Intra-Coronal Bleaching in Young Permanent and Primary Tooth with Biologic Perspectives

Divya S Sharma * / Khushboo Barjatya ** / Anuradha Agrawal ***

The odd attracts society in odd manner, as is the case when a patient with discolored tooth smiles. Because of that, pediatric patients have psychological impact. Trauma and pulpal necrosis are the most common causes for discoloration of teeth. If tooth is intact, intra-coronal bleaching is the most conservative and non-invasive treatment modality provided, it is done cautiously. This article intends to present two case-reports of successful intra-coronal bleaching using milder (sodium perborate) and tissue-friendly bleaching agent with walking bleach.

Keywords: *intra-coronal bleaching, external root resorption, sodium perborate*
J Clin Pediatr Dent 35(4): 349–352, 2011

INTRODUCTION

A non-vital, intact anterior tooth does not always needs extra coronal restoration.[1] If discolored, these teeth can be treated non-invasively and successfully with intra-coronal bleaching. Yet this treatment is not a frequent choice among pediatric dentists perhaps because of caustic nature of bleaching agents or uncertain results. Inspite of reported frequent post-op complication i.e. external root resorption with the use of concentrated hydrogen peroxide,[2,3] it is still used for intra-coronal bleaching.[4] Since the time of its introduction, sodium perborate (SP) has not been found associated with any such complications.[5,6,7]

Intra-pulpal hemorrhage due to trauma should be considered important in bleaching cases. Haem with time degenerates into ferrous form[8]. When hydrogen peroxide is introduced into the cavity, fenton reaction starts, forming various ions and radicals viz. hydroxyl ions and radicals, perhydroxyl radicals.[9,10,11] These ions, radicals and hydrogen peroxide together are called ROS. Fenton reaction is exothermic and more of hydroxyl radicals are formed in acidic medium than in alkaline medium.[11] Oxidation potential of hydroxyl radical is more than hydrogen peroxide.[12] Therefore if commercially supplied acidic solution of H_2O_2 is used as bleaching agent, reactions are very intense with abundant ROS formation. Hydroxyl ions and H_2O_2 has been detected on the outer surface of root in presence of intra-coronally placed H_2O_2, SP+H_2O or SP+H_2O_2.[9,13,14,23] Penetrated radicals directly injure the cells while H_2O_2 enters the Haber-Weiss cycle, again producing the ROS.[15] Therefore, both rate of formation and penetration of ROS into periodontal space should be controlled *in vivo*.

This article intends to elaborate successful use of milder bleaching agent (SP+H_2O) and possible procedures to control the rate of fenton reaction and penetration of ROS with the help of two case reports.

Case Report 1

A 12 year old female, visited the department of Pediatric Dentistry, Modern Dental College, Indore, India, with the chief complaint of discolored upper front tooth and slight proclination. History revealed trauma in anterior teeth two years back which was occasionally followed by thermal sensitivity in 21 for one month. After that patient did not have any discomfort but progressive darkening of 21. Intraorally there was no pain on percussion, swelling or sinus related with 21 but grey-black discoloration. The tooth was intact otherwise except for chipped off incisal edge. Radiograph did not reveal any adverse findings with 21. EPT showed delayed response with 21 confirming necrosis of pulp. Treatment plan of RCT followed by intra-coronal walking bleach was decided as tooth was intact.

In first appointment shade of the discolored tooth was recorded with the help of Vita shade guide (Fig. 1A).Root canal treatment was performed without anaesthesia further confirming necrosis of related tooth. After proper obturation, procedure for base placement was done. Length of clinical crown from incisal edge to base of sulcus was taken with the help of calibrated periodontal probe (Fig. 1B). To this length

* Divya S Sharma, MDS, Professor, Department of Pediatric and Preventive Dentistry, Modern Dental College & Research Centre, Indore (MP), India.
** Khushboo Barjatya, MDS, (Pediatric and Preventive Dentistry), India.
*** Anuradha Agrawal, MDS, Senior Lecturer, Dept. of Pediatric Dentistry, Govt. College of Dentistry, Indore (MP), India.

