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Bleaching and Bonding for the Older Patient

Abstract: Older people who remain reasonably well may wish to maintain or enhance their dental and oral appearance, preferably at minimal biologic and financial costs. Bleaching and bonding represents a very good treatment option and a sensible strategy for this group. Bleaching addresses the discoloration, while direct composite bonding can improve the shape of worn, or otherwise unaesthetic, teeth without damaging the structure or health of the residual tooth tissue. This pragmatic treatment is well tolerated by older patients. The visual and functional improvements are greatly appreciated by this group, partly because of the non-destructive and affordable nature of the benefits.

Clinical Relevance: Bleaching and bonding represents a proven, sensible, pragmatic, affordable and practical approach to managing the aesthetic problems of older patients, and the benefits are achievable without destroying their residual sound tooth tissue.

Dent Update 2011; 38: 294–303

Chronologic age affects different people in a huge variety of ways, including their perception of their self image. There are enormous variations in the expectations of older people. Many are physically well and want to maintain, or enhance, their dental and oral appearance, preferably at a minimal

biologic cost. For this group bleaching and bonding represents very good biologic and financial value. The accumulation of various stains over many years often results in yellowing or browning of the teeth. This can be regarded, by some patients, as being an unacceptably ageing feature of their smile. Many well-groomed older people regard these stains and discolorations as being capable of being interpreted by others, such as their young grandchildren, as reflecting poor maintenance cleaning on their part.

Wear of teeth is a normal physiologic aspect of ageing but, if pathologic, can result in shortened, worn teeth where the visible internal dentine shows. This visibly exposed dentine can become stained, often significantly, by normal dietary chromophores, for example tea, coffee, red wine, curry, or worse, by cigarettes, cigar or pipe smoking. These shortened teeth can look dark and the combination of dark colour and shortened shape is unacceptable to many patients.

At every age there is beauty for those who can see it. Attitudes to smiling in older patients show great variations, with the traditional loss of a visible smile being associated with 'unhappy granny' or 'grumpy old men'. Less upper tooth tends to show

with age and more lower tooth is frequently visible in older patients.

Thirty or forty years ago the loss of teeth and their replacement with dentures with small light teeth was regarded as a frequent part of growing old. That is certainly not the current perception of many demanding, well informed 'consumers' who are well aware of the benefits of having a youthful smile. Many such older people wish to have this more youthful smile accomplished without the significant long-term biologic downside of the loss or destruction of their teeth. They would also prefer to avoid very significant technical and financial costs in achieving this outcome.

Satisfaction with dental appearance seems to vary with the society in which the survey is undertaken. For instance, in a study with nearly 900 participants in Florida, dissatisfaction with dental appearance was common in middle-aged and older patients.¹ In another study, women's smiles were deemed to be most attractive if they had a light shade, a high lip line, a large display of teeth and radiated symmetry.² Women's smiles were deemed to be least attractive if they had a dark shade. Men's smiles were deemed to be attractive if they had teeth with a light shade, a

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moderate lip line and displayed symmetrical teeth. Men's smiles were perceived as being least attractive if the teeth were dark.

It is difficult to define what exactly is an 'older patient'. Formerly, the age of 60–65 would be regarded as approaching retirement age but, in many modern societies, this is regarded as 'middle-aged'. There is often a self deprecating humour employed by older patients attending for treatment such as *'when you get past 60 and you wake up in the morning and nothing hurts you are probably dead'* or *'if 60 is middle-aged, how many 120-year-olds do you know?'* In many developed countries, 70 years is frequently regarded as a minimum acceptable life span. Dentists therefore have to plan for appearance maintenance and possible improvement for very many more years than the typical 'three score years and ten'. This is in addition to maintaining chewing function for the long term.

