

Esthetic correction of calcified tooth discoloration by walking bleach technique

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Presentation of Case

Farzana Hoque Tanmi: A 33 year old male patient came to the outpatient Department complaining of the bad appearance of his upper left central incisor tooth. He had no history of trauma in that area but the tooth was discolored gradually (Figure 1A). Furthermore, the tooth was asymptomatic. There was no pain and discomfort during mastication. The patient had gastric irritation for the last 5 years and still using omeprazole irregularly. The clinical examination indicates that the left central incisor tooth was yellowish in color and the dentine was found to be exposed (Figure 1B). There was gross tooth tissue loss at the labial surface that includes the incisal edge of the tooth. Furthermore, the right central incisor showed rough labial surface and seems to be developmentally defective (Figure 1C). On pulp vitality test, the left central incisor tooth was non-vital and the right central incisor tooth was vital. A periapical X-ray was taken for morphological analysis of root canal system and the shade of the affected tooth was assessed by Shade guide.

Dr. Mozammal Hossain: The assessment of color was performed by vita shade guide which revealed that upper left central incisor tooth had A4 shade, which was differing from the adjacent right central incisor tooth of A1 shade (Figure 1C). This condition was not favorable for direct restoration in the left central incisor tooth. Therefore, it was decided that endodontic treatment followed by the bleaching of the left central incisor tooth was needed before the placement of restoration. The right central incisor tooth could be treated with composite lamination only.

Dr. Md. Mujibur Rahman Howlader: Periapical radiograph showed total obliteration of pulp space with the absence of the pulp chamber in upper left central incisor tooth. It might be due to excessive formation of irregular dentin which calcified almost the total root canal. Discoloration was due to excessive formation of irregular dentin. There was periodontal involvement around the affected tooth. The lamina dura, interproximal periodontal ligament space and

cementum found intact and healthy but remarkable loss of crest of the alveolus was noted in between two central incisors (Figure 1-D). Canal morphology of the right central incisor tooth was normal appearance and there was no obliteration of pulp space.

Dr. Tanmi: The treatment plan was fixed as follows: the upper left central incisor tooth needed to be treated endodontically followed by non-vital bleaching using walking bleach technique with sodium perborate and hydrogen peroxide (30%) and lamination with composite resin. The right central incisor tooth does not need endodontic treatment and can be treated with composite resin lamination only.

Root Canal Procedure

In the first day, oral hygiene was corrected by scaling of the teeth. The patient was advised to start omeprazole twice daily. On next visit, endodontic treatment was performed as follows: an attempt was done to prepare the access cavity of upper right central incisor tooth with # 4 diamond round bur from the palatal approach. Copious irrigation was done with normal saline and 2.5% sodium hypochlorite solution (NaOCl). An endodontic explorer was used to locate the canal orifice but at normal anatomical orifice level, no sign of orifice was found. Then # 2 bur was used to drill at slow speed into the center of the imaginary anatomical orifice of the root canal. A # 10 K file was used to negotiate the canal but could not be done rather than catch the orifice. Few drops of NaOCl and chelating agent in the paste form (glyde, dentsply, Germany) containing lubricant were kept for 5 minutes to clear the pathway. Then # 8 K file was placed and negotiated with very gentle reciprocating movement up to estimated length. A # 10 K file was negotiated and working length was determined by radiograph and the length was 20 mm. the root canal was prepared as standardized technique up to # 60 K file with lubricant and copious irrigation with normal saline and 2.5% NaOCl. The canal was then dried with paper point and Ca(OH)₂ mixed with normal saline was placed into the canal.



The cavity was filled with cotton pellet and glass ionomer. The patient was advised to visit after 7 days.

After 7 days, following removal of glass ionomer cement, $\text{Ca}(\text{OH})_2$ was removed by thorough rinsing with normal saline and NaOCl alternatively. The canal was soaked with 2% chlorohexidine for one min and the final irrigation was done with 17% EDTA to remove the debris like smear layer. The root canal was then obturated with gutta percha point using zinc oxide eugenol sealer by lateral condensation method and cavity was again filled with glass ionomer cement (Figure 1E).