Send all correspondence: Dr. Divya S. Sharma, Dept. of Pedodontics and Preventive Dentistry, Modern Dental College & Research Centre, Indore (MP), India

Mobile: +91 9977701098

Email: drdivyaagra@yahoo.co.in

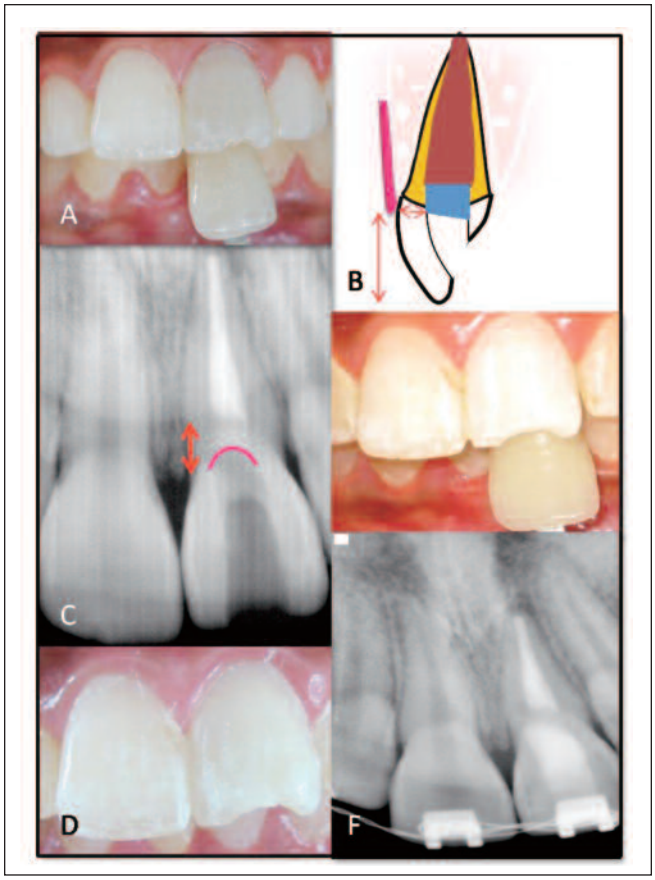

Figure 1.
A – pre-operative shade recording
B – schematic drawing for base applicaton
C – radiograph confirming thickness and shape of base
D – post-operative, one week
E – post-operative, three weeks
F – one month post-operative radiograph showing no cervical resorption in 21 and well attached brackets inspite of trauma

4mm were added. Gutta-percha was removed up to this length with the help of peizo reamer and hot pluggers. Remnants of gutta-percha were removed with chloroform. Access cavity was thoroughly rinsed with saline. Excess dentin trimming was avoided as young permanent tooth has very thin dentin. GIC base was applied over the stumped gutta-percha up to proximal sulcus base. The base was shaped according to the epithelial attachment of gingiva. The base was reduced with bur to make dome shape facially. Thus base on mesial and distal aspect was up to the base of sulcus, incisal to the level of CEJ. Lingually its level was beyond the base of sulcus. Shape of the base was confirmed in radiograph (Fig. 1C). Soft tissues were protected with petroleum jelly. SP tetrahydrate (Loba chemie Pvt. Ltd.) was the agent of choice. It was mixed with distilled water to a paste like consistency on a clean glass slab, carried to the access cavity, adapted to the facial surface properly with moistened cotton pellet. Access cavity was sealed with IRM(Caulk,Dentsply) for five to six days.

Considerable shade improvement was observed on the sixth day (fig-1,D). After three more weekly appointments desired shade was achieved (Fig. 1E). It was over bleached, should the color returns. The access cavity finally was sealed with moistened cotton pellet for one week. Following which it was restored with composite resin with the care that facial surface cured first followed by layer by layer filling and curing to seal facial surface properly. Patient was satisfied esthetically. Patient, immediately was taken to the orthodontic department. Three months later patient returned with trauma in front teeth again. Orthodontic wiring was loosened and 11, 21 were found extruded. Orthodontic wiring was removed and splinting with ligature wire on brackets was done after teeth secured in the socket (Fig. 1F). No post operative cervical root resorption in 21 was detected in post-operative radiograph, which confirmed the adequate positions of teeth too. Patient was called from orthodontic department after one month. Radiograph at this time did not show external root resorption (Fig. 3).

Case Report 2

A 5 year old child came to the department of Pediatric Dentistry with chief complaint of sinus in front region and multiple carious teeth in back region. Intraoral investigation revealed intra-oral sinus in relation to discolored 51 (Fig. 2A). History revealed trauma 6 months back. Pre-operative radiograph revealed periapical radiolucency in relation to 51. RCT followed by intra-coronal bleaching with SP+water was planned.

