

# Bleaching Discoloured Teeth

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**Abstract:** The bleaching of teeth has encountered some legislative problems over the past few years but it is now possible to use both vital and non-vital bleaching techniques in the UK. Hydrogen peroxide has a long history of use and would appear to be safe to use to change the appearance of discoloured teeth. It is conservative of tooth tissue and may delay the need for more invasive veneers and crowns. This article describes some of the methods of bleaching using hydrogen peroxide that are currently available.

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**Clinical Relevance:** At the time of writing bleaching appears to be a treatment option yet again. The technique is conservative of tooth tissue, relatively safe, reliable and can often provide a better restorative solution than direct or indirect restorations.

Home bleaching of teeth has had a chequered history in recent years since its introduction into the UK in the late 1980s and recent changes to the advice given to dentists by the legislative authorities have resulted in the technique being re-introduced into clinical practice. The use of hydrogen peroxide to bleach teeth dates back well into the nineteenth century but more recent applications have been researched by Haywood and Heymann<sup>1</sup>. The technique is safe, usually reliable and conservative of tooth tissue - and as such should be considered for improving the appearance of discoloured teeth. In 1992, *Dental Update* published an article on home bleaching but the timing was unfortunate, as it coincided with the authorities banning carbamide peroxide products.<sup>2</sup> This article will review the various methods of bleaching and show

clinical applications wherever appropriate.

There are two forms of bleaching:

- vital; and
- non-vital.

Both clinical techniques rely upon the action of hydrogen peroxide to change the appearance of the teeth.

## MODE OF ACTION

Hydrogen peroxide is a very small molecule and is naturally produced by the eyes in low concentrations.<sup>3</sup> It would appear that hydrogen peroxide oxidizes unattached stain or organic matter from teeth, changing their appearance.<sup>4</sup> Historically, hydrogen peroxide was activated by light or heat but more recent techniques have used slow release of the molecule close to the tooth surface. The porous nature of enamel and dentine allows hydrogen peroxide to permeate and oxidize the stains.<sup>5</sup>

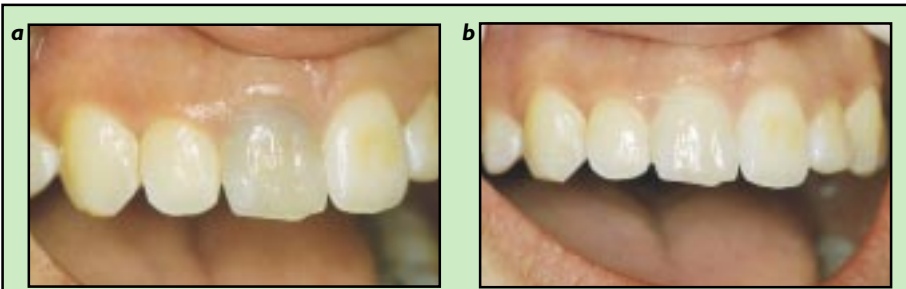
## SAFETY

The safety of any material used in

dentistry is paramount. Bleaching has been used for over a century, How, 1868<sup>6</sup> and Kirk, 1889<sup>7</sup> being the first to describe its use. Most of the early work concentrated on bleaching non-vital teeth but vital teeth were also treated. In the late 1960s Nutting and Poe<sup>8</sup> described the 'walking bleach' technique, which involved placing hydrogen peroxide and sodium perborate for prolonged periods in the access chambers of well-sealed, root-treated teeth. About the same time, carbamide peroxide placed in a close-fitting custom-made tray and applied to discoloured teeth was described as a method to bleach vital teeth.<sup>3</sup> The technique did not become widespread until Haywood and Heymann re-introduced it in 1989.<sup>9</sup> Carbamide peroxide and sodium perborate both break down to form hydrogen peroxide. Despite the recent changes in the regulations for its use the technique has held a high degree of support from dentists in the UK.

