Brush the pain away

Moira Crawford interviews David Gillam, the clinician behind Biomin F, about tackling dentinal hypersensitivity

When it comes to dentine hypersensitivity, there are few experts with more experience than Dr David Gillam.

A dentist for 40 years, his first involvement in the area started in 1989, and he has researched, published and developed new products to address the problem ever since. Now a clinical senior lecturer at Barts and The London School of Medicine and Dentistry, Queen Mary University of London (QMUL), Dr Gillam is also a consultant to Biomin Technologies, and has been instrumental in the development of their innovative new toothpaste, Biomin F.

He has, however, had a varied career, and did not immediately come to dentistry. David initially joined the British Army in 1964 as an Army apprentice (Royal Army Medical Corps) and ended up in the Royal Army Dental Corps (RADC) where he trained to become a dental hygienist. He was subsequently posted to Edinburgh, where he served as a hygienist until 1972 when he applied to Edinburgh Dental School to be a dental student.

Following graduation in 1977, his first job was in Germany with the American forces as a civilian dentist for a year before coming back to the UK to work in general dental practice until 1980. David then rejoined the RADC as a dentist and was posted to Germany to serve as a general duties dentist. He left the forces in 1983 and worked in the Community Dental Services for three years before applying for a two-year part-time MSC course in periodontology at the Guys Dental Hospital in London. During this time (1986-1988) he combined studying with teaching at King's Dental School in London, working with dental hygienists and undergraduate students.

In 1989, David made a decision that would influence much of his future work. He applied for a one-year research fellowship at the Eastman Dental Institute for Oral Health Care Sciences supervised by Professor Hubert Newman, who was conducting a clinical study to evaluate two desensitising toothpastes. He was hooked. The fellowship was extended and David went on to write his DDS thesis on sensitivity and initiated a number of laboratory projects investigating the claims of desensitising products. He was involved in clinical trials, developing methodology, publishing evaluations and supervising postgraduate students, and brought over £1 million of grants with colleagues into the Institute.

David Gillam: dentist, university lecturer, Biomin Technologies consultant

A change of career followed in 1998 when David moved into the oral care industry to work for Smithkline Beecham (now GSK). After a year he decided to work for Block Drug Company USA (Stafford Miller Ltd UK), the company that developed Sensodyne toothpaste. Following the acquisition of the company by GSK David then worked for a contract research company for five years, where he was involved in a number of clinical studies evaluating various dental products.

In 2009 he had the opportunity to return to academic dentistry, taking up a post as a clinical tutor with responsibility for teaching periodontology at the Barts and London School of Medicine and Dentistry, Queen Mary University of London (QMUL).

'Initially I was involved in undergraduate and postgraduate teaching, together with supervision with participation in a clinical study under Professor Francis Hughes. Gradually I was able to develop of my research interests and started supervising postgraduate projects,' he says.

A chance meeting with materials scientist Professor Robert Hill, also of the Dental Institute, Queen Mary University of London, took David's career in a new direction. Their collaboration resulted in a series of projects evaluating dental materials specifically designed to treat dentine sensitivity which subsequently led to the development of a number of novel products, including the development of Biomin toothpaste formulations.

Cinderella's slipper

One thing that his many years of evaluating desensitising products had shown him was that the claims of some of these products could be challenged. He was also concerned by deficiencies in the design of some of the studies.

'As part of my doctorate I had to look at a number of issues relating to the problem of sensitivity. I found that there were a lot of claims for a vast range of products which to my mind were not necessarily based on the science,' he explains.

'I was concerned that a number of claims in the laboratory setting were extrapolated into the clinical environment. Looking at the published literature it was apparent that despite the claims there was no universally agreed product that could resolve the

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Table 1: Categories of patients suffering from dentine hypersensitivity (DH)

- Patients with relatively healthy mouths and DH as a result of meticulous and perhaps overzealous oral hygiene
- Patients who complain of DH as a result of periodontal disease and/or its treatment and may also have aesthetic concerns relating to the loss of gingival tissue (gingival recession)
- Patients who complain of DH as a result of tooth wear problems.

problem, and this has been the consensus view from a number of committee reports.'

In fact, in 2013 he chaired a UK Expert Forum on dentine hypersensitivity, which produced guidelines on its management (Gillam et al, 2013) and which sets out three distinct categories into which patients with dentine hypersensitivity will fall (Table 1), with a different management strategy appropriate to each category. A step-wise approach to treatment, stepping up levels of intervention, is also possible.

'There isn't one single cause of sensitivity so there cannot be a single product that is the gold standard,' he says. 'It's like Cinderella's slipper – one size does not fit all.'

Meeting Professor Robert Hill, research director at the Dental Institute and Head of Dental Physical Sciences at QMUL, gave David the opportunity to seek a more effective treatment for sensitivity. Professor Hill is a materials scientist, who had been studying the potential uses of bioactive glasses, and on the basis of that conversation they started to collaborate.

