An interesting tenting procedure for bone regeneration using a novel biomaterial

Stability without membranes

MICHAEL AINSWORTH, BDS, SHEFFIELD, UK

Intraoral host bone regeneration may be affected by the pressures of the soft tissue as well as frenal muscle forces. To overcome these effects, many different methods have been employed including tenting screws, titanium meshes, autogenous plates (Khoury) and titanium reinforced membranes to maintain the space below the periosteum to the bone. This case report shows an interesting technique utilising "dome device" sutures to aid graft stabilisation. This technique has been utilised before, but here a new synthetic β-tricalcium phosphate (β-TCP) particulate graft material was used.

Case report

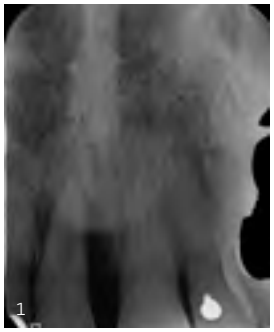
A 73-year-old male patient, non-smoker, with a non-contributory medical history presented with pain from a mobile upper right central incisor (tooth 11), that had received trauma approximately ten years prior to presentation. The tooth had been stable and the referring dentist had been monitoring the situation, however a sudden increase in mobility with associated purulent discharge precipitated referral. At presentation no discharge was noted, the acute situation having been managed with a course of amoxycillin. Clinical examination revealed that the affected tooth had deep pocketing of up to 9 mm mesially and was grade 2 mobile. The adjacent tooth (tooth 12) was grade 1 mobile and had pocket depths of 5 mm distally but no other pocketing greater than 3 mm. However, 5 mm of existing clinical attachment loss (CAL) and buccal gingival contouring consistent with underlying bony dehiscence was present. Importantly there was no other periodontal pocketing of > 3 mm in the mouth.

A diagnosis of lateral periodontal abscess secondary to external root resorption was made for tooth 11 (Figs. 1 and 2) and the tooth was given a hopeless prognosis. For tooth 12, a guarded prognosis was assigned due to CAL buccally and bone loss associated with proximity to tooth 11.

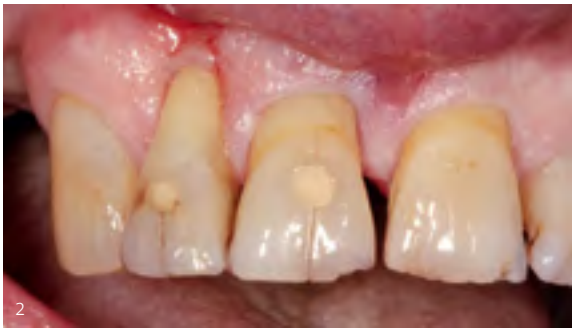
Given the bone loss and associated infection, an early-delayed implant placement treatment plan was proposed. The initial treatment plan involved:

- fabrication of a Maryland type adhesive bridge for immediate insertion;
- two-week post extraction CBCT;
- atraumatic extraction of tooth 11 with thorough debridement of the socket;
- implant placement at four weeks;
- simultaneous bone grafting with an in situ hardening synthetic resorbable bone substitute composed of β-TCP and calcium sulphate (CS), according to *Fairbairn* and *Leventis* [1];
- loading of the implant at twelve weeks post-op.

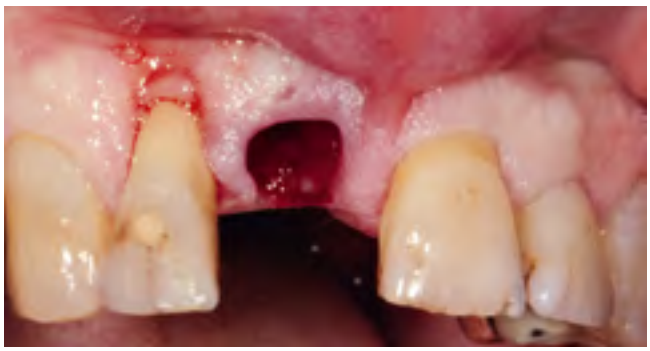
Antibiotic prophylaxis with 600 mg clindamycin one hour prior to surgery was given. Under local anaesthesia, atraumatic flapless tooth extraction was performed using periotomes (Stoma, Emmingen-Liptingen, Germany), taking special care to avoid the buccal and distal plates of intact bone. Immediately post extraction the socket was fully debrided of inflammatory tissue using Lucas curettes (Stoma) and degranulation burs (EthOss EK Strauss Degranulation Bur Kit, Ethoss Regeneration Ltd,