Kelleher and Roe, in their literature review,<sup>10</sup> reported that application of hydrogen peroxide, in the form of 10% carbamide peroxide, does not provoke mutagenesis in humans. The molecule is present naturally within the body in a variety of physiochemical processes and in all probability the effect on tissues is minimal. Ito *et al.* described malignant changes in rats continually exposed to 0.1-0.4% hydrogen peroxide for up to 100 weeks (over 2 years),<sup>11</sup> but other researchers have not been able to demonstrate similar findings. Dahl and Becher reported no significant change in duodenal tissue (apart from ulceration) following long-term exposure to relatively high concentrations of hydrogen peroxide.<sup>12</sup>

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**Figure 1. (a)** A central incisor that has darkened after trauma. **(b)** The tooth was root-treated and then bleached using the 'walking bleach technique' described by Nutting and Poë. The stability of this treatment varies between patients – in some people it lasts years but in others a much shorter time.

There appears to be little risk that home bleaching agents adversely affect teeth. For instance, Lewinstein *et al.* reported no changes to the hardness of enamel and dentine;<sup>13</sup> the surface characteristics of teeth appear unaffected<sup>14,15</sup> and composite materials appear likewise undamaged.<sup>16</sup> Some clinicians advocate bleaching teeth first and then reassessing the need for changing the colour of composite restorations.

The problem most commonly associated with bleaching is resorption; this is usually associated with techniques used to lighten non-vital teeth.<sup>17</sup> The more traditional techniques for activating hydrogen peroxide involved plunging red-hot instruments into the access cavity of a root-treated tooth and in these cases cervical resorption has been recorded as a possible sequel.<sup>18</sup> However, there are no reports in the literature of resorption occurring without temperature rises or with concentrations of hydrogen peroxide below 3%.<sup>3</sup>

## NON-VITAL BLEACHING

### Case Selection

Non-vital teeth that have discoloured as a result of trauma can be successfully bleached, but those with other intrinsic stains such as amalgam or remineralized lesions will be more resistant to colour change. Teeth with minor restorations on the buccal surface – or, ideally, those with only an access cavity present – are

the most successfully bleached. Teeth with extensive restorations are usually more effectively treated with crowns.

Ideally, the shade of the unbleached tooth should be recorded using a shade guide or clinical photographs before attempting to bleach it.

### Clinical Technique

Nutting and Poë<sup>8</sup> advocated placing a slurry of sodium perborate and hydrogen peroxide in the access chamber of non-vital teeth, provided that an adequate seal is present both apically and coronally. They called this the 'walking bleach' technique.

It is essential (in the view of the author) to ensure that the root treatment is asymptomatic, free from periapical changes and has a good obturation with gutta-percha. Once the root treatment has been completed all the remaining gutta-percha should be removed to below the level of the gingival margin within the radicular canals. It is also important to ensure that the buccal surface of the access cavity is free of restorative material such as composite; although theoretically the bleaching agent can permeate around or through the material, it is more convenient to ensure that the material has been removed at the start. A glass ionomer, zinc phosphate or composite lining should be placed in the radicular part of the root canal below the gingival margin to seal the canal from the bleaching agent. Some practitioners have advocated etching the internal surface of the cavity with a proprietary etchant. However, Casey and co-workers

reported that etching made no difference to the success of bleaching.<sup>19</sup>

Once the access cavity is clear, 100-volume hydrogen peroxide (obtainable from chemists or hospital pharmacists) is mixed with powdered sodium perborate to produce a damp slurry. The slurry is carried to the tooth, surrounded by a rubber dam, and placed so that it partially fills the pulpal chamber. A cotton wool pellet is then placed on top of the slurry and the access cavity sealed with temporary cement (this can be zinc oxide eugenol, polycarbonate cement, glass ionomer or composite). The patient is reviewed within 2 weeks and the process repeated until the colour is improved to the patient's satisfaction. Often the site that is most resistant to bleaching is around the cervical margin and onto the root surface.

Figure 1 shows the pre- and postoperative colour of a darkened non-vital tooth following trauma. The appearance improved greatly after 2 weeks.