All treatment was done as in the first case except for root

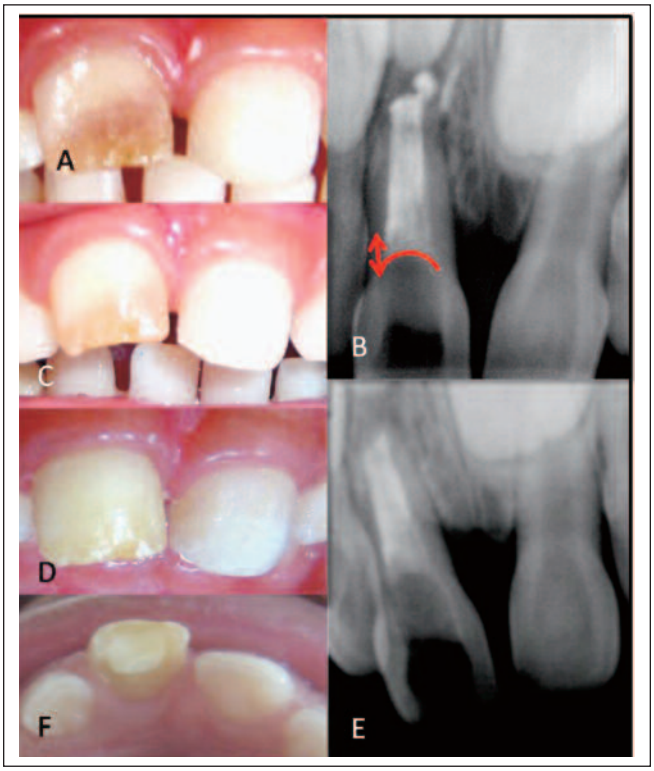

Figure 2.
A – pre-operative 51
B – shape of the base confirmed in X ray
C – one week post-operative
D – four week post-operative
E – one month post-operative X ray showing no root resorption
F – composite seal in access cavity

canal was obturated with metapex and only 3mm thick GIC base was applied so as not to interfere with physiologic resorption of primary root (Fig. 2B). The bleaching agent was changed weekly. Acceptable shade was achieved at fourth appointment (Fig. 2C,D). Mother expressed her inability to come then after because of personal problems. Access cavity was therefore restored with flowable composite. Two months post-op radiograph revealed no signs of external root resorption and perfect coronal seal clinically (Fig. 2D,E).

DISCUSSION

Mature permanent teeth, young permanent teeth and primary teeth differ in anatomy and physiology in many aspects among themselves (Table 1). Enamelo-cemental junction may be incomplete in 10% of cases.[16] In case of previous trauma, cementum in coronal region of root might be in resorbed condition and/or enamel cracks might be there under gingival attachment. These conditions may lead to higher penetration of bleaching agent in periodontal tissues.[13,23] Presented cases had discoloration primarily due to intra-pulpal hemorrhage, increasing the possibility of intense fenton reaction. External resorption was diagnosed 2 to 7 years after "walking bleach" with SP+H_2O_2 in young teeth with previous history of trauma.[2] External resorption/ankylosis in thermocatalytically bleached teeth with H_2O_2 had been found histologically.[17] More resorption was found on the root surface of tooth which was associated with least dentine bulk between prepared canal space and periodontium. Authors suggested that the bleaching procedures and chemicals should be confined to the supragingival chamber. Lado *et al* [3] also suggested that the dentinal tubules near the gingival attachment be protected by the base. Physiologically, actively dividing cells can be killed even at physiological concentration of exogenous H_2O_2.[15] Therefore intra-coronal bleaching in pediatrics is a challenge that requires procedures to prevent injury to vital tissues thereby avoiding post-operative complications.

