Better Composite Margins - Minimising the “White Line”

Michael N. Mandikos

The procedures employed to finish and polish a composite restoration are important for obtaining a successful aesthetic outcome. Unfortunately, clinicians frequently observe the formation of an apparent “white line” at the margin of their restoration, at the junction between composite and tooth structure (Figure 1). The relevance of this line, with regards to its possible deleterious effects on the longevity of the function and aesthetics of the finished restoration, has been debated in the dental literature. Authors have suggested that the white line may be the result of an adhesive failure of the bonding agent – tooth interface; a cohesive failure within the composite at the margin, a cohesive failure of the enamel at the margin; heating up and degradation of the composite matrix at the margin or even the composition of the composite.

One possible contributing factor to the formation of the white line is the finishing and polishing procedure used by the clinician to obtain the final form and surface gloss of the restoration. The choice between abrasive (diamond or aluminium oxide) or milling (tungsten carbide bladed burs) finishing instruments can influence the effects that will be observed in the superficial layers of the composite when it is cut. Many clinicians choose a medium or fine grit diamond bur to perform the reshaping of the restoration, and then use an aluminium oxide based polishing disc system to effect the final shine.

One potential problem with this system is that the diamond burs may leave undesirable scratches or surface features in the re-shaped composite, and then excessive time and pressure must then be used with the polishing discs in an attempt to “buff-out” these scratches to create a smooth, shiny surface. As this polishing is usually performed dry, without a water spray coolant, excessive heat can be generated at the enamel-composite margin, leading to degradation of the composite and white line formation. Extra Fine diamond burs also leave a smooth finish but clog and wear quickly and are not conducive to reshaping composites.

An alternate approach to finishing and polishing anterior composite restorations is to utilise a 12-fluted, tungsten carbide (TC) finishing bur to perform the finishing and shaping of the restoration, prior to final polishing. 12-fluted TC burs have the advantage of cutting the composite to leave a relatively smooth surface with no visible scratches. Creating a final lustre is then a relatively easy process using the clinician’s preferred polishing method.

In order to achieve the best results with a TC finishing bur, it is important to understand their mechanism of cutting. TC burs rotate in a clockwise direction and generally have a radial or zero rake angle. When the bur is applied to the composite, the leading edge of the bur blade will create some friction and a zone of compression ahead of the blade. This pressure builds and eventually exceeds the proportional limit of the composite causing separation of some composite from the underlying mass. However, the process also causes heat generation and can lead to heating up and degradation of the composite. If a TC bur is applied to a composite margin such that it strikes enamel first and then drags onto composite, the bur is more likely to heat, lift
and chip the fine edge of the composite. If on the other hand, the bur is held such that it strikes composite first and then drags onto enamel, it is more likely to burnish the composite down and cause less damage. The same principle applies when the final polish is formed after finishing. If abrasive discs are to be used to create a lustre, then the handpieces should be held so that the discs spin in a direction that allows them to strike composite first, and then drag across onto enamel. The discs should also be spun in a single direction, for example from cervical to incisal, rather than moved back and forth across the restoration. Doing this will prevent damage to the composite margin and prevent white line formation.

The prevention of a white line during the finishing and polishing stages of a composite restoration is sometimes difficult to prevent. However, adopting the use of TC finishing burs together with consideration of the direction in which they spin when applied to the tooth, can significantly minimise this undesirable occurrence. The case report below illustrates this technique.

Figure 2.
The patient presents after an existing restoration in the mesial surface of the maxillary right lateral incisor was dislodged. The case is a typical presentation where the cavity is mostly on the palatal and mesial surfaces of the tooth, but extends just far enough through to the labial surface such that it will have a margin that will be readily visible in the patient’s aesthetic zone. Clinicians would recognise this as a high risk situation for the possible formation of a “white line” as a result of treatment.

Figure 3.
The remnants of the prior restoration were removed and the cavity re-shaped for a new composite. A bevel was placed onto the labial surface, fully extending what was once mostly just a two-surface restoration into a full-blown three-surface restoration. Bevels placed on anterior teeth should be wide, and gradually tapering, with no abrupt end line. Bevelling the margin will improve the aesthetic integration of the composite and also prevent de-bonding of the dentine bonding agent from the enamel margin during polymerisation.

Figure 4.
A Vitrebond liner was placed over the deeper dentine adjacent to the pulp. The tooth was etched for 20 seconds with 35% phosphoric acid and the zone of etching was extended well beyond the prepared bevel to ensure that no composite could be placed onto an area of tooth that had not been primed for adhesion. Singlebond 2 dentine bonding agent was applied and cured ensuring a bond between composite and tooth structure. Filtek Supreme Universal composite was used in a multi-layered approach. The shades used to build-up the tooth were A1 Dentine, A2 Enamel and then a superficial layer of Grey Translucent. A bond brush lightly moistened in unfilled bonding resin was then used to further adapt and “blend” the composite against the enamel, extending the full distance and slightly beyond the previously described “infinite” bevel.

Figure 5.
The tooth was built to form without significant over contouring. Medium and Fine grit Soflex Discs were used to refine the labial and interproximal contours.
Figure 6
A 12-fluted tungsten carbide finishing bur was used to perform the final shaping of the restoration. This bur is favoured over 8-fluted burs for its ability to cut composite, yet leave a smooth surface finish. It is preferred over 22-fluted burs as they do not readily cut composite and thus do not allow the clinician to significantly re-shape the restoration.

Figures 7a and 7b
If the bur tungsten carbide bur is allowed to pass from the composite and then to the enamel, the blades will cut the composite cleanly leaving no observable marginal defect (7a). If the bur first strikes enamel and then composite, chipping of the margin and white line formation is more likely to occur (7b).

Figure 8
The handpiece thus needs to be aligned in the right orientation to ensure that the bur turns such that it strikes the composite first and then enamel. If the margin is more horizontal than vertical (as it is towards the cervical region in this case), then the handpiece must be rotated accordingly.

Figure 9
After trimming with the 12-fluted TC bur, the restoration has its final shape and a smooth surface finish suitable for final polishing. Care has been taken to correctly orientate the bur during trimming and an intact enamel-composite margin is seen.

Figure 10
Fine and Extra Fine abrasive discs can be used to achieve a final high polish. The author prefers to use a silicon carbide impregnated brush to effect a final polish on the surface. The brush does not cut the composite but care should still be taken to endeavour to spin the brush in the direction from the composite towards the enamel.

Figure 11
The final restoration is shown immediately post-operatively. Although there is some dehydration of the adjacent enamel, the restoration is nicely shaped, with a high lustre and shows no visible white line.

References

About the Author
Dr. Michael N. Mandikos
BDSc (Hons), MS (New York), Cert Pros, FRACDS

Dr. Mandikos received his Bachelor of Dental Science Degree with honours, from the University of Queensland. In 1998, he graduated from the State University of New York at Buffalo, with a Certificate in Prosthodontics and Masters Degree in Biomaterials. He has researched direct and indirect composite resins and he has published several papers in Australian and international journals on clinical and dental materials topics. Dr. Mandikos has presented continuing education programs at Dental meetings throughout Australia and Southeast Asia and he is a Fellow of the Royal Australasian College of Dental Surgeons and a recipient of the College Medal.

Dr. Mandikos is a Visiting Specialist Prosthodontist to the University of Queensland Dental School, the Royal Australian Air Force and the Australian Army. He is a reviewer for the Australian Dental Journal, Quintessence International and Clinica (International Journal of Brazilian Dentistry). Dr. Mandikos is a product evaluator for several dental companies and he maintains a private practice limited to Restorative Dentistry in Brisbane City.