An effective bleaching technique for non-vital, discoloured teeth in children and adolescents

Discolouration of a permanent incisor may have a significant social impact on children and adolescents. Intervention should be minimally destructive of tooth tissue and should not compromise future restorative options. This paper reviews the technique of inside/outside bleaching, and proposes it as an efficient, effective and acceptable method for use in the compliant younger patient with an unaesthetic non-vital tooth.

This paper aims to describe the use of the inside/outside bleaching technique as an excellent management option in selected young patients with a discoloured permanent incisor.

The inside/outside bleaching technique
Settembrini et al (1997) originally described the inside/outside bleaching technique. As its name implies, bleaching takes place within the tooth and on the outside of the tooth simultaneously. Bleaching gel is placed on the internal and external aspects of a non-vital, root filled, discoloured tooth and refreshed regularly. 10% carbamide peroxide gel is the most commonly used concentration and the most researched. Gel is usually available in a user-friendly pre-loaded syringe. A variety of products are commercially available including Opalescence®, NiteWhite® and Polanight. Carbamide peroxide was originally used as an oral antiseptic in the

### Table 1: Management options for a discoloured permanent incisor.

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**Key words**
Bleach, non-vital, discoloured, endodontics, children, adolescents.

**Introduction**
Permanent incisors may discolor following trauma, loss of vitality, endodontic treatment and restorative procedures. The blood pigment haematin is responsible for enamel and dentine staining following trauma-induced erythrocyte destruction. Other causes of discoloration in endodontically treated teeth include obturation materials, remnants of pulp tissue in the pulp horns, intracanal medicaments and coronal restorations.

Noticeable discoloration of teeth can impact on a person’s self-image, self-confidence, physical attractiveness and employability. A darkened incisor is of particular concern in children and adolescents, as during these vulnerable formative years facial appearance may affect friendships and confidence development. Over the years a number of bleaching and restorative techniques have been proposed for managing discoloured non-vital incisors (Table 1).
Bleaching in children and adolescents

Intervention is clearly indicated for a discoloured non-vital incisor if it is deemed that the presence of the unsightly tooth is a cause of social distress to that person. In these cases the inside/outside bleaching technique often represents the most conservative and effective treatment option compared to placing restorations. It is usually desirable to delay definitive restorative treatment of young permanent incisors until they have fully erupted and the gingival architecture is mature. The technique has also been used successfully in immature teeth following apexification procedures (Case 4). It has been reported that the teeth of young adolescents are easier to bleach than adult teeth as the enamel is more permeable and this permeability decreases with age.11 As compliance may be a problem in younger patients, it is important that both the child and the parent are fully informed and committed before pursuing tooth-whitening treatment.

Case selection

Case selection is paramount to the successful use of the inside/outside bleaching technique. A thorough assessment must be made to ensure suitability of the patient and the endodontically treated tooth.

Patient selection

Assess patient compliance, and that the patient has the necessary manual dexterity required for bleaching administration. It is important that the patient understands the unfavourable consequences of delayed coronal seal replacement. In the three- to seven-day treatment course, the coronal access is open but unlikely to develop problems, especially given the antibacterial nature of urea. A longer time frame will predispose the vulnerable tooth to bacterial invasion, possible endodontic failure and caries. Immature root development may also predispose the tooth to cervical fracture, especially without reinforcement from an intra-coronal restoration.14

The patient’s medical history should be reviewed to highlight any medical conditions that may contraindicate bleaching, e.g., enzymatic disorders and any known allergies to H2O2 and plastics.15

Tooth selection

A comprehensive clinical and radiographic examination must be carried out, including trauma history, existing restorations and quality of endodontic treatment. Some oral conditions that need to be resolved prior to bleaching or may contraindicate the use of bleaching.

The chemistry of bleaching

10% carbamide peroxide (CH3N2O2) releases 3.35% hydrogen peroxide (H2O2) and 7% urea in a hydrophilic environment.1,2 The urea elevates the pH of the mouth, imparting antibacterial and bacteriostatic properties. CH3N2O2 is reported to be more antibacterial than 0.2% chlorhexidine in vitro.10 H2O2 is the active ingredient, being a powerful oxidising agent, which produces free radicals and nascent oxygen in the presence of water.11,12

These small molecules can pass freely through and penetrate the enamel and dentine to decolour or solubilise the chromogenic material within the tooth structure.1,8 It is thought that the bleaching action is achieved by breaking down large coloured molecules that cause staining (by cleaving or reducing double bonds) into smaller molecules. These smaller molecules are then either small enough to diffuse out of the tooth structure or absorb less light and appear lighter.13 H2O2 degrades over time, with a reported 50% being available after two hours.14
Step 1: Obtain written informed consent.

Step 2: Ensure quality of endodontic restoration and vitality of adjacent teeth (Figure 1).

Step 3: Record pre-operative shade clinically and photographically (Figure 2A).

Step 4: Construct plastic bleaching tray from an alginate impression (Figure 2B).

The tray should extend to at least two teeth on either side with a reservoir on the tooth to be bleached.

B: TOOTH PREPARATION

Step 1: Remove necessary restoration.

Remove restorative material from the external facial surface of the tooth requiring contact with the bleaching gel, e.g., composite veneer (see Case 3).

Step 2: Access the pulp chamber and thoroughly clean off any debris.

An ultrasonic scaler or EMS is useful for removing residue.

Step 3: Remove GP 2-3mm below cementoenamel junction.

Use endodontic burs, Gates Glidden or a heated plugger. Confirm measurement using periodontal probe or endodontic files with a stop (Figure 3).

