

Controlled fluoride delivery: a breakthrough in oral health

The controlled release of fluoride at low dose for many hours after brushing may be more effective at remineralising early lesions than increasing the amount of fluoride in toothpaste, reports **Moira Crawford**

Fluoride has been a standard ingredient of toothpaste ever since it was found to have a beneficial effect in preventing tooth decay. It has played a huge part in improving dental health, and soluble fluoride has been added to toothpaste, varnishes and drinking water in certain areas.

However, it has traditionally been held that increasing the concentration of fluoride within a product would correspondingly increase its efficacy. As a result, therapeutic toothpastes can contain up to 5000ppm fluoride with the aim of strengthening teeth and preventing tooth decay for high risk patients.

Wasted fluoride

However, research has shown the quantity of soluble fluoride in toothpaste is not the complete answer. Professor Robert Hill, research director at the Dental Institute and head of dental physical sciences at Queen Mary University, London, believes much of the fluoride in conventional toothpastes goes to waste.

Studies have shown that when conventional toothpaste containing a soluble fluoride is used, there is an immediate 'high' of fluoride in the mouth, but this drops exponentially as the toothpaste is washed away by salivary flow. After about 100 minutes the amount of fluoride in saliva decreases below therapeutic levels – irrespective of the initial concentration (Figure 1). Fluoride varnish, too, is only temporarily effective as it absorbs water and eventually breaks down.

Professor Hill said: 'Simply increasing the amount of fluoride within the toothpaste is frankly a crude solution. Much of the additional fluoride is just wasted.'

In addition, high concentrations of fluoride form calcium fluoride (also known as fluorite), which deposits a whitish crust on the tooth surface. This was previously thought to act as a reservoir of fluoride, but Professor Hill's research shows this is not the case. 'It is completely insoluble and does not release fluoride at all,' he said.

Professor Hill and his team have been studying the properties of bioactive glass, which slowly dissolves in saliva. Their research has culminated in the launch of BioMin F, a novel toothpaste that controls the delivery

of fluoride more effectively, together with calcium and phosphate, and has been commercially available in the UK for about two years.

Controlled slow release

BioMin F is based on a new generation of bioactive glass that incorporates fluoride within its structure, together with an optimum combination of phosphate and calcium ions to promote effective remineralisation of tooth enamel. Following brushing with BioMin F, the tiny particles adhere to the tooth surface and enter the dentinal tubules. As the glass slowly dissolves, these ions are gradually released and precipitate fluorapatite, the fluoride analogue of natural tooth mineral.

'As it dissolves, the glass structure in BioMin F provides a slow release vehicle for the fluoride, calcium and phosphate together, restoring the pH balance and enabling the formation of fluorapatite, which is more stable and resistant to acid conditions,' explained Professor Hill.

Tests in artificial saliva have shown that the glass begins to convert to fluorapatite less than an hour after brushing. Even smarter, in acidic conditions, the BioMin F particles start to dissolve faster to protect the teeth against acid attack. The process of precipitating fluorapatite continues for approximately 12 hours, but some effects have been seen even 24 hours after brushing (Figure 2).

Studies from around the world have demonstrated that not only does the fluorapatite form on the tooth surface, but also penetrates deeper into the subsurface (Bakry et al, 2018). The authors hypothesise this is due to the low fluoride content of the BioMin, released slowly over several hours, which allows the penetration of the calcium and phosphate ions through the porous enamel sub-surface, effecting the successful remineralisation of the demineralised enamel lesions.

BioMin F has been shown to be a very effective treatment for dentine hypersensitivity, as the tiny particles enter the dentinal tubules and deposit fluorapatite crystals on the walls of the tubules, gradually plugging them and preventing the fluid flow that causes hypersensitivity (Sivaranjani et al, 2018).



'Ideal solution'

Dentists and hygienists are seeing the results in their surgeries. Dr Don Gibson, a dentist in Yeovil, read about BioMin and was immediately interested.

'I liked the slow release principle, and the chemistry was appealing: laying down the apatite makes sense to a dentist,' he said. 'This is a principle that all dentists should realise is going down the right road.' Patients are returning to surgeries requesting further supplies of BioMin, with some clinicians reporting up to 90% of patients are experiencing relief of hypersensitivity, while teeth are actually looking more dense as the enamel is remineralised (Figure 3).

Dr Nigel Slattery, from Little Lever, Bolton, was particularly attracted by the idea of sustained release and continued protection over 12 hours. 'I wasn't comfortable with the concept of a "big dollop" of fluoride, most of which is washed away,' he said. 'BioMin F delivers the optimum amount of fluoride for benefit – you don't need any more than that – and I like that it adheres to the tooth to be slowly taken on, looking after the teeth for 24 hours. That seems ideal.' **D**

Email newsdesk@dentistry.co.uk for a full list of references.

BIOMIN F IS the first and only toothpaste to have been accredited for its efficacy both at remineralising dental enamel and providing relief from dentine hypersensitivity by the expert panel of the respected Oral Health Foundation.

BIOMIN C – which contains phosphate and calcium, but no fluoride – is available for those who do not wish to use a fluoride toothpaste, but require a remineralising toothpaste, which efficiently develops 'toothlike' hydroxyapatite.

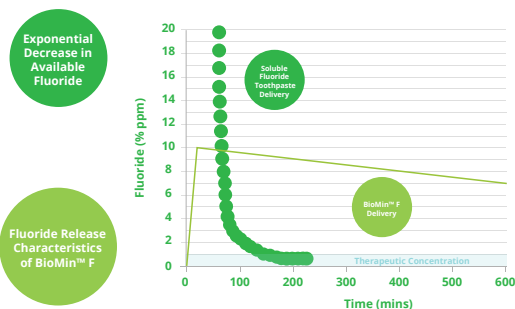


Figure 1. Soluble fluoride dropping

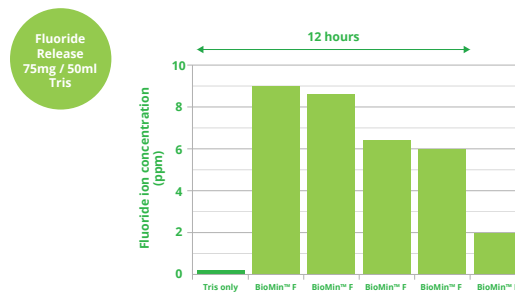


Figure 2. Presence of BioMin F up to 24 hours

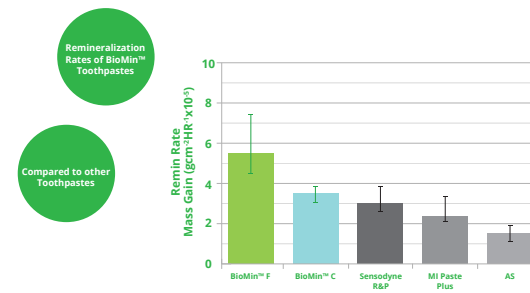


Figure 3. Remineralisation rates of BioMin F compared with other toothpastes

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