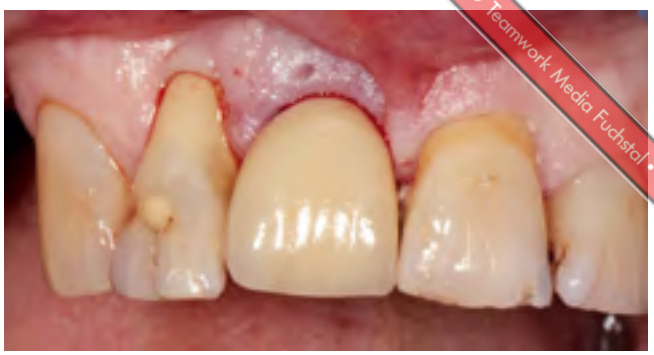
1 I Initial situation – periapical radiograph shows resorption on the mid third of the root of tooth 11. Large 100 per cent wide mesial angular periodontal bone loss and a lateral lesion in the apical third interstitially between teeth 11 and 12. Importantly interstitial bone is present in the coronal third.



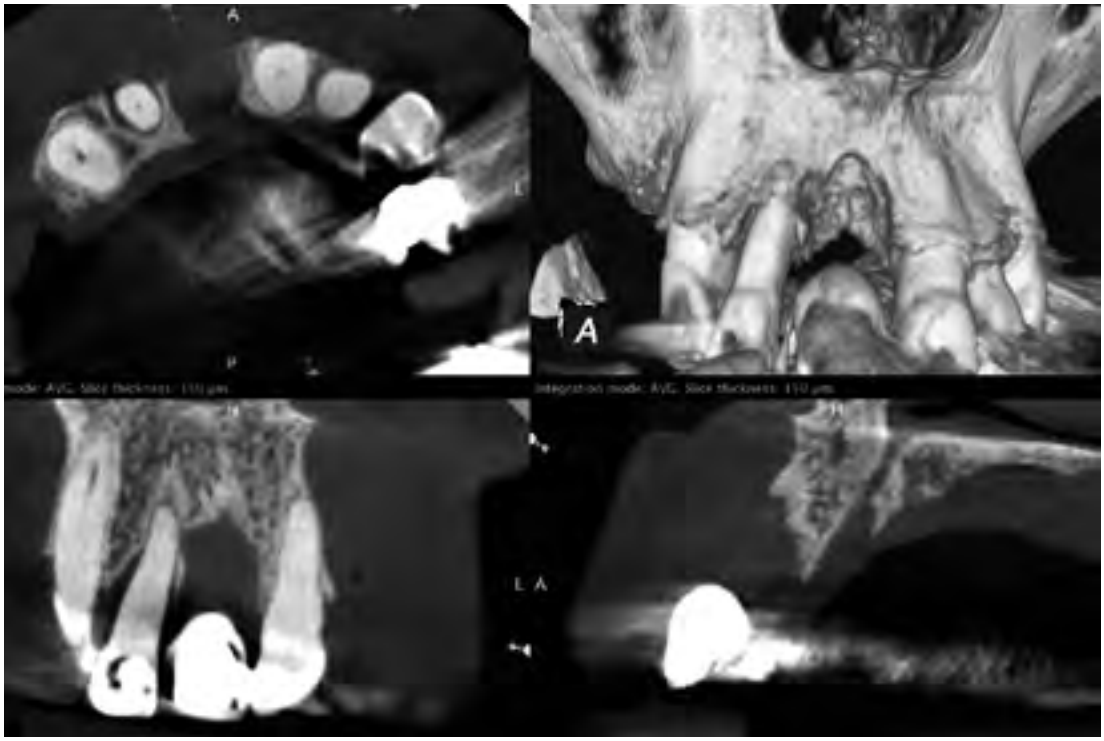
2 I Initial presentation. Systemic antibiotics had been taken for five days. Note the clinical attachment loss and thin tissue buccally on tooth 11.