Efficacy of bleaching

The efficacy of nightguard vital bleaching has been established in multiple randomized, double blind, controlled clinical trials.³⁻⁴ Nightguard vital bleaching was first popularized by Haywood and Heymann in 1989.⁵ Standard nightguard vital bleaching is undertaken with 10% carbamide peroxide within a customized mouthguard, which is made from an impression of the patient's teeth. Considerable controversy exists as to how important it is to have reservoirs for the bleaching gel, but most of the classic studies show that reservoirs enable the tray to be fully seated, particularly when one is using a highly viscous 10% carbamide peroxide material. The use of this combination of a viscous gel within the customized mouthguard at night, or at least for two hours, but preferably overnight, will result in a very improved appearance of the teeth (Figures 1, 2 and 3).

Nightguard vital bleaching is done at the patient's own pace and in his/her own time. Once appropriate discussion of the options has been undertaken and consent has been obtained for the treatment, there is very little clinical time involved other than for the impressions, fitting of the trays and giving instructions in the correct methods of use. Written instructions should also be given to patients to reinforce the verbal messages and also to



Figure 1. Discoloured teeth in a 70-year-old patient.



Figure 2. Customized bleaching trays in position with 10% carbamide peroxide.



Figure 3. Teeth after bleaching with 10% carbamide peroxide.



Figure 4. Stained irregular teeth in a 65-year-old patient.



Figure 5. Palatal view of patient in Figure 4. Note heavily repaired dentition.



Figure 6. Close up view of upper anterior teeth. Note Class II div 2, crowding and palatal amalgams.

confirm the patient's responsibilities in terms of compliance being required in order to obtain their desired outcome.

Safety of dental bleaching

The hardness of enamel is not affected by 10% carbamide peroxide at neutral pH, nor is the subsurface hardness of enamel affected down as far as the amelodentinal junction.⁶

After bleaching both dentine and enamel change colour.⁷

Some minor calcium loss has been shown to occur in some laboratory bleaching studies. The loss of calcium that occurs with a night of nightguard vital

bleaching has been estimated as being equivalent to the calcium loss which occurs from drinking one can of Cola.⁸ However, these laboratory results take no account of the dilution and remineralizing effects of saliva, which are obvious protective features of saliva in the normal clinical situation.

Bleaching is simple, safe and effective used alone, or in combination with other bonding techniques. It is particularly effective in lightening yellow or brown teeth, such as those seen in ageing. It is very effective with intrinsic stains of moderate darkness and intensity which are precisely the sort of stains that one sees in older patients. It is good with mottled and darkened areas. Figures 4, 5 and 6 show a

patient aged 65 with significant staining of the teeth. Some of this discoloration is extrinsic and some of it is intrinsic.

It is important to remember that old amalgam restorations should be removed from anterior teeth before undertaking bleaching as otherwise, during bleaching, any copper containing amalgams can produce a green colour of the teeth because the copper in some amalgams can become oxidized to copper oxide which has a green colour. Figure 7 shows the block out resin used to produce the reservoirs for the bleaching agent.

Older patients can be helped to identify which teeth to bleach by using a Stabilo permanent inker pen (Staedtler Permanent Lumocolor Black, Germany ART NR. 313-9) to mark the teeth that are to be bleached on the outside, non-fitting surface of the mouthguard (Figure 8). Figure 9 shows the replacement of palatal amalgams with composite resin followed by bleaching to achieve the desired goal.

The customized bleaching tray can be cut back over those teeth, such as premolars, which contain large amalgams which are *not* to be removed or bleached in order to ensure that these large amalgam-containing teeth do not go green as a result of bleaching. Protective salivary enzymes, such as peroxidases and catalases, inactivate the hydrogen peroxide released by carbamide peroxide. Cutting the tray back in such a way that the saliva can gain access to the teeth that are *not* to be bleached controls any possible greening from teeth where there are existing 'satisfactory' or at least stable large amalgam restorations (Figure 10).

Bleaching and bonding

Once nightguard vital bleaching has been undertaken, simple bonding with direct acid etch retained composite (which should only be undertaken about a week after bleaching) can produce a significant improvement in the dental appearance, with minimal damage to teeth, because the composite is directly bonded to the *external* aspects of the teeth with conventional acid etch techniques. Provided this composite is polished properly, staining is not usually a problem but, even if the composite does stain, it is very easy to re-polish. Alternatively, an impression can be taken following the



Figure 7. Models blocked out to produce reservoirs for bleaching gel.



