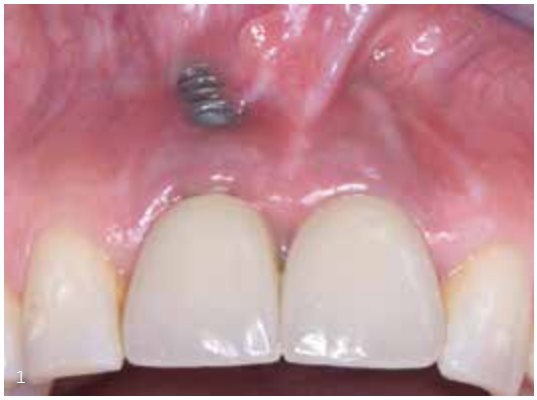
Management of a failed implant with a self-hardening bioactive synthetic bone graft

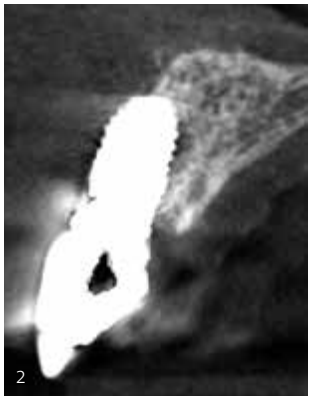
Complex problem, modern solution

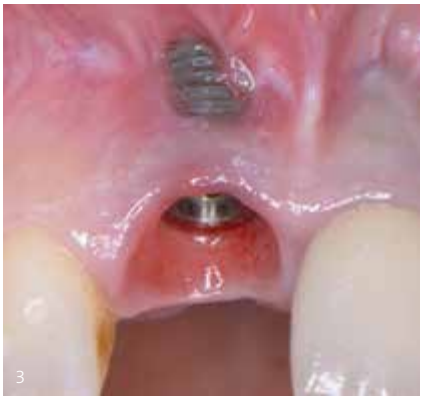
MINAS LEVENTIS[1,2] PHD, PETER FAIRBAIRN[1,3] BDS, GEORGE KEFALIDIS[4] DDS, STUART KILNER[1] BDS

This case report highlights the use of a bioactive in situ hardening synthetic resorbable bone substitute, composed of beta tri-calcium phosphate (β-TCP) and calcium sulfate (CS), for the minimally invasive treatment of a demanding case of a failed implant in the esthetic zone. A standardized staged approach with digital implant planning and fully guided placement enabled the correct replacement of the implant, and the simultaneous regeneration of vital bone and newly-formed thick keratinised soft tissues. Patient morbidity, complication risk, cost, length and complexity of the procedures were thus minimized; resulting in a successful outcome, regarding aesthetics and function.

The patient, female, aged 38, presented with a wish to restore the soft tissue defect buccally to her implant 11. According to the patient, due to trauma 10 years ago, she lost both her upper central incisors, which were replaced at that time with two Xive S Plus implants (Dentsply, Mannheim, Germany) – both 5.5 mm in diameter and 9.5 mm in length – and separate implant crowns. Clinical examination revealed a soft tissue dehiscence with exposure of the labial mesial and apical threads of the implant 11 (Fig. 1). There was no clinical mobility of the implant nor other signs or symptoms. Regarding the adjacent implant 21 there were no clinical problems associated. The initial CBCT scan showed significant bone loss, with complete bone loss at the buccal aspect of the implant 11 (Fig. 2). The same radiological findings were also observed for implant 21. The diagnosis was that the implant 11 was not salvageable, and implant 21 had a poor prognosis. It was decided to treat firstly only the failed implant 11, as removal of both implants 11 and 21 at the same time would result in severe collapse of the area, that would be very difficult to restore. The treatment plan consisted of removal of implant 11, placement of a new implant 6 weeks post-op with simultaneous bone augmentation according to the Fairbairn and Leventis (2015) published protocol [1], and loading of the implant 12 weeks post-op with the final restoration.



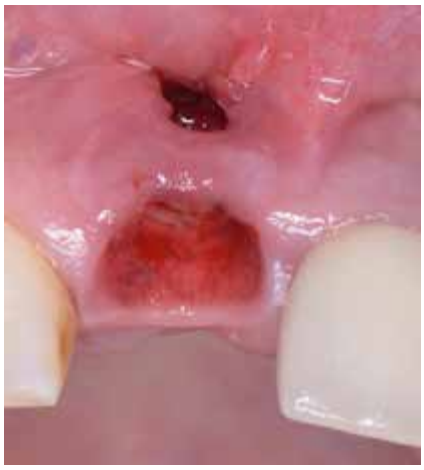




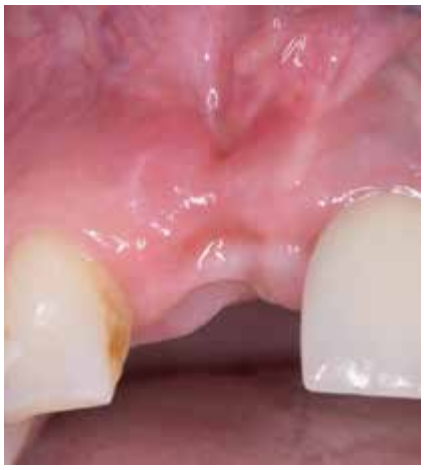
1 I Initial situation of the failing implant 11. Note the buccal soft and hard tissue defect, leading to the exposure of the implant threads.
2 I Initial CBCT. The wide diameter (5.5 mm) and the wrong positioning of the implant in the upper central incisor area contributed to the loss of the buccal hard and soft tissues. 3 I Clinical view after removing the screw-retained implant crown.