3 I Atraumatic extraction leaving the socket epithelium intact.



4 I Placement of Maryland bridge, note close adaption and support of the socket periphery.



5 I Two weeks following extraction – CBCT image of the extraction socket; note angular defect on the distal of tooth 12.

Silsden, UK). A Williams probe was used to assess the buccal and palatal plates which were found to be entirely absent. Haemostasis was achieved with a stable clot (Figs. 3 and 4).

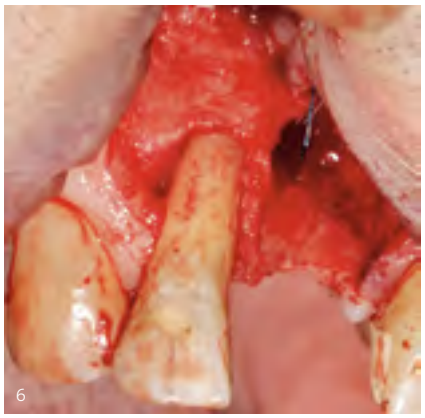
Immediate temporisation with a well-adapted adhesive FPD (Maryland design) was important to maintain clot stability and mechanically support the gingival architecture. The socket was allowed to heal for four weeks via secondary intention.

In this period, at two weeks post-op review, a sectional cone beam CBCT scan was used to accurately analyse the bony defect. The defect was significant on tooth 11 – larger than previously estimated. A distal, narrow angle, infra-bony defect was detected on tooth 12 (Fig. 5).

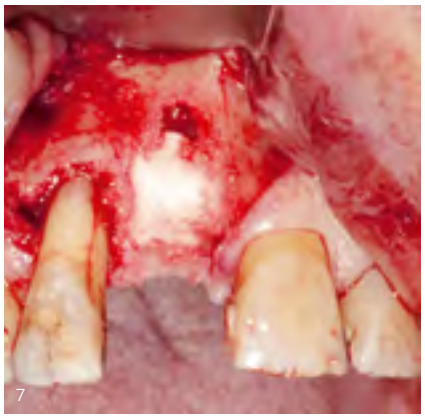
Management of these factors was incorporated into the treatment plan:

- The large defect may leave the particulate material subject to micro-movement hence stabilisation was deemed necessary: placement of PDS(II) (Ethicon; Johnson & Johnson, Somerville, NJ, USA) dome device sutures for graft stabilisation.
- Incorporation of a Modified Minimally Invasive Surgical Technique (MMIST) periodontal regeneration procedure according to *Cortellini* and *Tonetti* [2] and *Parma-Benfenati* et al. [3] to manage the distal infra-bony defect on the lateral.
- Tooth 12 flap design to be coronally repositioned to counteract potential recession.

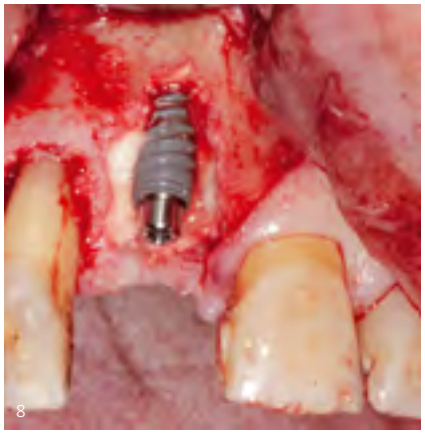
Preoperative assessment determined that frenal pull was present, and under local anaesthesia a simple incisive frenectomy was performed to reduce muscle pull on the flap during healing for increased graft stability and closed with 5-0 Prolene (Prolene, Ethicon; Johnson & Johnson, Somerville, NJ, USA). A section of attached gingiva was de-epithelialized in preparation for coronally repositioning the flap distal to tooth 12. A full thickness papilla preservation flap that did not include the mesial papilla of tooth 11, a palato-crestal incision and split thickness distal to tooth 12 was raised using microsurgical instrumentation (SM69 blade, Swann Morton, Sheffield, UK). Full periosteal relief to mobilize the flap and careful