Bleaching Technique

The bleaching procedure was performed as follows: Two weeks later as the tooth was asymptomatic glass ionomer cement, obturated gutta percha and root canal sealer were removed to a level of 2-3 mm below the cement-enamel junction. A 2 mm layer of flowable composite was placed on top of the gutta-percha filling to prevent percolation of bleaching agent. A periapical radiograph was taken to confirm the establishment of a protective barrier (Figure 1F). Sodium perborate (trihydrate) and 30% hydrogen peroxide were mixed in relation 2 g to 1 mL and creamy paste was prepared which was placed into the prepared cavity for bleaching. The excess liquid of the material was removed by tamping with a cotton pellet and the paste was pushed to all areas of the pulp chamber. The cavity was then filled with cotton pellet and glass ionomer cement. The patient was recalled after 7 days for the assessment of color improvement by shade guide and re-application of bleaching agent was performed followed by glass ionomer restoration. A total of 6 visits were needed for completion of the treatment. In order to neutralize acidic environment and prevent possible cervical resorption, $\text{Ca}(\text{OH})_2$ mixed with saline was applied into the pulp chamber for 7 days. At this

stage, tooth color shade was improved as A1 shade level (Figure 1G).

Lamination with Composite

After completion of bleach treatment, the labial surface and incisal edge of the right and left central incisor teeth were corrected by composite resin. The tooth preparation was performed by diamond fissure bur up to the cervical margin. Metal abrasive strip was used in the proximal area. The gingival finishing line was placed at the gingival crest. Composite resin (ceram-X, dentsply, Germany) was then applied on the prepared surface and light cured for 40 sec at lingual, facial and incisal. Finishing and polishing strips were used between two teeth. Flexible aluminium oxide disc was used for the adjustment of the incisal angle. Silicone rubber polisher was used for the polishing of the restoration (Figure 1H).

Provisional Diagnosis

Tooth discoloration and calcific metamorphosis

Differential Diagnosis

Dental Trauma

Dr. Md. Joynal Abdin: When a tooth is injured, partially dislodged, or otherwise damaged, discoloration can occur as a result of presence of blood into the dentinal tubules.^{1,2} Furthermore, when the tooth interior is damaged, blood can move into them and change tooth color as pink, gray, or even black.² In that case, teeth bleaching might help to restore it to its natural color.³ However, it is important to ensure the appropriate diagnosis and treatment. In some cases, a damaged tooth needed to be removed or might require a root canal to prevent serious pro-

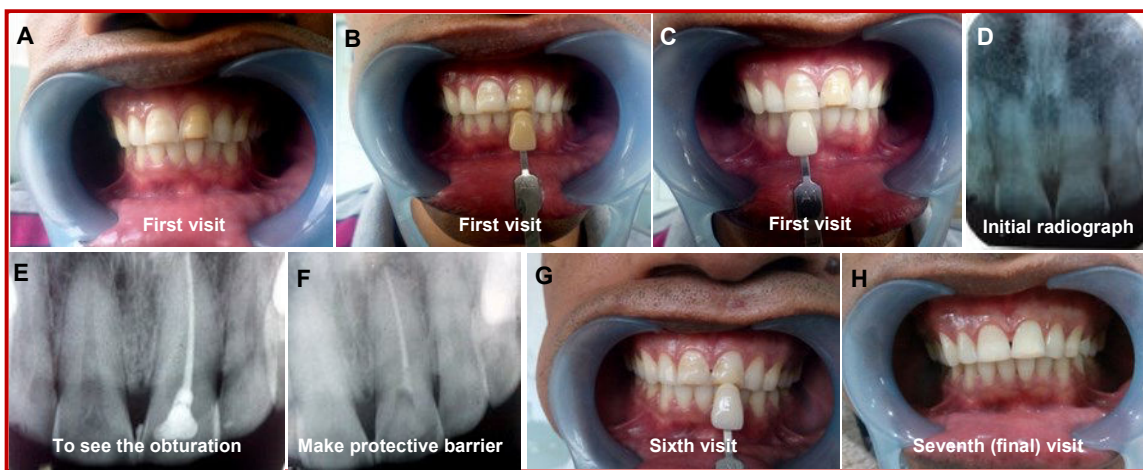


Figure 1: Preoperative photographs of tooth discoloration (A-D) and endodontic treatment followed by bleaching (E-H)

blems in the future. Furthermore, discoloration of teeth is the common sequelae of dental trauma and is associated with a sign of irreversible pulpal degeneration, particularly if the crown becomes gray or blue-gray in appearance.⁴ Moreover, when revascularization occurs following trauma to teeth, the removal of blood pigments can be seen.⁵

Non-carious Tooth Surface Loss

Dr. Abdin: In this case, the patient had a history of gastric reflux which might result in chemical tooth erosion followed by discoloration of the upper anterior teeth. Furthermore, discoloration may also occur due to underlying dentin as a result of the loss of enamel tissue by parafunctional habits. The effects of chemical erosion might increase the rate of tooth wear caused when then is abrasion, and attrition due to parafunctional habit. Excessive tooth wear is the most frequently cited sign of bruxism, because tooth wear progresses faster in bruxism than non-bruxers.⁶⁻⁸ Chemical erosion of tooth occurs due to diets,⁹⁻¹⁰ gastric reflux.¹¹⁻¹² Moreover, bruxism may accelerate tooth tissue loss.¹³ Therefore, it should be considered that patient with a history of gastric reflux often associated with tooth wear.