Figure 9. Palatal amalgams removed and teeth bleached and bonded with composite.



Figure 11. Appearance before bleaching and bonding with direct composite.

composite bonding and a new customized bleaching tray can be made to cover the altered shapes of the newly bonded teeth. Subsequently, 10% carbamide peroxide can be used on an intermittent basis to remove the extrinsic stain, as required, and at such intervals as determined by the patient (Figures 11 and 12).

It is important to point out to patients during the discussion that bleaching and bonding is not destructive of enamel and that composite is a renewable resource. Enamel is not a renewable resource. In the older patient, enamel and any other sound dental tissue are extremely valuable and precious resources which are, potentially, of immense importance for any future dental requirements.

Inside/outside bleaching

Inside/outside bleaching is particularly helpful for teeth that have



Figure 8. Teeth to be bleached identified by permanent black inker pen on non-fitting aspect of bleaching tray, ie avoid bleaching the upper left central incisor. Note dental irregularities.



Figure 10. Bleaching tray that has been cut back at the premolar teeth to prevent the large amalgam filled teeth from going green.



Figure 12. Appearance after bleaching and bonding with direct composite.

become discoloured.

Inside/outside bleaching, particularly if there is a high lip line, can produce a dramatic effect in the appearance of teeth without destroying any enamel in the process.⁹ Once access has been gained to the chamber, it is important that about ten minutes is spent with a very fine ultrasonic tip within the chamber in order to vibrate out the discolouring physical debris, which is often left lurking inside the pulp cornuae and down below the cemento-enamel junction. The residual blood-containing products need to be physically removed with the ultrasonics. The speed with which the tooth can change colour with 10% carbamide peroxide using the inside/outside bleaching technique is often very



Figure 13. Non-vital upper right central incisor and sclerosed upper left central and lateral incisors.



Figure 16. Mouthguards used to hold stannous fluoride gel in position overnight.



Figure 14. Appearance after inside/outside bleaching at the upper right central incisor for 3 days and prolonged bleaching at the upper left central and lateral incisor.



Figure 17. Fluorigard Gel is neutral stannous fluoride forced interproximally between the teeth and kept in contact with them overnight.



Figure 15. Neutral stannous fluoride and 10% carbamide peroxide with customized bleaching trays.

impressive.¹⁰ Figures 13 and 14 show the before and after results of bleaching a non-vital root-filled upper right central incisor with inside/outside bleaching and bleaching two sclerosed upper left incisors.

Bleaching trays and caries prevention in older patients

Part of the reason for the increased longevity of patients is as a result of the multiple medications prescribed for various illnesses. Sadly, many of these life-extending drugs produce xerostomia as an unwanted side-effect. While these drugs do keep patients alive and 'healthier', a drug-induced dry mouth can be very uncomfortable. This drug-induced xerostomia often results in the resumption of intake of sugary drinks, fizzy drinks and other cariogenic substances. In order to combat this potentially serious problem, active dental prevention is required. To combat the development of caries in this age group, stannous fluoride gel can be supplied, or prescribed, to be worn within a customized bleaching tray style mouthguard. Neutral stannous fluoride is obtainable as *Fluorigard* (Colgate-Palmolive Manufacturing, Salford,

Greater Manchester, M5 3FS). *Fluorigard* is an oral gel containing 0.4% w/w stannous fluoride. It is a thick, viscous material and is ideally placed within the standard mouthguard made with the standard bleaching tray protocol.¹¹

The manufacturers of *Fluorigard* are Colgate-Palmolive Manufacturing (UK Limited) who also make *Duraphat 5000* and *2800* which can be used inside the customized trays.

The most sensible Sensodyne gel to use on a pragmatic basis is probably *Sensodyne Total Care* gel which contains both 1450 ppm fluoride as well as sodium fluoride and 5% potassium nitrate which is a proven desensitizing gel. Importantly, this particular gel does not contain n-lauryl sulphate. N-lauryl sulphate is a surfactant and foaming agent which has been linked to sore gingival tissues in some rare cases. There is no need for foaming, as the material is held within the trays and saliva is very much reduced, which means that the risks of swallowing significant amounts are minimized. Please note this needs to be used cautiously and sensibly and only in appropriate patients where the risk to reward ratio is favourable and the risks of serious caries, or worse,

extractions are great eg in patients on IV bisphosphonates (Figures 15 and 16).