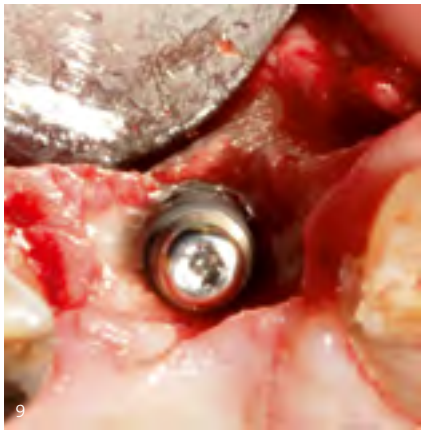
6 I Four weeks following extraction – surgery, flap raised, completion of degranulation. Note the infrabony defect distal of tooth 12 and the partial loss of palatal bone and de-epithelialisation distal to tooth 12 for coronally advanced flap closure.



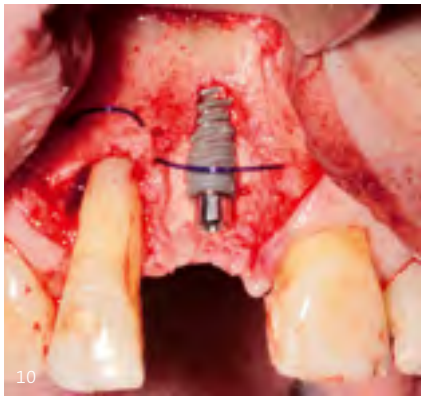
7 I Palatal defect repair with β-TCP (65 %) and calcium sulphate (35 %). Following drying with gauze, the material maintains its shape via crystal geometry and setting of CS.



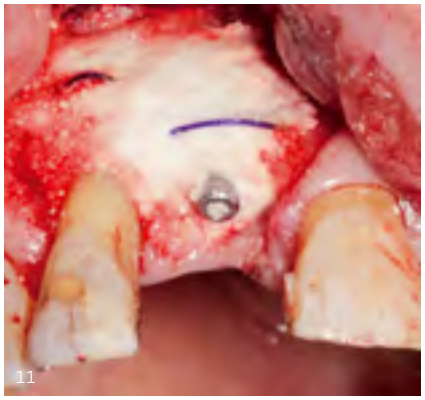
8 I Implant placement with 2 mm cover screw.



9 I Implant placed in ideal position for cement-retained prosthesis.



10 I Placement of 2-0 PDS tenting sutures to create "dome device" to prevent micromovement of the graft material.



11 I Placement of a "wetter" mixture of graft material in stages under the dome device, carefully drying and compressing with each stage.

curettage of the site was subsequently performed with hand instruments and degranulation burs. A large palatal bony defect and complete buccal bone loss was noted at tooth 11. The angular defect distal to tooth 12 had an emergence of less than 22° suggesting a regenerative procedure would have good prognosis (Fig. 6).

An osteotomy was prepared using a 2 mm twist drill creating an undersized osteotomy for a Neodent 3.5 x 11.5 implant (Neodent Batel, Curitiba, Brazil). Prior to insertion of the implant the palatal defect was augmented with a resorbable synthetic bone grafting material (EthOss; EthOss Regeneration Ltd., Silsden, UK), a novel biphasic bone substitute consisting of β-TCP (65 %) and calcium sulphate (CS, 35 %). The material was hydrated, mixed and partially dried, according to manufacturer's instructions, and placed on the palatal aspect of the prepared osteotomy site. Gentle pressure with a sterile gauze for three to five minutes "set" the material (Fig. 7). The implant was subsequently placed in an ideal position at 35 Ncm, with good primary stability and a 2 mm cover screw fixed in order to tent the flap taking pressure away from the implant shoulder during healing (Figs. 8 and 9).