Developmental Disorder

Dr. Abdin: Several genetic disorders affect tooth development such as odontogenesis, enamel hypoplasia and enamel hypocalcification are examples of defective enamel that are responsible for abnormal tooth appearance and discoloration. These teeth are more susceptible to further staining which can acquire throughout life.¹ Furthermore, amelogenesis imperfecta and dentinogenesis imperfecta cause yellow-brown or blue-gray discoloration with increased translucency.^{14,15} Congenital erythropoietic porphyria is associated with red or brown discolored teeth.^{16,17} Hyperbilirubinemia during the tooth formation results in yellow-green or blue-green discoloration.^{18,19} Thalassemia and sickle cell anemia results in blue, green or brown tooth discoloration.²⁰ One study reported in children that a high proportion of cystic fibrosis has discolored teeth.²¹ Furthermore, cystic fibrosis in enamel formation is responsible to tooth discoloration regardless of exposure to tetracyclines.²²

Medication

Dr. Abdin: Medications such as tetracyclines have been reported to develop intrinsic tooth discoloration, which may lead to permanent tooth staining in expectant mother or child at the time of the developmental period of both the primary and secondary dentition.^{23,24} Minocycline may produce generalized intrinsic discoloration in the form of green-gray or blue-gray staining in fully developed teeth.²⁵ It does not chelate calcium well, but develop insoluble complexes with iron and integrated into

the secondary dentin (intrinsic) as well as in the enamel (extrinsic).²⁵ Tigecycline, a glycylcycline tetracycline may also develop yellow, gray, or brown tooth discoloration if taken during second and third trimesters.²⁴ Greenish discoloration of newly erupted teeth found in infants who received intravenous ciprofloxacin against Klebsiella infection.²⁶

Dr. Tanmi's Diagnosis

Tooth discoloration and calcific metamorphosis

Discussion

Assessment of Tooth Color

Dr. Hossain: In the present study, the shade analysis of the tooth was performed by the Shade guide. It was revealed that there was A4 shade before treatment. Furthermore, there was a chemical erosion of the affected tooth. Color changes can also be assessed by the radiographic evaluation and laser doppler readings with laser light transmission. However, still now, the visual radiographic and symptomatic assessment remains as the principal diagnostic criteria. Traditionally, the visual color determination is used based on visual comparison of the tooth with color standards. Such color standards (also known as shade guides) were developed from porcelain material to match the available shades of porcelain teeth. However, there are several disadvantages with the use of shade guides for color assessment. Shade guides are inadequate and there is a lack of consistency among and between dentists in using the shade guides to match colors.²⁷

Radiological Discussion

Dr. Howlader: In the present study, periapical radiograph showed obliteration of pulp space with absence of the pulp chamber. It might be due to excessive formation of irregular dentin which calcified almost the total root canal. Furthermore, discoloration of the present case might be due to excessive formation of irregular dentin. The previous study has indicated that it is more often observed in patients who have suffered chronic chemical irritation or those who have suffered concussion or subluxation injuries.²⁸ Obliteration may be either dentin like, bone like or fibrotic in primary teeth.²⁸ It can also observe as tube-like structures with histological appearance of osteodentin with cellular inclusions in primary teeth or by an increase in collagen content and a marked decrease in the number of cells.²⁹ However, this condition is not the same as pulp stones which are usually develop in dentin lined by odontoblasts. On the other hand, false pulp stones are formed by

mineralization of pulp cells.³⁰ Furthermore, the obliteration of pulp space (also called calcific metamorphosis) is initiated by stimulation of odontoblastic activity.³¹ It may be due to injury to the neurovascular supply of the pulp. The bleeding in the canal and blood clot may cause calcification when the pulp remains vital following trauma. Traumatic injury to the apical blood vessels may also cause calcific metamorphosis as well as obliteration.³¹

