

True bone regeneration for long-term tissue stability

Peter Fairbairn and **Minas Leventis** demonstrate a new paradigm in restorative dentistry.

T rue bone regeneration is a host-driven response to heal a bone fracture or defect (as a result of extraction or localised disease) to return the site to its original healthy state. This is what the patient would prefer and the host biology needs for long-term success. Put simply, it is living tissue and must be dealt with as such. As Horvarth alluded to in his research, merely maintaining a physical dimension is not necessarily seen as success. Hence, when remnant foreign materials are present in the healed site, this is integration and not true regeneration.

From the early days of implant dentistry, the effects of this bone loss have been addressed with many different solutions, from blocks (autogenous or allogenic) to particulates, with or without the use of membranes of many types – from collagen to titanium. These methods are loosely regarded as Guided Bone Regeneration (GBR) and particulates can be xenografts (bovine and equine), allograft (human donor), autogenous, or alloplastic (synthetic).

One key factor to host healing and regeneration is oxygen, hence blood supply, so porosity for improved angiogenesis is paramount. Thus, the authors prefer the use of particulates and, whilst there are many types, as discussed, they use the alloplasts, mainly, beta-tri calcium phosphate which seems to be the only material



Fig 1: Four weeks post extraction healed site .



Fig 3: In optimal site for restoration.



Fig 2: Dio 3.8 by 12mm Implant placed.



Fig 4: Grafted with EthOss and dried with sterile gauze.

to fulfil all the criteria of the ideal particulate as described in the research of Yip and Lang (COIR). This is that the material should be both osteoconductive and osteoinductive as well as being biocompatible. It should also be totally replaced by bone in the appropriate time for bone formation and maintain the volume stability with good mechanical properties. Finally, they should not be able to transmit disease.

Here, we will show the use of a novel material EthOss, a biphasic matrix of BTCP and calcium sulphate (CS), which



Fig 5: Sutured closed with Vicryl 4.0.

due to its stable nature, does not require the use of a traditional membrane again for improved angiogenesis and host healing.

Case study

The patient is a 59-year-old heavy smoker (20 a day), non-diabetic, who presented with a mobile, over erupted, upper right central tooth. A routine extraction was performed using



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Fig 6: Flap to access the implant.



Fig 7: Showing new regenerated host bone.



Fig 8: Osstell Peg type 49.

Forceps and rotation and a plastic ridge fit partial denture was fitted for the soft tissue-healing period of three to four weeks (fig 1). The surgical protocol used in this case was the Early Delayed protocol published by the authors in 2015 (J of Dentistry) and used in more than 4,500 clinical cases in a 15-year period.

After anaesthetising the site using articaine infiltration, a site-specific flap retaining the adjacent papillae was raised using a periosteal elevator (Buser). The osteotomy was then created using Dio drills, showing the extent of the defect radiographically. As implant dentistry is a prosthetically driven treatment modality, the placement of the Dio 3.8 by 12mm Implant was sited optimally for the restoration, here not too palatally (figs 2 and 3). It was also placed to the optimal level, about .5 mm sub-crestally of where the bone would have been and primary stability (20 Ncm) was achieved from the apical



Fig 9: Loaded four years, showing retained profile.



Fig 10: Re-cemented crown, showing soft tissue retention.

portion (five threads).

The particulate material, EthOss, was then mixed following the manufacturer's instructions, here the paste was made 'drier' by using less saline and drawing it out with a more robust compression into the sterile gauze. The material was then transferred to the site and compressed with a dry sterile gauze for three minutes until stable (fig 4). The site was then sutured closed in a tension free manner using 4.0 Vicryl (Ethicon) (fig 5) in this case, although we now prefer the use of mono-filament type sutures. The sutures were then removed a week later and the healing was uneventful, with most cases (90 per cent) not requiring any pain medication the following day due to the bio-compatible nature of the material.

After a 12-week healing period, a small flap was again raised in order to access the implant after the new bone had grown over the cover screw, which again is often seen (fig 6). This showed the presence of new host regenerated bone to the level of the adjacent bone (fig 7) which in recently published research by the authors has more than 50 per cent new bone in volume and around 12 per cent residual graft material. After careful exposure of the implant using a round bur, an Osstell round bur, a reading was taken using a Type 49 peg (fig 8). It was 76 ISQ up from 46 ISQ at placement. This is further

evidence of improved integration as a result of the new regenerated bone. The implant was then restored with a stock abutment (SACN 4845 T) and an Emax ceramic crown. Radiographically, the level of the new bone was noted and the patient was asked to have a review appointment.

Sadly he did not come in until after four years loaded, due to a de-cementation issue, as Premier retrievable cement had been used.

Here we noticed a stable, hard and hence soft tissue profile as the implant had been in function (fig 9) and an adequate gingival level seen when the crown was re-fitted (fig 10). Radiographically, the bone level had improved – again, a routine observation over this period of time, despite the patient being a heavy smoker.

Discussion

For more than 125 years, since the findings of Woolf (Woolf's Law 1892), the medical world has understood the value of function in the retention of bone in re-modelling. This is the case in the dento-alveolar region as well naturally and by utilising a fully bio-absorbed material such as EthOss we ensure that this re-modelling is unaffected by the presence of foreign material. Put simply, we are working with living tissue not merely doing carpentry hence our need to respect biology.

The osteo-inductive potential of all calcium phosphates (as reported in more than 200 high impact medical journals) allows for an improved host response resulting in an increase in new host bone regenerated as seen with EthOss. The biocompatible nature of EthOss results in a reduced post-operative pain for the patient with no giant cell presence seen in any histology.

The CS element of EthOss which is bacterio-static, stabilises the graft and assists as a barrier function, enabling more favourable soft tissue healing. This element then resorbs at three to six weeks, providing increased porosity for further vascular ingrowth as well as providing nutrients for the new host bone mineralisation.

Thus, with the use of EthOss, we are able to work with host healing and regeneration to optimise the outcome.

For all associated research, please use Pubmed and look under the authors' names.