Products include poor oral hygiene, dry mouth, un-restored caries and severe enamel erosion. It is important to diagnose the cause and type of tooth discolouration. Grey-brown intrinsic discolouration of pulp origin is most amenable to the inside/outside bleaching technique. Other causes of staining may be less predictably bleached. In the authors’ experience, a yellow discolouration may be less amenable to bleaching, may require multiple treatments and may recur.

The adequacy of the endodontic obturation should be reviewed and have a well-condensed appearance on a periapical radiograph (Figure 1). It is imperative to ensure that there is no evidence of periapical pathology. Inadequate root fillings must be revised and re-treated, and bleaching delayed for at least

Concerns regarding bleaching

Cervical root resorption

Resorption is thought to be related to bleach diffusing through patent dentine tubules into the cervical cementum and periodontal ligament, causing a tissue reaction and an inflammatory response, leading to root resorption. The cases in which internal bleaching has been associated with cervical resorption are invariably those cases where heat, light and high concentrations of H₂O₂ have been used. Further risk factors include trauma, bleaching before endodontic materials are set, and failure to seal the gutta percha (GP) with an appropriate base material. There is no evidence reporting cervical resorption when low concentrations of H₂O₂ are used without heat, as in inside/outside bleaching.
Step 4: Seal the GP.
Place ≥2mm glass ionomer cement (resin modified or conventional) or zinc phosphate cement as a protective seal over the GP to prevent leakage (Figure 4). Placing the base at the CEJ reduces bleach permeability through the cervical dentine.22

Step 4: Etch the internal aspect of the tooth with 30% phosphoric acid.
Etch for one minute; this removes the smear layer and opens the tubules.

Step 5: Deliver 10% CH₃N₂O₃ bleach, tray and clear instructions.

C: BLEACHING HOMEWORK
Step 1: Instruct the patient to inject bleaching gel into the canal orifice.
Step 2: Load the tray reservoir with a pea sized amount of gel. It may be useful to mark the correct tooth on the tray with an alcohol pen.
Step 3: Insert the tray over the teeth and remove any excess gel. Use finger, cotton wool, tissue.
Step 4: Change bleach gel every two to four hours during the daytime and before bed. Remove for tooth cleaning only. Avoid contact sports.
Step 5: Clean the access cavity between bleaching sessions. Use end-tufted or TePe® brush, or a syringe with water.

D: CLOSURE
Step 1: Review after three to five days.
Assess the degree of lightening. Continue for a further three to four days if necessary. It is recommended to slightly over-bleach the tooth (see Cases 1 and 4). When the desired colour has been achieved, clean the pulp chamber thoroughly with an ultrasonic scaler.
Step 2: Provisionally restore the access cavity for at least two weeks, to ensure set of obturation and sealant materials.8,17
Patients should be aware that even adequate coronal restorations may require replacement following bleaching to ensure good aesthetic match.

Protocol for inside/outside bleaching (see panel above)
The protocol may be divided into four stages:
- preoperative visit;
- tooth preparation;
- bleaching homework; and,
- closure stage.

Legal aspects
There is ongoing controversy over the legal situation regarding the use of tooth bleaching products. Under European legislation, 10% CH₃N₂O₃ is considered a cosmetic product rather than a medical device. At present it is illegal to supply a product for the purpose of tooth whitening, if that product contains or releases more than 0.1% H₂O₂. Changes to this legislation have been forecast, and the reader is referred to the following website for links and the latest updates: http://www.bdb.co.uk/.

Given the unclear legal situation, it is important to discuss the options, weigh up the risks and benefits with the patient, and obtain written informed consent. Clinical notes should reflect that the bleaching option is in the best interest of the patient. In many cases, non-vital bleaching represents the most predictable and conservative treatment option compared to destructive removal of healthy tooth structure.
Clinical cases

Cases 1 to 4 show some examples of successful use of the inside/outside bleaching technique in children and adolescents by the authors. These cases illustrate the variable clinical circumstances in which this easy and effective technique may be applied.

Case 1
A 12-year-old boy presented with a history of luxation of tooth 21 at age 10. The incisor had subsequently lost vitality and discoloured. Adequate endodontic treatment had been completed. Inside/outside bleaching was applied for four days, with the incisor being slightly over-bleached. The bleaching result remained stable at 15-month review.

Case 2
A 13-year-old girl presented with a discoloured 21. The tooth had lost vitality following trauma six months previously. Root canal treatment was performed and the tooth was monitored for healing for a number of months. Inside/outside bleaching was subsequently carried out for six days. A highly cosmetic post-bleaching result was achieved and lightening remained stable at seven-month review.

Case 3
A 13-year-old boy presented with a discoloured 11 and an unaesthetic composite veneer. There was a history of luxation injury to this tooth at age nine. The tooth was asymptomatic with a satisfactory root canal treatment. The composite veneer was removed to allow bleach access to external tooth surface. Inside/outside bleaching was applied for five days. A stable highly aesthetic outcome was achieved; the patient was very satisfied and requested no further treatment.

Case 4
A 10-year-old girl presented with a history of an uncomplicated crown fracture of 21 at age eight. An apexification procedure was performed using MTA on the immature incisor. The tooth was subsequently bleached using the inside/outside technique for four days and then restored with composite resin.

Conclusion
The above clinical cases highlight the effectiveness of the inside/outside bleaching technique in producing successful and predictable cosmetic results in young patients. The use of lower concentration H2O2 minimises the risk of root resorption that exists with walking and power bleaching techniques. Inside/outside bleaching provides a less destructive and cost-effective alternative to veneers and their subsequent replacement. Although increased patient co-operation and commitment is required, results are more rapid and reliable than the walking bleach technique. The authors have found both in-chair and homework compliance to be excellent, and patients reported exceptional satisfaction with the outcome. The clinical success and reduction of potential harmful sequelae invite the inside/outside bleaching technique to be recommended as the treatment of choice for non-vital discoloured incisors in young compliant patients.

References