The mouthguard forces the neutral stannous fluoride interproximally, thereby helping to arrest decay, especially interproximally (Figure 17).

There is some limited evidence that *Fluorigard Gel*, used in conjunction with carbamide peroxide, controls interdental caries, especially when used with interdental brushes. The customized mouthguards that are used can, therefore, have dual functions by helping to control caries and also improving the appearance of teeth. It should be noted that carbamide peroxide is an antiseptic and is listed as such in *Martindale's Pharmacopoeia* (www.martindalecenter.com) and the *British Pharmacopoeia* (2011) (www.pharmacopoeia.com).

This active prevention, or medication of the teeth, approach is particularly important when dealing with a heavily compromised dentition (Figures 18 and 19), where recurring decay around the necks of the teeth can produce a 'chipmunking' effect which can be extremely difficult to control with a conventional 'drill and fill' approach. For many of these heavily compromised dentitions, the loss of one tooth can precipitate further difficult and unpredictable decisions involving invasive procedures. Most of these further destructive procedures do not have a good prognosis because the teeth adjacent to the tooth that has to be lost are often heavily compromised themselves.

Replacement of one single implant between heavily compromised teeth carries with it its own high risk



Figure 18. Heavily restored dentition with caries around the margins of the crowns.



Figure 19. Radiograph of very heavily restored dentition with evidence of marginal caries.

profile, especially given the time and cost implications for implant therapy in this older age group. Stopping the 'chipmunking' effect of the recurring caries around the teeth is therefore very important and cost-effective. This can be done as night-time 'active prevention'. If the patient sleeps with the mouthguard with the neutral stannous fluoride 0.4% w/w within it, this can significantly alter the biologic balance in the favour of remineralization. That said, this preventive approach can occasionally produce a yellow (tin) staining of teeth in some patients, although this staining is very superficial and easy to remove. If staining is a problem, then using 10% carbamide peroxide overnight in the mouthguards quickly eliminates the stain. In addition to its bleaching effect, carbamide peroxide is a known oxidizing antiseptic which interferes with bacterial synthesis. As well as re-bleaching the teeth themselves, carbamide peroxide eliminates any yellow/brown tin staining which can be an undesirable side-effect of using the protective stannous fluoride gel.

The recent realization that the widespread use of bisphosphonate therapy carries with it a whole new series of, as yet unquantified, implications for extractions means that *active* prevention using mouthguards with a combination of carbamide peroxide and stannous fluoride can help the ageing, multiply medicated, patients preserve their dentition and thereby avoid the possible dangers of extractions for those on bisphosphonate therapy. Toothpastes with up to 5000 ppm fluoride in them could be used within the tray. Other remineralizing substances are under investigation for use within these bleaching trays.



Figure 20. Crowned upper right central and dark teeth prior to bleaching and minor bonding.



Figure 21. Clinical appearance after other teeth have been bleached to match the existing crown on the upper right central incisor. The dark triangles have been reduced by bonding with direct composite.



Figure 22. Appearance of worn teeth and gaps.



Figure 23. Increased overbite with worn teeth and missing posterior teeth.

Bleaching and existing restorations

It is relatively easy to bleach older looking dark teeth to match existing restorations of lighter colour (Figures 20 and 21).

Simple infilling of dark triangles with directly applied composite, where recession has occurred, can reduce the visual effects of 'black triangle disease'. This approach can make the teeth look more symmetric rather than having to replace existing relatively satisfactory crowns or bridges with ones of a *darker* shade. Patients rarely want all their crowns or bridges to be replaced with darker ones in order to match the discoloured, more aged looking, adjacent

teeth. Given the opportunity, most older patients are enthusiastic about bleaching the adjacent discoloured teeth to make them lighter. To older patients this is preferable to replacing satisfactory existing crowns or implant retained bridgework, simply because they now appear to be of a lighter shade than the natural teeth which have become discoloured over time. Obviously, this approach removes the biologic and financial issues inherent in replacing crowns and bridges and, as such, should be welcomed by patients and their dentists alike.