Table 1. Anatomical, physiological and procedural differences between young permanent and primary teeth

Differences (as compared to mature permanent teeth)	Young permanent	Primary
Anatomical		
	Lesser dentine thickness	Even more less
	Secondary/tertiary dentine absent	Absent
	Dentinal tubules are wider	Even more wider
	Gingival attachment is coronally	Coronally
	Bigger pulp space	Bigger
	Adequate cementum thickness	Lesser thickness
	Microhardness of enamel and dentin is lesser	Even more less
Physiological		
	Cells are actively dividing (growing phase)	Even more (transitional phase)
Procedural		
	Hermetic sealing of root canal	Not achieved as only paste is filled
	Base thickness may be more	Limited thickness can be put

Base thickness of 2 mm is usually recommended, but one stereomicroscopic study recommended at least 4mm base thickness to prevent the percolation of bleaching agent.[18] On the basis of this study 4 and 3mm base upto gingival attachment was applied.

Walking bleach was preferred as fenton reaction is exothermic. External heat if applied, not only kinetizes the reaction but also promotes decomposition of hydrogen peroxide. Also external heat increases the temperature of radicular dentin by 40°C, results in hydraulic conductance of non-etched dentin increasing by 1.8 folds and 4 folds of etched dentin.[9] Therefore, the cavity was not etched and was never washed with sodium hypochlorite as hydroxyl radicals on outer surface of the root was detected in presence of sodium hypochlorite in pulp chamber.[9] Instead EDTA was used to clean the dentin surface.

Tetrahydrate, instead of mono or trihydrate forms of sodium perborate was used because of its alkaline nature which is non-injurious to vital tissues.[19,20] Its pH, from first day to seventh remained in alkaline range, which was due to control release of hydrogen peroxide.[19] In access cavity there is controlled formation of ROS for the following reasons: controlled supply of H_2O_2[19], because of retarded rate of formation of hydroxyl radicals in alkaline medium.[19] The paste remains steadily active for seven days because of the presence of six molecules of water of crystallisation.[19] Likewise convenient appointments can be scheduled for a child. In order to remove residual ROS and to return hydration of dentine, access cavity was copiously washed with saline and sealed with moistened cotton pellet for one week. Residual ROS may interfere with polymerization of composite resin.[21] Being in paste form, SP+water is easier to carry with no fear of spillage. Microhardness too, is non-significantly effected as compared to concentrated H_2O_2[22]. Sharma DS et. al.[23] found radicular penetration of hydrogen peroxide from SP tetrahydrate+water within physiologic range, even in presence of cervical cemental defects. In deciduous teeth, because of the reasons given in Table 1, smoother and successful bleaching is mainly dependent on selection of bleaching agent.

Trauma was found as common cause(84%) for discoloration.[24] Central incisors were the most commonly treated teeth with bleaching (72%). Among them 40% were the left central incisor, as is the case 1.[24] Risk of cervical root resorption with intra-coronal bleaching, surgery, trauma and orthodontic treatment is 3.9%, 5.1%, 15.1% and 24.1% respectively. But if bleaching is combined with any other factors, the risk raises to 13.6%.[25] Goon and Cohen[26] had reported a case of walking bleach with SP+H_2O_2 without previous history of trauma, but developed external root resorption

after post-op trauma. Molecular research showed presence of minute amount of exogenous H_2O_2 (penetrated ROS) could cause delayed cytotoxicity.[27] Re-trauma puts injured tissues under stress leading to endogenous production of ROS which together with exogenous ROS may result in root resorption at that site. The first case had become very important for follow-up, as patient had four reasons for developing root resorption i.e. previous trauma, bleaching, orthodontic treatment and post-op trauma again. Residual amount of ROS in periodontal space, if any, may lead to complication in future. Though all precautions were taken to prevent the ROS production and penetration, cases are under observation. Radiograph taken one month after re-trauma showed no signs of resorption in tooth 21 (Fig 3).

Figure 3. Four months post-operative radiograph (one month after re-trauma) showing no root resorption.

CONCLUSION

The article presented two successful conservatively treated cases of discolored young permanent and primary teeth. Both cases were treated with walking bleach using SP+water. The technique reduces the chair time, an important consideration for a pediatric patient. Last but not the least SP is a very cost effective bleaching agent. Therefore from the biologic perspectives use of SP tetrahydrate+water is recommended as it is biocompatable and user friendly.