### Other Non-vital Bleaching Techniques

Non-vital bleaching can be achieved with different formulations, but all use the reactivity of the superoxide ion to change the colour of a tooth. Any technique that relies upon heat to activate the peroxide ion increases the risk of cervical resorption and should be avoided.<sup>17</sup>

Sodium perborate mixed with water has been shown in *in vitro* and clinical studies to be as effective as mixing hydrogen peroxide and sodium perborate.<sup>20,21</sup> Holmstrup and Lambjerg-Hansen reported a 90% success at the end of the bleaching but, after 3 years, 20% had begun to discolour again.<sup>21</sup> Some practitioners may have difficulty in obtaining the necessary concentration of hydrogen peroxide (100 volume or 30-35%) from pharmacists and this simpler method may prove to be more convenient.

Frazier,<sup>22</sup> amongst others, reported that home bleaching agents could be used to bleach non-vital teeth successfully. The protocol differs only slightly from that described below but requires patient



**Figure 2.** White opaque lesions on the two central incisors. These could be treated by bleaching but may be more responsive to acid abrasion or enamel biopsy techniques followed by localized composite restorations.

compliance for success.

Inside-outside bleaching using home bleaching and an open access chamber is another method to achieve the same results.<sup>23</sup> The difference in this method is that the access chamber in the root-filled tooth is left open, a material placed to seal the radicular canal, and the home bleaching agent placed buccally and palatally to produce the bleaching. The only reservation about using this technique is the potential for microleakage around the radicular seal and the possibility of apical changes as a result. Provided the radicular seal is placed (recommended for all non-vital bleaching techniques) the technique should be safe.

Finally, the plasma light, which produces an intense curing light, has been used to bleach vital teeth and could theoretically be used to enhance the effect of non-vital bleaching.<sup>24</sup>

## VITAL BLEACHING OR HOME BLEACHING

### Case Selection

Unlike non-vital bleaching, most cases of vital bleaching involve more than one tooth. Darkening of teeth caused by ageing is possibly one of the more common forms of discoloration of teeth and is successfully treated with vital bleaching. Tetracycline-stained teeth are not as common as they were 10-15 years ago as the medical and dental profession are now fully aware of the implications of prescribing drugs that cause staining

during tooth development. However, tetracycline stain can be found in people born outside the UK. The severity of tetracycline stains can vary from a brown-yellow coloration, which can respond to bleaching, to a blue-black, which traditionally is more resistant. Fluorosis is more commonly found within the UK and can present as white or brown speckles or patches on teeth (Figure 2). The brown discoloration can be removed by bleaching but the white opacities are more resistant, although bleaching can in some situations reduce the brilliance of the white by merging the colour with the surrounding teeth. More localized discoloration on teeth can occur in any severe childhood illness and may also cause changes in the shape of the teeth due to disruption in the tooth development.

For successful bleaching case selection is extremely important. People perceive colour differently and what appears acceptable to one person may not be to someone else. It is also important to attempt to distinguish with what aspect of a tooth a patient is dissatisfied. It may be that the relatively darker area around the cervical-gingival margin of a canine is unacceptable to a patient, but once this is explained as a natural phenomenon their concern may be alleviated and treatment becomes unnecessary. Incidentally, this area is also more resistant to changes in tooth colour by bleaching.

### Clinical Technique

The most commonly referenced vital bleaching products are those containing a 10% solution of carbamide peroxide.

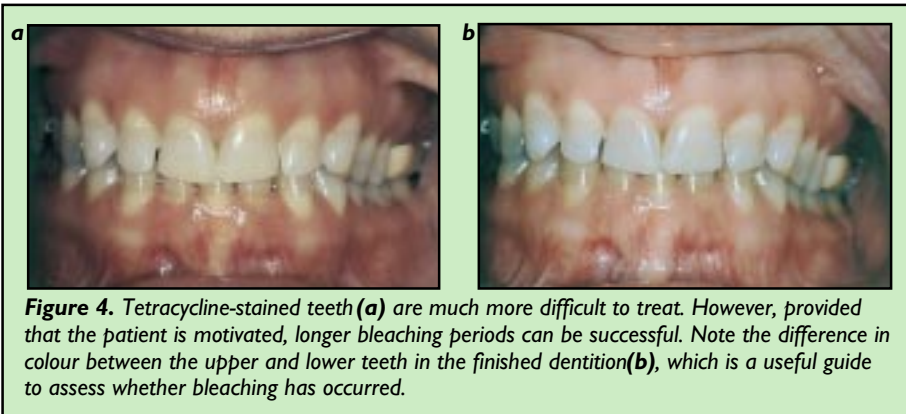
This material breaks down to form a 3% solution of hydrogen peroxide and urea. The carbamide peroxide is usually delivered in a viscous gel, which is applied closely to teeth via a custom-made vacuum-formed appliance. The appliance should be well contoured to the gingival margins to reduce the potential for irritation of the gingival tissues and spaced over the teeth that are to be bleached. This spacer is applied to the working model on the teeth that will be bleached and can be a proprietary material or common laboratory product such as die relief or nail varnish. The thickness of the appliance should be around 2 mm – not so thick that it causes discomfort.

