical skills and understanding the treatment that will be done, is a basic requirement in achieving good result.

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