Figure 24. Upper and lower remaining teeth showing wear and discoloration.

Bleaching and bonding for the shortened dental arch in the older patient

The shortened dental arch still has a very major role in option planning for the older patient. The well-proven and documented contribution of osseointegration to restorative dentistry should not be underestimated, but there are significant time and cost implications with this option. For a variety of reasons, not every older patient can benefit from these advances. Figures 22 and 23 show a patient with an increased and complete overbite, with significant wear of the lower incisor teeth and also of the upper incisor teeth. The appearance problems seen are the usual ones of missing back teeth, dark colour, reduced length of teeth, size and shape of teeth, irregularity of teeth, as well as issues of visibility and contour of various teeth.

Figure 24 shows the erosion and attrition of Tooth Wear Index III (wear exposing more than one-third of the dentine). The history was that the patient had had atypical facial pain for about ten years which was treated with various fillings followed, sadly, by root fillings of the back teeth and, more sadly, by extractions. Only eventually was the appropriate antidepressant therapy prescribed. The patient was very nervous about having



Figure 25. Prior to bleaching with 10% carbamide peroxide.



Figure 27. Palatal view of teeth before bleaching and direct composite bonding.



Figure 29. Adhesive bridges on maxillary cast.

any further surgical interventions, which would be required for implant therapy, and he was very opposed to wearing dentures. He accepted readily that his lower incisors, whose marked staining was the result of his previous cigarette smoking, required long-term bleaching to help improve this aspect of his problems. The long-term safety profile of prolonged nightguard vital bleaching is well known with follow-up studies being available of up to ten years on people treated with six months of nightguard vital bleaching using 10% carbamide peroxide.¹² These studies show that, in spite of treatment having been undertaken with standard nightguard vital bleaching for six months, there were no root canal treatments necessary, no resorption was seen and there was no long-term sensitivity of any of the teeth that had been bleached for such



Figure 26. After bleaching and bonding of the tips of incisors with direct composite.



Figure 28. Palatal view of teeth after bleaching and direct composite bonding.



Figure 30. Three adhesive bridges after sandblasting with alumina oxide.



Figure 31. Lower adhesive cantilever bridge prior to cementation.

a long period of time. Therefore, the plan discussed and agreed with the patient was that he could bleach his teeth for as long as necessary and then have direct composite bonding to build up the tips of the worn



Figure 32. Before bleaching, bonding and adhesive bridges.



Figure 33. After bleaching, bonding and adhesive bridges.



Figure 34. Upper jaw before bleaching, direct composite bonding and placement of adhesive bridges.



Figure 35. Upper jaw after bleaching, direct composite bonding and placement of adhesive bridges.



Figure 36. Before treatment.



Figure 37. After bleaching, bonding and adhesive bridgework filled to produce shortened dental arch. Please note increase in anterior vertical dimension.



Figure 38. Wear of lower teeth with available lingual enamel. This is called the 'enamel ring of confidence'.



Figure 39. Composite bonded to the lingual and incisal as well as labial enamel.

teeth as the first stage of management (Figures 25–28).

Opening up the anterior vertical dimension by direct bonding of the tips of the teeth meant that the canine and

premolar teeth were separated in order to provide the necessary space for adhesive metal pads. The adhesive system used for retaining the composite tips was *All Bond 2* (Bisco Inc, Schaumburg IL 60193, USA)

and the composite material used was *Charisma shade A1* (Heraeus Kulzer GmbH, Gouner Green, USA WEG11, D-63450 Hanau, Heraeus Kulzer, Germany).

Three adhesive bridges were used to replace the two upper premolars and one extra adhesive bridge was used to reduce the gap in the lower anterior region (Figures 29–31).

Following try-in these metal pads were blasted with alumina oxide and cemented with *Panavia 21 OP* (Kuraray Medical Inc, Okayama 710–8622, Japan).

