How less is more

Moira Crawford discusses the benefits of slow-release, low level fluoride

Ever since the benefits of fluoride for oral care have been known, it has become the mainstay of dental public health, incorporated into toothpastes, varnishes and other treatments, even added to the water supply in many regions.

Its positive effects in terms of decreasing levels of caries in children, especially in deprived areas, have been clearly shown, but there have also been increasing concerns regarding toxicity, and the risks of fluorosis in children receiving too high doses of fluoride.

Criticisms

One of the criticisms of the use of fluoride has been the assumption that increasing the amount or concentration of soluble fluoride in, for example, prescription toothpaste, will also increase its effectiveness, something that researchers are now questioning.

Professor Robert Hill, research director at the dental institute and head of dental physical sciences at Queen Mary University of London, argues that applying ever higher concentrations of fluoride to the teeth is not the best strategy. 'Simply increasing the amount of fluoride within the toothpaste is frankly a crude solution,' he says. 'Much of the additional soluble fluoride just goes to waste.'

In the UK, regular fluoride toothpastes contain around 1,450 parts per million (ppm) soluble fluoride, while prescription toothpastes can contain concentrations of up to 5,000ppm.

These pastes deliver an immediate 'high' of fluoride when the teeth are first brushed, but studies have shown that this drops rapidly as the toothpaste is washed away by salivary flow, and after around only about 100 minutes, the amount of fluoride that remains is below therapeutic levels (Figure 1) – even with the very high concentrations in prescription pastes.

A further disadvantage of this approach is that high concentrations of fluoride may form calcium fluoride (also known as fluorite) in the mouth rather than fluorapatite, the fluoride analogue of natural tooth mineral, which is what is needed for effective remineralisation.

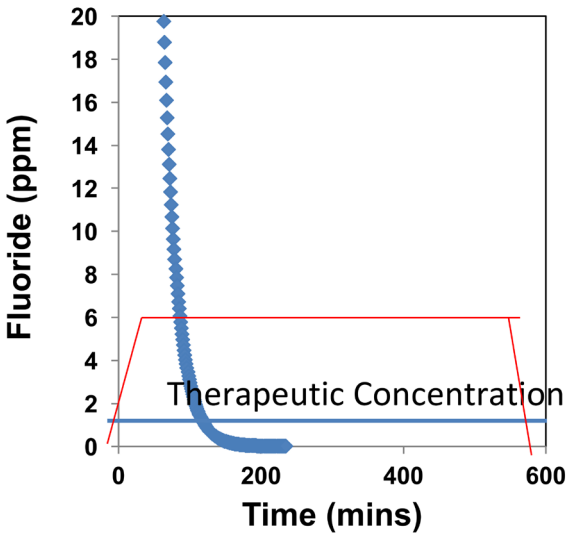

Figure 1: Soluble fluoride drops rapidly below therapeutic levels

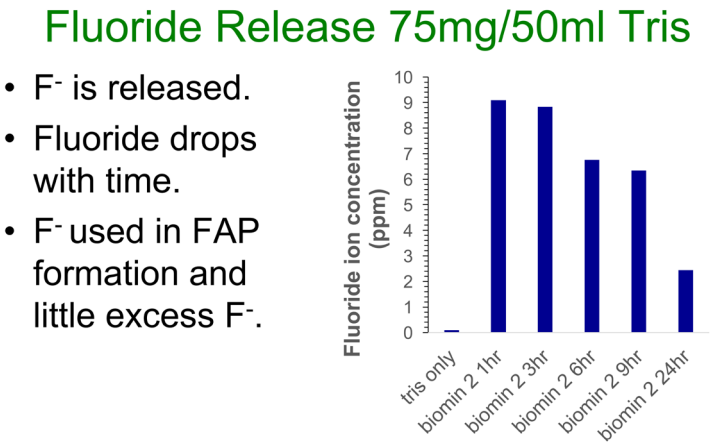

Figure 2: Biomin F releases low levels of fluoride over several hours

New challenge

The challenge has been to find a way to deliver the fluoride in a more effective, long-lasting way – and in doing so to actually reduce the amount of fluoride needed.

Professor Ten Cate, one of the world's leading cariologists from ACTA, Amsterdam, has claimed for many years that: 'Low concentrations of fluoride have a beneficial effect on enamel and dentine remineralisation. After fluoride treatments, salivary fluoride concentrations decrease exponentially in a biphasic manner to very low concentrations within a few hours.

'For treatments to be effective longer than the brushing and salivary clearance, fluoride needs to be deposited and slowly released.'

This has been the thinking behind Biomin F, which has been developed

Moira Crawford

Moira is a freelance writer and editor, with more than 20 years' experience of specialising in the dental field.

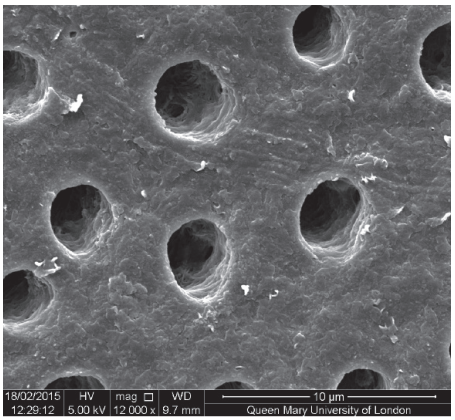

Figure 3a: Scanning electron micrograph images – tubule occlusion. Before brushing