Due to the large volume of particulate grafting material to be used in the area, it was deemed preferable to tent the soft tissue with a "dome device" 2-0 polydioxenone suture (Ethicon; Johnson & Johnson, Somerville, NJ, USA) in both sites. This tenting helps prevent mechanical micromovement of the graft during the healing phase and allows larger than normal volumes of graft material to be used without fear of resorption from instability during turnover. PDS(II) maintains 60 per cent tensile strength at six weeks. In the "dome" application sutures are placed under compression which is favourable. Compressive strength may be maintained

longer. Polydioxanone material is subject to hydrolytic degradation with absorption times of 182 to 238 days and only minor inflammatory reaction. The PDS material can therefore be placed within the body of the graft and safely left in situ without secondary removal surgery. A green Stabilock dentine pin drill (Stabilok; Fairfax Dental, London, UK) was used to punch four mini osteotomies in the buccal plate, to a depth of 2 mm. Two lengths of 2-0 PDS(II) suture were cut to approximately 12 mm and 8 mm and inserted into the prepared osteotomies with stability checked with digit pressure. Care must be taken not to place too long a section of suture in order to maintain the mechanical resistance to pressure (Fig. 10).

A wetter mix of the bone grafting material (EthOss) was prepared utilizing sterile saline. This was carefully placed into and underneath the dome devices in small increments, and to the adjacent infra-bony defect of tooth 12. Pressure was applied at each stage to dry and therefore stabilise the material. The dome device was partially covered with the graft material but not over-filled, contouring to the expected final bone levels. Steady pressure was applied for five minutes with sterile gauze to maintain a dry field and allow the calcium sulphate to set (Fig. 11).

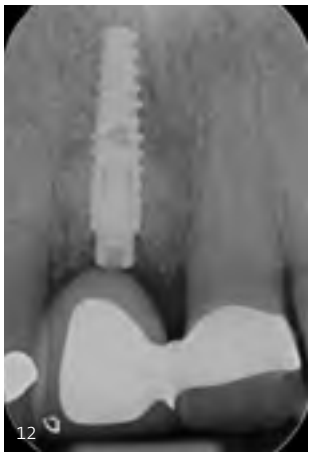
The mucoperiosteal flap was directly repositioned to cover the graft site, without a traditional collagen barrier membrane, in a 2 mm coronal reposition on tooth 12 without tension utilising 6-0 proline monofilament sling and interrupted sutures (Ethicon; Johnson & Johnson, Somerville, NJ, USA). Non-resorbable sutures were utilised in order to reduce inflammatory response at the graft site. Antibiotic therapy consisting of 500 mg amoxicillin every eight hours for five days and mouth rinsing with 0.2 % chlorhexidine every eight hours for ten days were prescribed. The sutures were removed after an uneventful seven-day healing period.

At twelve weeks, control radiograph showed that good bony architecture had been maintained (Fig. 12). Gingival architecture was observed to be maintained and a thickening of keratinised tissue was noted at the margin of tooth 12 with increased bulk apically. A good band of keratinised soft tissue was also noted at site 11. A small crestal incision with no relief was utilised to expose the implant and a 4.5 x 4.5 mm healing abutment placed (Fig. 13).

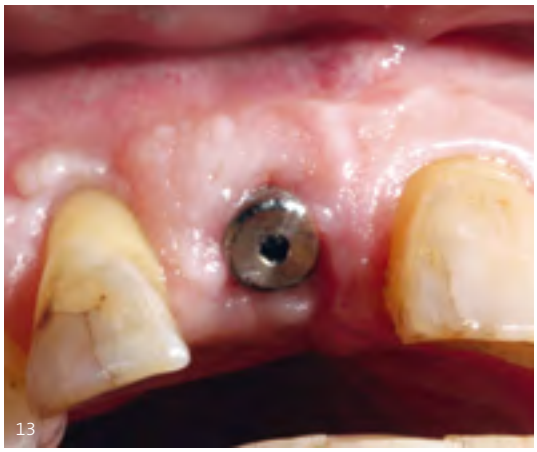
After two weeks of maturation an open tray impression was taken with monophase impression material (Impregum; 3M ESPE St. Paul, Minnesota, USA) and a milled custom abutment fabricated with layered zirconia cement. A retained crown was fitted with temporary cement (TempBond; Kerr UK Ltd, Uxbridge, UK).