In a study by Frazier and Haywood,<sup>25</sup> 81% of dental schools taught the use of reservoirs and scallops around the gingival margin in the design of the bleaching appliance, whilst only 13% used trays without reservoirs, indicating the popularity of the former technique.

Home bleaching products are most successful if the patient applies the material into the trays for 6-8 hours a day (often overnight) and usually over a period of 3-4 weeks, but different products vary. Frazier and Haywood reported that bleaching was most commonly successful after 2-4 weeks.<sup>25</sup> For more intense stains, such as that found with tetracycline, it may take between 3 and 6 months to reach a successful result. If patients do not add the bleaching agent regularly to the tray there is insufficient time for the hydrogen peroxide to work and they become disappointed, which becomes a vicious circle and success is unlikely.



**Figure 3.** Slight changes in colour due to ageing or a generalized yellowing of teeth can be successfully changed with bleaching. This form of treatment is much more conservative of tooth tissue than the alternatives, which are veneers or crowns.



**Figure 4.** Tetracycline-stained teeth (a) are much more difficult to treat. However, provided that the patient is motivated, longer bleaching periods can be successful. Note the difference in colour between the upper and lower teeth in the finished dentition (b), which is a useful guide to assess whether bleaching has occurred.

It is helpful before treatment to match a shade guide to the stained teeth before treatment is commenced and if possible take a photograph of the teeth for the patient's records.

Figure 3a shows the initial appearance of the teeth of a patient who requested bleaching. The teeth were bleached with a proprietary vital bleaching product for a period of 3 weeks, during which time they whitened considerably (Figure 3b). The potential for success in this type of stain is good. More importantly, the alternative treatment for minor changes in tooth colour would be veneers or crowns – both of which would be more destructive.

Although tetracycline staining can be successfully treated (Figure 4 a and b), a longer period of bleaching is needed to ensure a satisfactory result. In addition, the cervical margins around tetracycline-stained teeth appear to be more resistant and generally the colour appears brighter rather than whiter.<sup>3</sup>

Single teeth that would otherwise have needed crowns or veneers can also be bleached. In Figure 5 an implant-supported bridge has been placed using the adjacent teeth as a guide to the colour of the crowns. However, once the bridge had been placed the patient was unhappy with the appearance of the canines, which were subsequently bleached. Arguably, the canines should have been bleached before the implant-supported bridge had been made but (as is often the case) patients appreciate the possibilities only after treatment has been performed.

### Possible Complications

A relatively common feature with vital bleaching is cervical sensitivity. Obviously if this becomes problematic the treatment should be discontinued but some patients are willing to accept minor discomfort in an effort to achieve a change in the colour of their teeth.

Another possible complication is that the teeth may darken over time and the colour change reverses but the result is individual to each patient. This can affect both vital and non-vital bleaching techniques. Haywood reports that bleaching is usually stable for 1-3 years and, whilst the shorter time may be acceptable to some patients, the longer duration would probably be acceptable to most.<sup>10</sup> If the bleaching reverses in a relatively short time, other methods should be considered to change the colour of teeth.