This plan represented a non-destructive, financially viable approach to solving the problems and this sort of treatment, with its many variations, is particularly suitable for older patients (Figures 32–37). Patients control the colour they want with nightguard vital bleaching using just 10% carbamide peroxide. The tooth shape change is done with direct composite bonding, which can be easily modified as required. If chipping occurs it is simple to repair without any further destruction. This approach can restore chewing function, as well as contributing to a general feeling of psychosocial well being.

Direct composite bonding has been shown to be successful in dealing with lower incisor wear. In one prospective split-mouth clinical trial of the use of direct composite for worn lower teeth, the vertical dimension of the worn lower front teeth was opened by up to 5 mm with direct composite bonding. In this study, 168 Herculite restorations were placed. In all cases, the posterior contacts were re-established at six months. The restorations had a 94% success at 30 months and patients' satisfaction was very high. Neither circumference or the height of the addition of the composite to the lower incisor teeth affected the outcome.¹³

Wear of upper and lower incisor teeth can be managed very effectively with bleaching and bonding. It is important to note that the remaining enamel should be regarded as 'gold dust' and that, as long as it is present, one can continue to bond to it very predictably. This is sometimes called the 'enamel ring of confidence' where the area of erosion is surrounded by a peripheral enamel ring (Figures 38–39). The clinical tip or technique of choice with this problem

is to bond to the **lingual** of the lower incisor teeth and bonding on to the labial as well as the incisal edges of the worn teeth.

Provided the composite is placed in thick section at the incisal tips of lower incisors, it does very well. Even if there are minor chips of the composite, these are easy to polish or repair and the fallback position remains very good. In other words, the composite restorations can be 'repointed' (repaired) and recycled as required without significant damage to the enamel. This is in marked contradistinction to using porcelain veneers, or conventional porcelain fused-to-metal, or all ceramic crowns, where the fall back is poor because the teeth are significantly damaged, severely weakened structurally and often pulpally compromised by the preparations. The more destructive the procedure, the less of the tooth is left for the 'next time'.

Discussion

The prevalence of self-assessed tooth discoloration in the UK has been the subject of cross-sectional study.¹⁴ Of the 3,250 subjects surveyed, over half perceived their teeth as having normal colour, 44% expressed some dissatisfaction with the tooth colour and 6% claimed that they had severe discoloration. In another study by the same group,¹⁵ one-third of the patients were dissatisfied with tooth colour. Interestingly, the subjects over 55 in this study were more likely to be satisfied with the appearance and the colour of their teeth than those in younger aged groups. It may, therefore, be a question that, for many patients, the colour of the teeth is not a major issue and that they may wish to grow old gracefully (or disgracefully) as they are. That is entirely their right. It is inadvisable, inappropriate, and possibly unethical to imply to them that they ought to have their teeth lightened. Requests for bleaching should be driven by the patient rather than by the dentist. Some very well respected authorities argue, often quite forcibly, that it is the naturalness and variations in colour, shape and position of older teeth that reflects nature in all its glory and variety.

In their view, this should be regarded as the normal and, therefore, the preferred and more desirable appearance. That is certainly a very reasonable position for very many older patients and their dentists to adopt.

However, what is equally true is that there is another group of patients in modern society who actively seek functional and aesthetic benefits from bleaching and bonding in order to restore the colour and shape of their teeth. There is no absolutely right or wrong answer as to what is appropriate for an individual patient. It is a matter of patient autonomy, but they should be given sound, neutral, information about the options that are available to them. In addition to improving the appearance in a non-destructive way, bonding will obviously protect the remaining teeth, as well as improving the shape, colour, contour, occlusal contacts and chewing function. All of this can be accomplished with minimal biologic cost and moderate financial cost for a group where these issues are often important.

Summary

Bleaching and bonding for older people represents a biologically smart, effective and proven approach, which helps not just the appearance of teeth, but also improves the long-term function of teeth.

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CPD ANSWERS

May 2011

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| 1. A, B, D | 6. B, C |
| 2. A, B, D | 7. B, D |
| 3. A, B, C | 8. A, C, D |
| 4. C, D | 9. A, B |
| 5. A, B | 10. B |