[1] Private Practice, London, UK
[2] Researcher, Laboratory of Experimental Surgery and Surgical Research "N. S. Christeas", Medical School, University of Athens, Greece
[3] Visiting Professor, Department of Periodontology and Implant Dentistry, School of Dentistry, University of Detroit Mercy, Detroit, USA
[4] Private Practice, Athens, Greece

4 I "Atraumatic" removal of the failed implant using the implant driver in an anti-clockwise direction.



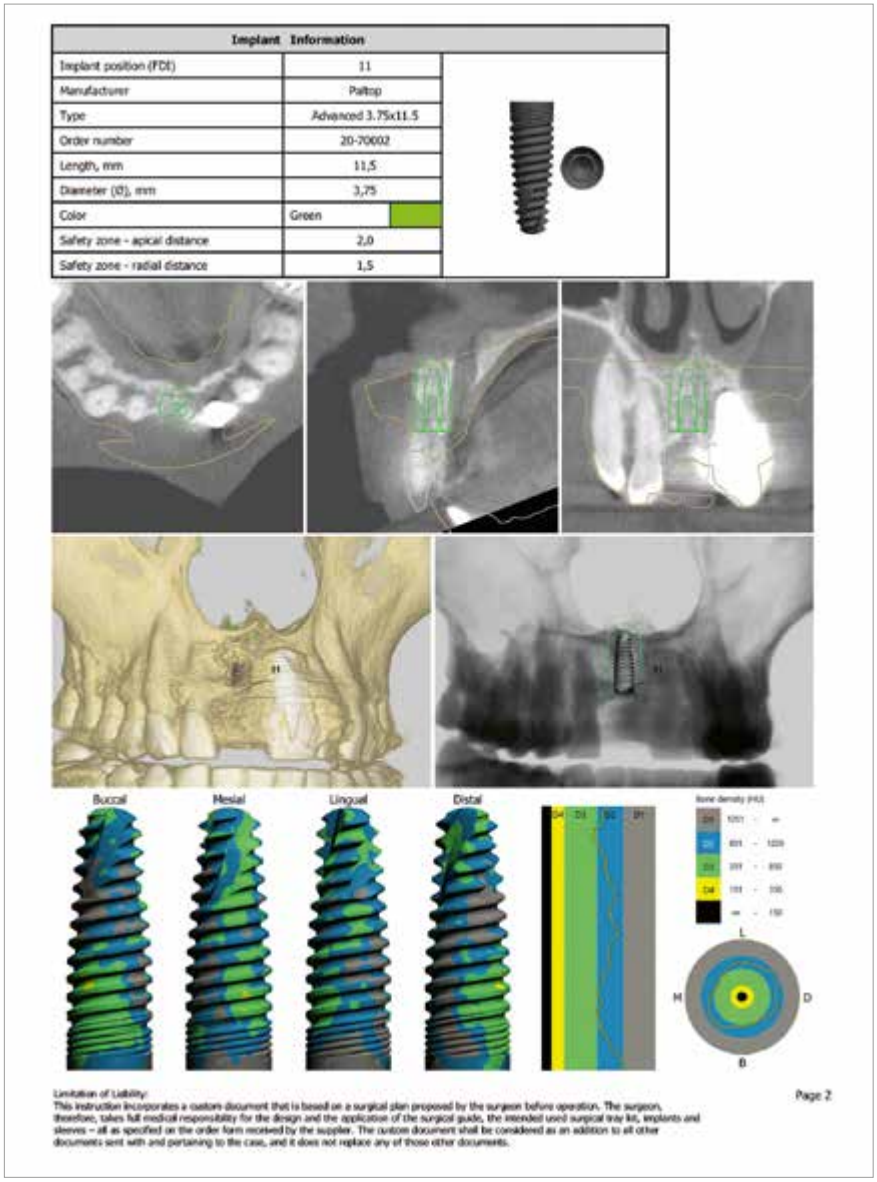
5 I The site immediately after removal of the implant, presenting a severe lack of soft and hard tissues buccally.