### Variations on Home Bleaching

Methods using high concentrations of hydrogen peroxide have been described

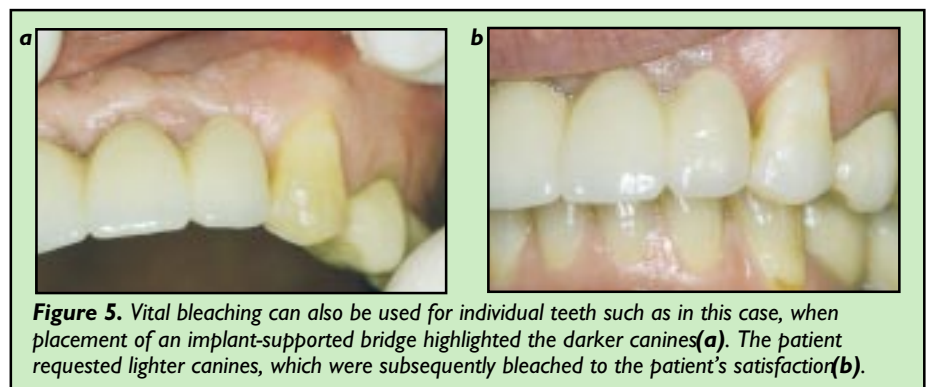
to bleach discoloured teeth. Some of these involve the dentist applying a high concentration of bleach to 'start' the process or may, in some cases, be successfully used on their own. Activation with a plasma light has also been described.<sup>24</sup> The legal basis for using these techniques may be more complicated than for the techniques described above.

### ACID ABRASION

Reports of the use of concentrated hydrochloric acid mixed with pumice on teeth to improve the colour date back to early in the nineteenth century. These techniques were re-introduced by Shaw and Welbury in 1990,<sup>26</sup> and more recently by Elkhazinder and Welbury.<sup>27</sup> Acid abrasion utilizes the etching power of hydrochloric acid together with the abrasive nature of pumice to remove the outer portion of enamel to remove localized stains on enamel. Unlike bleaching, this technique is limited to localized discoloration and is not applicable to more extensive stains such as tetracycline and age-related changes. This technique can be used to remove the brown speckles on fluorotic teeth, but it is less successful on the white opacities.

### CONCLUSION

Assessment is the most important stage in the treatment of discoloured teeth. It is essential to identify with what aspect of a tooth's appearance the patient is dissatisfied and to direct treatment



**Figure 5.** Vital bleaching can also be used for individual teeth such as in this case, when placement of an implant-supported bridge highlighted the darker canines (a). The patient requested lighter canines, which were subsequently bleached to the patient's satisfaction (b).

accordingly. Bleaching, whether vital or non-vital, is a useful adjunct to treatment and is conservative of tooth tissue. Importantly, provided the right case is selected, it is also successful.

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ABSTRACTS

MORE EVIDENCE TO STOP PATIENTS SMOKING

Effect of Smoking on Periodontal Health in Molar Teeth. V. Kerdvongbundit and U.M.E. Wikesjö. *Journal of Periodontology* 2000; **71**: 433-437.

Whilst we frequently tell our patients that the primary cause of their gum disease is bacterial infection of long duration, how many times do we reinforce the fact that research shows an increased breakdown of alveolar bone in smokers compared to non-smokers?

These workers examined 120 regularly attending patients, half of whom were long-term smokers. The average consumption was 17 cigarettes per day, and the average duration of smoking was 21 years.

No noticeable differences were found between the oral hygiene standards and dental care habits of the two groups.

However, the smoking group had significantly fewer molar teeth remaining, and significantly advanced gingival recession, probing depths, clinical attachment loss, furcation involvement and tooth mobility.

Next time you are treating a patient with periodontal disease, your advice about smoking cessation may actually be more beneficial than that about oral hygiene measures!

UP TO DATE WITH THE CORE OF KNOWLEDGE?

Are Dental Radiographs Safe? P. Abbott. *Australian Dental Journal* 2000; **45**: 208-213.

It is important to remember that any dose of radiation has the potential to induce malignant change, and that such effects are cumulative. All dentists have a duty to be familiar with the 'Core of Knowledge' of radiographic procedures. This paper sets out the historical and current situation, and recommends 'best practice' techniques, including the use

of film-holders, equipment maintenance and accurate processing.

It is disturbing to read that in an Australian dental survey, 65% of films were considered to be inadequate for diagnostic purposes, and 89% had not been processed adequately. In spite of the relatively low risk of radiation in dental practice, the author suggests that dentists should not be complacent, but have a professional responsibility to maintain good safe radiation procedures at all times.

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