practice management

Materials for sinus graft procedures

A summary of past and present experiences by **Tony McGee** and **Ian Seddon**.

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The first reported application of bone grafting to allow the placement of implants into a pneumatised sinus was published in 1980[1]. The technique is now well documented and has a high success rate. The question is, of course, which augmentation material is the most predictable? The answer is, many different materials have been used and most appear to be successful.

Autologous bone has been reported to give success rates between 85 per cent and 94 per cent depending upon the data source. When the procedure was first developed, bone marrow harvested from the iliac crest was used[1] and whilst this was successful, donor site morbidity and financial costs limited its application. Cranial bone has also been used[2], but a weakening of the cranial vault meant that this source of bone saw limited use. Whilst the use of autologous bone undoubtedly, in general terms, gives a good result, the downside of its use is, of course, donor site morbidity. This has recently been reported to be substantial[3]. Post-operative morbidity following chin graft surgery was reported to result in 33 per cent morbidity with symptoms such as parasthesia of the chin, numbness of the lower anterior teeth and pain at the graft site lasting up to 12 months. A further publication[4] showed few long-term problems with ramus donor sites, but reported 18 out of 29 patients with permanently altered lower lip sensation and decreased sensitivity of the lower anterior teeth up to 18 months post-surgery following harvesting from the syphysis. Changes in chin contour were noted as a problem by the patient.

Demineralised freeze dried bone has also been used in an attempt to mimic the benefits of autologous bone. However, reports suggest variable success with unpredictable bone growth[5]. Irradiated cancellous bone is presumed to be a safer option since any potential infection is assumed to be irradicated by the sterilisation process. Although very little has been published about this material, one study[6] reported that irradiated bone gave excellent results with 59 out of 69 implants placed in the grafted site being successful. The same study also showed a 100 per cent success rate when the irradiated bone was mixed with tri-calcium phosphate. Bovine derived products such BioOss have also been used. This is a partially resorbable material where new bone interlinks with unresorbed bovine hydroxyapatite particles (as high as 30 per cent to 45 per cent) even after four years [5,7,8,9]. Whilst this material is undoubtedly successful in this application, concerns still remain over potential cross-infection[10].

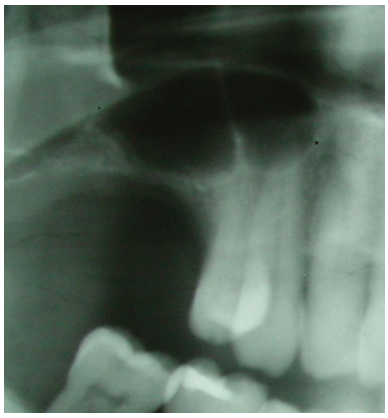

Fig 1. Pneumatised sinus pre-op.

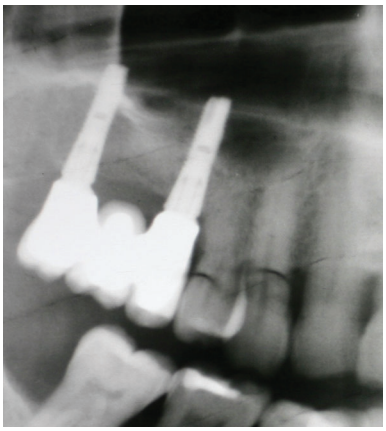

Fig 2. Grafted sinus two years post-loading.

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A number of synthetic materials have also been used with varying rates of success. In the last decade tri-calcium phosphate has been increasingly used and indeed has been compared successfully with autologous bone in bilateral sinus grafts[11] . This study makes a poignant statement regarding rates of replacement of the augmentation material with bone: '…when the bone formation was slow, it was slow on both sides, when it was fast, it was fast on both sides'. The differences were attributed to individual patient factors as opposed to the materials used.

So, it seems that there are a number of bone graft materials that have been used to produce (or not produce) bone in the pneumatised sinus. Recent developments have led to the isolation of bone morphogenic proteins (BMP's). These single proteins or peptides are added to a base material such as

hydroxyapatite in an attempt to enhance bone growth. However, bone grows with a cascade of BMP/Protein activity and an (as yet) unknown number of these proteins are present at different times and in different amounts during this cascade. The benefit of adding these single proteins is therefore dubious. Some of these proteins are also animal derived defeating the object of moving away from animal derived products.

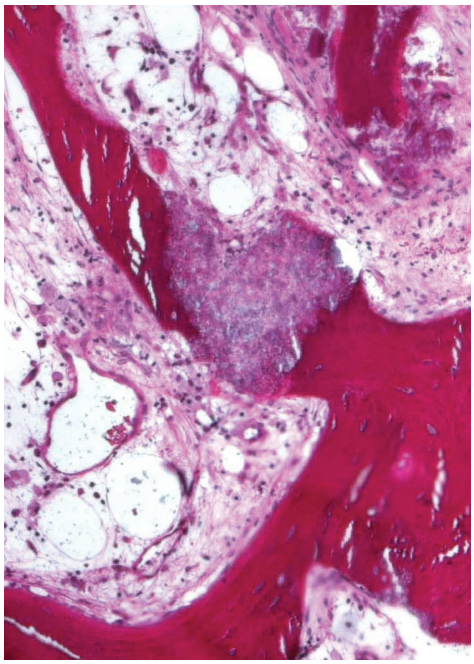
One interesting new technology which is a British invention (VITAL - Biocomposites Ltd.) takes a different perspective. Proteins are not added to the graft, but instead host proteins are attracted into the surgical site when they are needed and in the amounts the body needs to produce bone. This is achieved by Zeta Potential Control (ZPC).

By shifting the iso-electric potential, the electro-static surface charge of the material is changed such that it creates positive osteoblasts activity. This results in an upregulation of gene expression. What this means is that a number of proteins – Transcription Factors, Peptides or 'Master Switches' such as CBFA1, Osteocalcin and others present in human bone growth are attracted into the site in greater quantities than would normally occur.

The result of this is that bone grows quicker than with a 'normal' graft material. This represents a very important breakthrough.

The material has been used successfully for over five years in periodontal defects and periodontal-endodontic lesions. More recently it has been used with dental implants and indirect sinus lift procedures. VITAL has been used by us in a five bilateral sinus grafts over the last three years. In all of these cases we have compared VITAL to a mixture of irradiated cancellous bone and beta-tri-calcium phosphate. One such case is shown in figs 1 (pre-op) and 2 (two years post-implant loading). A biopsy taken from the right sinus shows good bone growth (fig 3). The results of both materials have, to date, been comparable and no implants have been lost.

It appears that any number of materials can be used to regenerate bone in the pneumatised sinus. Our results have given us the confidence to choose a synthetic material.■



●Fig 3. A biopsy taken from human sinus eight months post-op.

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