Twelve months post-operatively the patient attended for review. A periapical radiograph showed no bone loss around the implant (Fig. 14). Probing depths were measured at ≤2 mm around implant at tooth 11 and the adjacent natural tooth (Fig. 15).

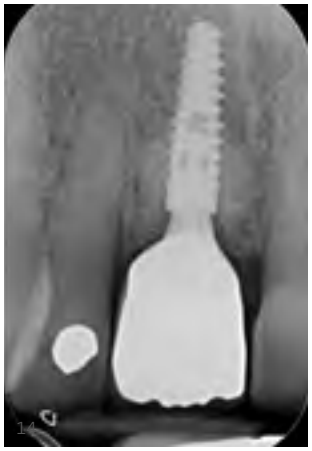
12 I Control radiograph at twelve weeks healing.



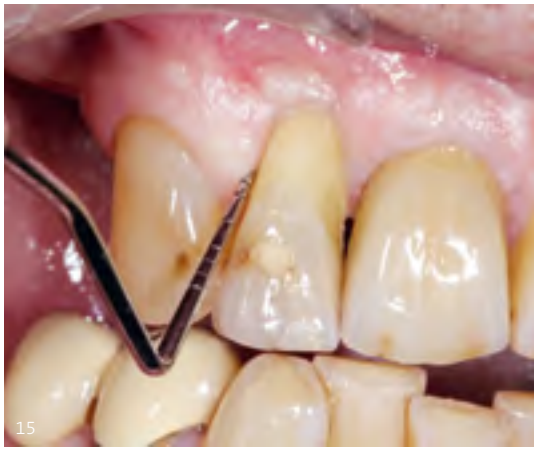
13 I After two weeks healing post second stage. Note the increased attached gingival marginal collar on the lateral incisor and thick keratinised tissue around the healing cap.