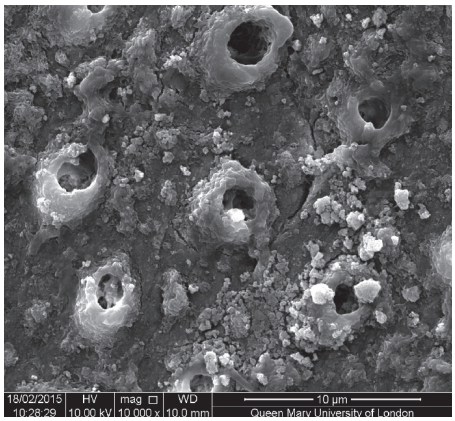

Figure 3b: Scanning electron micrograph images – tubule occlusion. After brushing with Biomin F

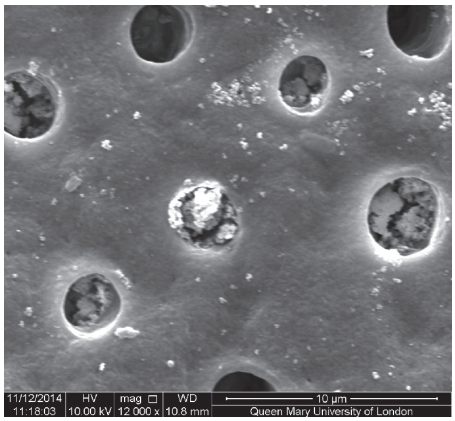

Figure 3c: Scanning electron micrograph images – tubule occlusion. After acid challenge

As it dissolves, the glass structure in Biomin F provides a slow release vehicle for calcium, fluoride and phosphate together

in the laboratories of Queen Mary University. Biomin F takes a radical approach to the delivery of fluoride based on a new generation of bioactive glass, which incorporates fluoride into its structure, enabling it to release low levels of fluoride slowly over up to 12 hours.

'As it dissolves, the glass structure in Biomin F provides a slow-release vehicle for calcium, fluoride and phosphate together, enabling it to form fluorapatite, which aids effective remineralisation and is more stable and resistant to acid conditions than hydroxyapatite formed by the previous generation of bioactive glasses,' explains Professor Hill.

Trials by Professor Hill and his team have demonstrated that, as it dissolves, Biomin F continues to release fluoride over several hours, with levels gradually dropping as fluorapatite is formed, and little excess fluoride remaining. Some effects are seen to be continuing up to 24 hours after brushing (Figure 2).

Because it is used more effectively, the quantity of fluoride required in Biomin F is lower than in conventional toothpastes containing simple soluble fluoride salts; good news for those concerned about potential toxicity and fluorosis.

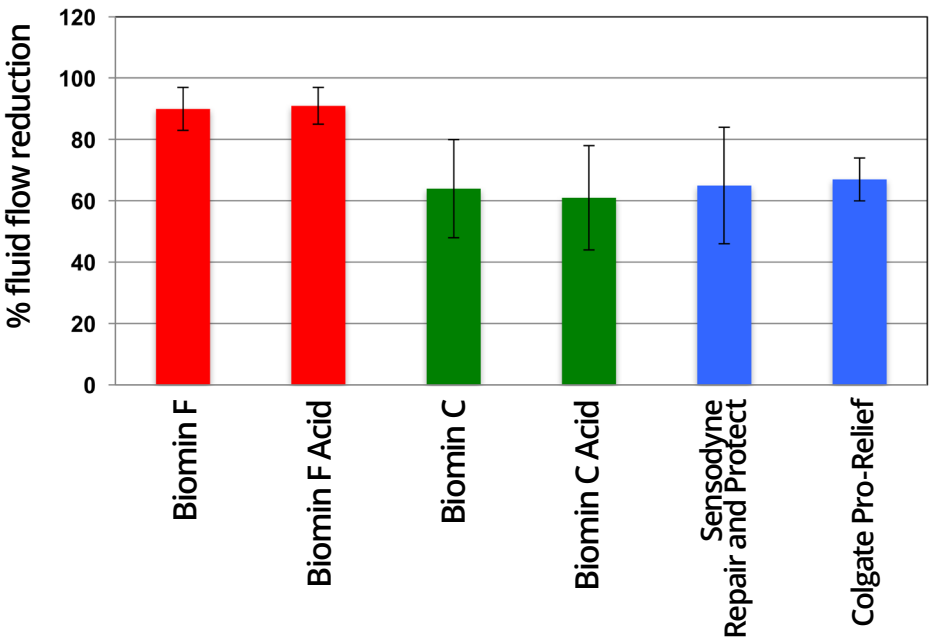

Figure 4: Comparison of Biomin F and Biomin C with leading brands

Particle adhesion

Important to the success of the slow release mechanism is that the Biomin F particles should remain in place over several hours to deliver the fluoride.

Biomin F contains a polymer that not only increases its viscosity but also chemically bonds to both the calcium in the tooth enamel and the calcium in the glass structure, so that it adheres to the tooth surface and remains there to release the fluoride, calcium and phosphate ions. This also works in concert to neutralise the acids and aid remineralisation. Because the particles are extremely small, they are also able to enter the dentinal tubules and work there to occlude them gradually, an effect still seen after acid challenge (Figures 3a-3c).

The use of bioactive glass in Biomin F, incorporating the optimum combination of fluoride, calcium and phosphate ions within the structure of the glass, enabling it to release them gradually over several hours, is set to revolutionise the way fluoride is delivered.

This new concept means that the fluoride that is so beneficial in promoting remineralisation of tooth enamel can be released slowly, at a low dose over several hours, with very little excess remaining or ingested.

Remineralisation rates are demonstrably higher than with other toothpastes because fluorapatite is deposited, and the lower concentrations of fluoride reduce the risks of toxicity and fluorosis (Figure 4).

In this instance, when delivered effectively, less is more. OH