Different formulations of Biomin are already under development

'We developed a rapport and enthusiasm for working together towards developing products for the management of sensitivity,' says David.

'Robert is a very open and generous individual who is passionate about developing dental materials and I have enjoyed working with him on a number of projects, developing new materials and being involved in several patents.'

On the basis of the fluoride bioactive glass patent a university spin-off company was formed, Biomin Technologies, of which David is a non-executive director.

What is Biomin?

In a departure from toothpastes containing soluble fluoride, and from earlier generations of toothpaste based on bioactive glasses (such as Novamin, for example), Biomin F is formulated using a new generation of bioactive glass, which incorporates fluoride into its structure, enabling it to release low levels of fluoride gradually 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 re-mineralisation and is more stable and resistant to acid conditions than hydroxyapatite formed by the previous generation of bioactive glasses.

The tiny particles of Biomin F are also able to enter the dentinal tubules, occluding them and building up fluorapatite to prevent fluid movement within the tubules and subsequently triggering sensitivity.

It has a further 'smart' effect – in the event of acid challenge (after the consumption of an acidic drink), it dissolves more rapidly to restore the pH balance and prevent demineralisation.

David has been involved in the development of the product from its earliest conception, working closely with Professor Hill.

'As a clinician with a background in working in both university and industry, I was able to help develop the research at QMUL,' he says.

A number of in vitro tests were initiated to evaluate the bioactive glass formulation for both re-mineralisation and tubular occlusion purposes. He's been particularly excited by the results of the in vitro testing that has taken place in QMUL, and also by being involved with Biomin from the start of the project.

'It has been very satisfying to move from a concept of developing a toothpaste and seeing it formulated into a product which is sold in the market,' he explains.

He also sees Biomin F as taking its place within the armamentarium of products for use in the treatment of sensitivity. 'It is clear that bioactive glasses in toothpastes such as Novamin are fairly dominant in the market, so Biomin F would fit quite comfortably into this category,' he says.

He's optimistic that Biomin F will prove to be superior to previous products. 'We haven't conducted any clinical trials yet, but comparison studies in the laboratory have demonstrated that Biomin F has better properties than others we've have tested,' he says.

'Because it forms fluorapatite, rather than hydroxyapatite, it is more acid resistant, produces better tubule occlusion and re-mineralization, and it stabilises pH faster.'

Currently, a clinical study has been published based on the Indian version of Biomin (Elsenz) but David suggested that more independent clinical studies should be conducted to validate and support any previous in vitro and in vivo studies.

Future possibilities

David sees further applications for formulations of Biomin in both the prevention and treatment of other aspects of dentistry, such as periodontal disease and the early stage caries lesion, including dental composite materials, varnishes, polishing pastes and periodontal grafting materials for bone defects.

Different formulations of Biomin are already under development, including a composite filling material that releases fluoride, phosphate and calcium ions to remineralise the surrounding dentine, and a resin for bonding orthodontic appliances to prevent the formation of white spot lesions.

A novel high phosphate chloride containing bioactive glass has also been designed and recently introduced into a toothpaste (Biomin C) for faster remineralisation and desensitisation.

'The availability of fluoride, calcium and phosphate creates a fluorapatite layer or covering on the tooth's enamel surface,' he says. 'This fluorapatite layer may help protect the tooth from an early stage caries lesion and helps neutralise the acidity from food and drink in the modern diet.'

'One of the advantages of Biomin F is that it provides a constant supply of low levels of fluoride in the biofilm/saliva/dental interface, which may be beneficial in preventing both the loss of tooth mineral and enamel white spot lesions,' he goes on.

For orthodontic patients, he can also envisage a topical 'mousse' type application, which would require a different loading of the bioactive glass. 'From a prevention point of view, it is also important to maintain a very high level of oral care during the orthodontic treatment to reduce the level of plaque,' he warns.

David is recognised to be a leading expert on dentine sensitivity, both as a clinician and as a researcher who has tested and evaluated many of the products currently on the market.

While he stresses that no single product will produce the solution to all types of sensitivity, his quest to find and fully test a product that fulfils its claims to treat the problem has led him and his co-researcher Professor Hill to develop novel products, in particular Biomin F – and with that the possibility to treat and prevent other dental problems.

Its unique bioglass formulation, slowly releasing the optimum levels of fluoride, phosphates and calcium to remineralise tooth enamel and occlude dentinal tubules to reduce sensitivity, means that it has far reaching possibilities in many aspects of dentistry. Thanks to the meeting of minds of a dentist and a materials scientist, innovative products based on bioactive glasses will play an ever greater part in the dentist's armamentarium – and Biomin Technologies will be right there. OH

Reference

Gillam DG, Chesters RK, Attrill DC et al (2013) Dentine hypersensitivity – guidelines for the management of a common oral health problem. **Dental Update** 40: 514-524