Bleaching Technique

Dr. Tanmi: Patient was treated by walking belching followed by direct composite lamination. However, it is necessary to consider the amount of remaining tooth structure as well as the superiority of root canal treatment and condition of the periodontium. Bleaching techniques always need the biological and clinical safety.³² Because it may cause irritation of soft tissue, reduce enamel hardness and increase dentin permeability.³² The use of 30% hydrogen peroxide and sodium perborate is considered more effective than sodium perborate with water.³² Placement of a reliable intraorifice barrier is required during intracoronal bleaching. Hydrogen peroxide can be applied as intracoronal bleaching because of its low molecular weight, penetrability into the dentin and ability to release oxygen that breaks the double bonds of the organic and inorganic compounds inside the dentinal tubules.³³ But it may also irritate the periodontal tissues.³³ Therefore, a layer of approximately 2-3 mm barrier was produced by flowable composite in the present case. Another method is known as thermocatalytic that includes the placement of chemical oxidants into the pulp chamber, which can be later activated by different heat sources to accelerate the whitening process.³⁴ However, excessive heat might develop cervical resorption.³⁴

Restorative Correction

Dr. Tanmi: In this case, considering the quality of root canal treatment, amount of remaining tooth structure and health of periodontal tissues, tooth bleaching followed by direct lamination was performed. Porcelain crown can also be used to cover the teeth with esthetic disorder. However, excessive tooth preparation and damages to surrounding tissues (e. g. gingival tissue), are the disadvantages of a crown. To reduce the disadvantages of the crown, lamination with composite resin is considered as conservative treatment and better esthetic treatment option than the crown.³⁵ Laminate is also capable to correct esthetic deficiencies or abnormalities.

Direct laminations are applied on the prepared surfaces and there is no need for tooth preparation. Its cost is lower than the indirect techniques or any other prosthesis. Furthermore, intraoral polishing of direct lamination is easy and any fracture or cracks

or fractures could be repaired at the same time. The marginal adaptation of laminate veneer is better than that of indirect restorations.⁶ Furthermore, direct restorations were applied in the correction of congenital or acquired malformations, esthetic problems, tooth discolorations, rotated teeth, diastemas, discolored restorations, coronal fractures and palatally positioned teeth. However, the main disadvantages of direct lamination are low resistance to fracture, cracks, wear and discoloration.³⁶

Follow-up

Following lamination with composite resin, the patient was pleased esthetically. He was advised to keep the oral hygiene and avoid hard objects such as hard toothbrush, abrasive and any hard object that can cause fracture of the restoration.

Dr. Mahbuba Kafia Parvin: Dr. Tanmi, would you please tell us the present condition of the patient?

Dr. Tanmi: After completion of the treatment, he was satisfied and maintained a healthy life. Only he took omeprazole once in the night. A follow-up observation at 6 months showed that two central incisor restorations keep their natural tooth color and texture.

Dr. Shegufta Tabassum: Would you please tell us about the mechanism of bleaching with sodium perborate?

Dr. Tanmi: Sodium perborate is an oxidizing agent. When it mixed with H₂O₂, it breaks down into sodium metaborate, H₂O₂ and nascent oxygen. This active oxygen diffuses into dentinal tubule, oxidizes and then bleaches the iron sulfide and other pigments within the tubules.³⁷

Dr. Kazi Hossain Mahmood: What is the treatment of erosion?

Dr. Tanmi: He has only received omeprazole 20 mg once daily at night.

Dr. Hamida Khatun: What is the reason of several visits required in this treatment?

Dr. Tanmi: Due to chronic irritation, tertiary dentin can narrow the dentinal tubule which may cause less diffusion of bleaching agent and reduced its effectiveness.

Dr. Farhana Haque Chowdhury: Dr. Tanmi, what about the longevity of the laminate restoration?

Dr. Tanmi: The concept of lamination with composite resin and porcelain has become an increasingly popular esthetic restoration used to modify the appearance of anterior teeth. Good performance of composite and porcelain restoration showed with excellent esthetics, and there was no adverse effect

on the periodontium.^{38, 39} A recent study found that the estimated survival rate was 93% with composite resin lamination and 87% at 3 years with porcelain lamination.^{40, 41} However, the main reason for failure was fracture of the laminate veneer. The surface quality of composite veneer material could be changed after a period of time and therefore required proper maintenance.⁴²

Dr. Hossain: The clinical outcome of lamination depends on the adhesive strengths between tooth tissue and composite resin. If adhesion is weak, the longevity of a restoration may be reduced. Although tooth bleaching followed by composite lamination has shown promising results, controlled clinical studies are necessary to know the longevity of the restoration.

Final Diagnosis

Discoloration of tooth and calcific metamorphosis

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