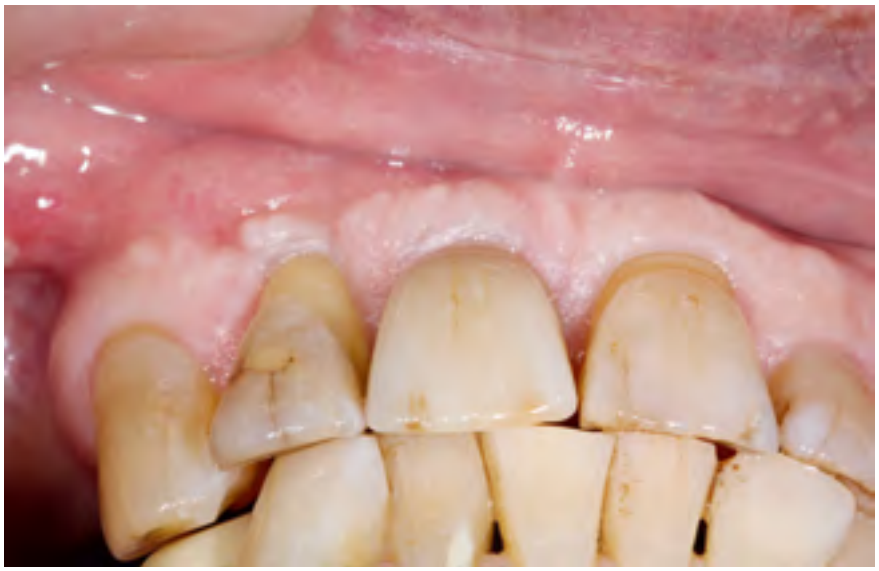


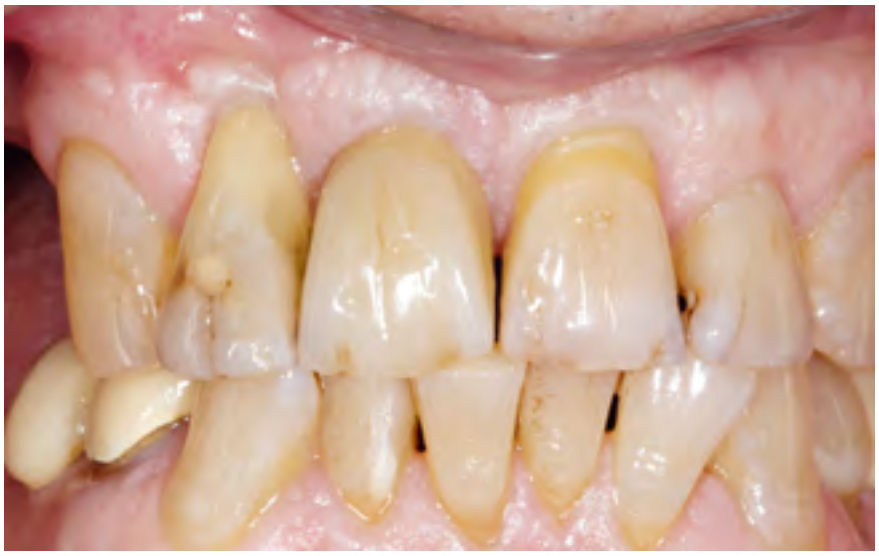
14 I Twelve months control, following crown cementation. Bone maturation continues.



15 I Probing the distal of tooth 12 shows 1 mm pocket depth indicating adequate healing response.







16 and 17 I Final tissue maturation at twelve months, shows stippling, contour and volume consistent with underlying bone health.

At all sites, no mobility or exudate was noted. The gingival architecture showed stippling and a natural contour with good maturation of the interdental papilla (Figs. 16 and 17).

Discussion

Whilst this unique protocol for tenting was first published in 2011, newer self-hardening bioactive materials which become stable in situ, and hence do not need a barrier membrane, have led to a revived interest in the method.

The combination of bioactive β-TCP and CS produces an in situ self-hardening grafting material that may not need additional stabilisation with the use of membranes or other meshes. Moreover, the CS can act as a barrier, halting the ingrowth of soft tissue during the early phases of bone regeneration. Both CS and β-TCP are fully resorbable bone substitutes, leading to the regeneration of high quality vital host bone without the long-term presence of residual graft particles. The CS element will resorb over a three- to six-week period, depending on patient physiology, thus creating a vascular porosity in the β-TCP scaffold for improved vascular ingrowth and angiogenesis, while the β-TCP element will resorb by hydrolysis and enzymatic and phagocytic processes, usually over a period of 9 to 16 months. The presented case follows a published protocol utilizing these materials in a delayed immediate procedure with placement at three to five weeks post extraction with simultaneous grafting for improved preservation of residual host hard tissue along with upregulated host regeneration [1].

The β-TCP element, apart from being osteo-conductive, shows an osteo-inductive potential which improves host regeneration of bone in the healing process. As the material was stable and in contact with the host periosteum yet supported from compression by the tenting, the host healing process improved. For further reading regarding the science behind bioactive calcium phosphates and their clinical applications, the readers may refer to papers published in previous issues of the EDI Journal [4–6] and other international journals [1,7,8].

In conclusion, it would appear that this method of tenting the soft tissue, when placing a dental implant with an associated grafting procedure, shows significant benefits, primarily by providing stability without the need for a secondary surgery to remove the tenting appliance, as well as reducing the prospect of a soft tissue dehiscence after the initial surgery. The bioactive properties of β-TCP and CS grafts might explain the successful outcomes in this case. It is always of great importance that clinicians should be familiarized with the surgical methods that they employ, and have thorough understanding and knowledge of the specific properties of the grafting materials that they use, in order to control and enhance the biologic mechanisms of regeneration in each individual implant case, and thus achieve successful and predictable results.

The references are available at www.teamwork-media.de/literatur

Contact address

Michael Ainsworth
The Dental Referral Centre Ltd
55 Chesterfield Rd
Dronfield S18 2XA
United Kingdom
michael_h_ainsworth@yahoo.co.uk