Micro-invasive approach to controlling white spot lesions

Considerable white spot formation around brackets in a 12-year-old male patient. — Fig. 2. Brackets are removed to allow good access to the lesions. — Fig. 3. Bonding and composite remains are removed using a specially designed bur. — Fig. 4. Before a rubber dam is applied, the tooth surfaces are polished with a fluoride-free polishing paste. — Fig. 5. The pseudo-iodine substrate layer is removed with 15% hydrochloric acid. In this step, only 10 μm of the surface layer is removed and the complete lesion is then visible. — Fig. 6. After removing the acid gel, the etching gel is removed and the tooth surfaces are rinsed with water. — Fig. 7. The lesions are dried with ethanol to remove the water from the capillaries. Remaining moisture would interfere with the penetration of the resin. The lesions appear whitish and chalky. — Fig. 8. The drying step allows intermediate control of the successful removal of the surface layer. After application of the etching gel, the lesions disappear if they are still visible, the etching gel is removed with water and the infiltration gel is applied. — Fig. 9. After 2 minutes, the etching gel is removed and the teeth are dried with ethanol to remove the water from the capillaries. — Fig. 10. Gross excess is removed, the rubber dam is removed and the tooth surfaces are polished immediately after removal of the rubber dam and after final polishing. The aesthetic impairment is reduced significantly and lesion progression is controlled effectively.

Carious enamel lesions have a superficially intact surface but considerable loss of minerals below. The porosities inside the lesion body result in the typically whitish appearance of these lesions, so-called white spots. Carious enamel lesions on smooth surfaces are a frequent side-effect of orthodontic treatment with fixed appliances. Although adhesively bonded brackets simplify orthodontic treatment, maintaining sufficient hygiene is significantly complicated during treatment, causing considerable plaque accumulation and in many cases the formation of carious lesions in these areas.

Even though the progression of these lesions after removal of the brackets may be inhibited with preventive measures, such as topical fluoridation, the persistence of white spot lesions in the visible areas frequently leads to severe aesthetic impairment.

The standard treatment for white spot lesions includes topical fluoridation and improvement of the patient’s oral hygiene in order to promote remineralisation of the demineralised enamel. Ten years ago a research group at the Charité hospital in Berlin in Germany began developing procedures and materials to control early carious lesions by micro-invasive means, reducing the amount of tooth substance that has to be sacrificed to the minimum. A novel alternative approach to the treatment of white spot lesions, caries infiltration, is based on the concept of sealing the micro-porosities of the lesion body and thereby inhibiting the substrate supply to inhibit the progression of the lesion. In randomised controlled clinical trials, this approach was proven to be clinically effective in halting caries progression. The hyper-mineralised surface layer is removed with a 15 per cent hydrochloric acid gel. In the next step, a specially developed low-viscosity resin is applied to the lesion to infiltrate it, driven by capillary forces. Since the capillaries in a carious lesion are extremely thin, a penetration time of 5 minutes is required to ensure complete infiltration of the lesion. Caries infiltration creates a diffusion barrier for cariogenic substrates inside the lesion, unlike sealing, which only forms a barrier on the surface. This procedure prevents the creation of artificial plaque retention areas and the formation of marginal gaps. A positive side-effect of caries infiltration is that the enamel lesions will lose their whitish or brownish appearance, thereby neutralising unfavourable aesthetic effects. Once the micro-porosities have been filled, the light refraction behaviour adapts to that of the surrounding healthy enamel. The light refraction behaviour is described by the refraction index.

The lesions are dried with ethanol to remove the water from the capillaries. Remaining moisture would interfere with the penetration of the resin. The lesions appear whitish and chalky. The drying step allows intermediate control of the successful removal of the surface layer. After application of the etching gel, the lesions disappear if they are still visible, the etching gel is removed with water and the infiltration gel is applied.