REFERENCES

1. Galen W. Wagnild, Kathy I. Mueller. Restoration of the Endodontically Treated Tooth. In: Pathways of Pulp, Stephen Cohen, Kenneth M. Hargreaves, 9th edn. Mosby, Elseveir Science, 786–821, 2006.
2. Harrington GW, Natkin E. External resorption associated with bleaching of pulpless teeth. J Endodon, 5: 344–8, 1979
3. Lado EA, Staneley HR, Weisman MI. Cervical resorption in bleached teeth. Oral Surg, 55: 78–80, 1983.
4. Bussadori SK, Roth F, Guedes CC et.al. Bleaching non vital primary teeth: case report. J Clin Pediatr Dent, 30(3): 179–182, 2006.
5. Silvas C. Perborate as a bleaching agent. JADA, 24:324, 1938.
6. Spasser HF. A simple bleaching technique using SP. NY State Dent J, 27: 332–4, 1961.
7. Andreasen JO, Andreasen FM, Andersson L. Textbook and color atlas of Traumatic Injuries to the Teeth, 4th edition, Blackwell publishing; Munksgaard. p. 853, 2008.
8. Grossman LI, Oliet S, Del Rio CE, Endodontic Practice, 11th edi, Indian Edition, Varghese Publishing House, Bombay 1991.
9. Farmer DS, Burcham P, Marin PD. The Ability of Thiourea to Scavange Hydrogen Peroxide and Hydroxyl Radicals during the Intra-Coronal Bleaching of Blood Stained Root- Filled Teeth. Australian Dental Journal, 51(2): 146–152, 2006.
10. http://www.lenntech.com/Fenton-reaction.htm
11. http://www.rsc.org/Education/EiC/issues/2007May/Exhibition Chemistry.as
12. Hydrogenperoxidehttp://www.lenntech.com/library/oxidation/h2o2/hydrogen-peroxide.htm
13. Rotstein I, Torek Y, Misgav R. Effect of cementum defects on radicular penetrations of 30% H_2O_2 during intracoronal bleaching. J. Endod, 17(5): 230–3, 1991.
14. Sharma DS, Sharma S. Radicular Penetration of Hydrogen Peroxide From Various Intra-Coronal Bleaching Agents: An *in-vitro* Study. JPFA, 22: 53, 2008.
15. Imlay JA, Chin SM, Linn S. Toxic DNA damage by hydrogen peroxide through Fenton Reactions *in vivo* and *in vitro*. Science. 29, 240, issue 48, 52: 640–642, April 1988
16. Schroeder HE, Scherle WF. Cemento-enamel junction revisited. J Periodont Res, 23: 53–9, 1988.
17. Madison S, Walton R. Cervical root resorption following bleaching of endodontically treated teeth. J Endodon, 16: 570–4, 1990.
18. Sherwood AI, Miglani RS, Lakshminarayan L. Efficacy of glass ionomer as a barrier material in non-vital bleaching – A stereomicroscopic study. Endodon, 16: 12–15, 2004.
19. Weiger R, Kuhn A, Lost C. Effect of various types of SP on the ph of bleaching agents. J Endodon, 19 (5): 239–41, 1993.
20. Ari H., Ungor M. In vitro comparision of different types of SP used for intracoronal bleaching of discoloured teeth. Int. Endod J, 23: 167–9, 2002.
21. Ellias E., Sajjan G. Effects of bleaching on microleakage of resin composite restorations in non-vital teeth: An *in vitro* study. Endodont, 14: 9–13, 2002.
22. Oliveira DP, Teixeira ECN, Ferraz CCR, Teixeira FB: Effect of Intracoronal Bleaching Agents on Dentine Microhardness. J Endod, 33: 460–462, 2007.
23. Sharma DS, Sharma S, Natu SM, Chandra S. An in vitro evaluation of radicular penetration of hydrogen peroxide from bleaching agents during intra-coronal tooth bleaching with an insight of biologic response. J Clin Pediatr Dent 35(3): 289-294, 2011.
24. Amato M, Scaravilli MS, Farella M, Riccitiello F. Bleeching Teeth Treated Endodontically: Long-Term Evaluation of a Case Series. J Endod, 32: 376–378, 2006.
25. Plationo G, Buono L, Grande NM et.al. Nonvital Tooth Bleaching: A Review of the Literature and Clinical Procedures. J Endod, 34: 394–407, 2008.
26. Goon WWY, Cohen S, Borer RF. External cervical root resorption following bleaching. J Endod, 12: 414–8, 1986.
27. Gardnera AM et.al., Apoptotic vs. Nonapoptotic Cytotoxicity Induced by Hydrogen Peroxide. Free Radical Biology & Medicine, 22 Issue 1–2: 73–83, 1997.