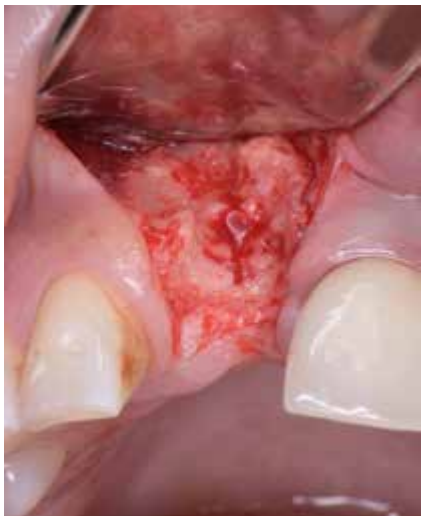
6 I Secondary intention healing for 6 weeks to allow the body create new soft tissues.

Under local anesthesia, the non-salvageable implant 11 was "atraumatically" removed without raising a flap. Firstly, the screw-retained crown was removed (Fig. 3) and the implant was easily mobilised and removed using the implant driver and the ratchet in an anti-clockwise direction (Fig. 4). Then, the site was thoroughly curetted and debrided of any soft tissues with the use of Lucas hand bone curettes and degranulation burs (EthOss EK Strauss Degranulation Bur Kit, Ethoss Regeneration Ltd, Silsden, UK), followed by rinsing with sterile saline. After completion of the procedure, a severe buccal hard and soft tissue defect was evident (Fig. 5). The patient used an acrylic partial denture as a provisional prosthesis during the whole healing period, without applying any pressure on the surgical site.

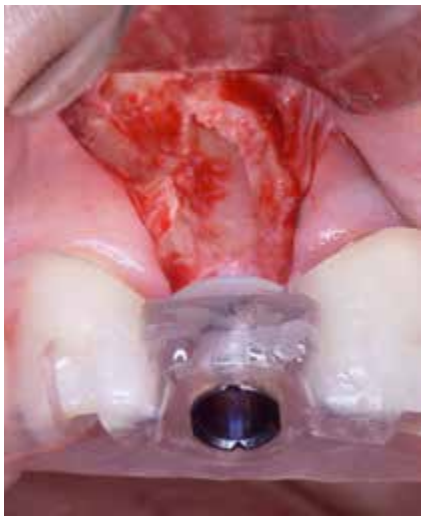
The site was left to heal spontaneously under secondary intention. After 6 weeks, the area was free of any inflammation and uneventfully covered by newly-formed soft tissues (Fig. 6). A new CBCT scan and digital impressions were taken and a digital workflow was carried out by Paltop Digital Solutions using the Implant Studio software (3Shape, Copenhagen, Denmark) in order to identify the ideal size of implant and its precise 3D positioning (Fig. 7). According to the digital plan a surgical guide was 3D printed. Under local anesthesia, a site-specific, papilla-sparing, full-thickness flap was designed, as described by Greenstein and

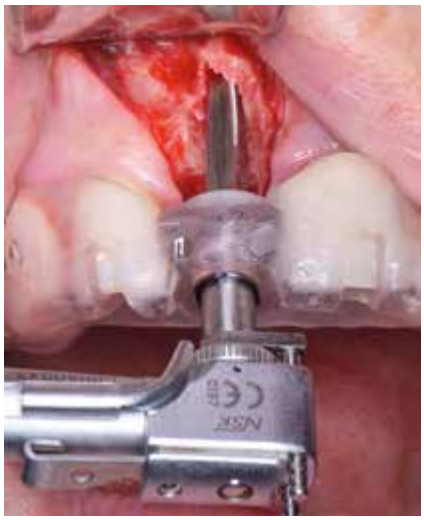


7 I Digital planning of the case. A 3.75X11.5 implant was selected, and the optimal positioning was digitally planned.

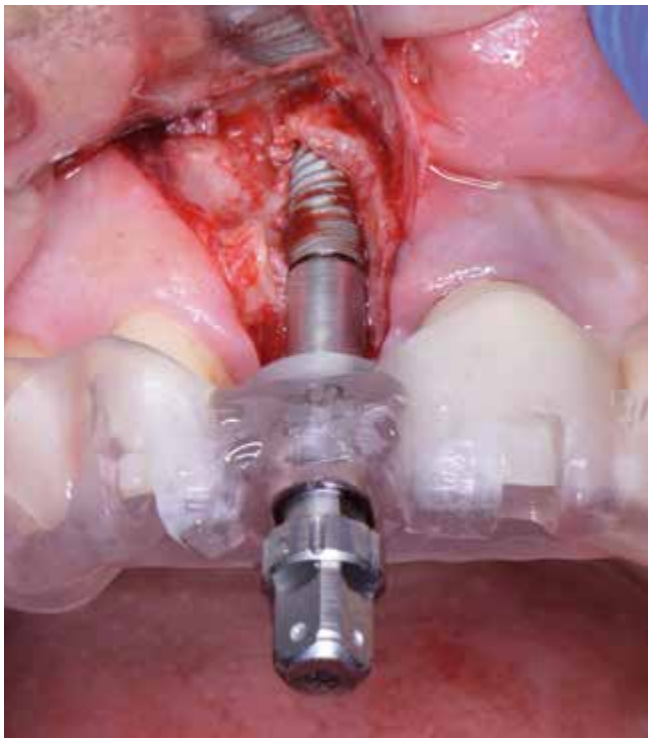


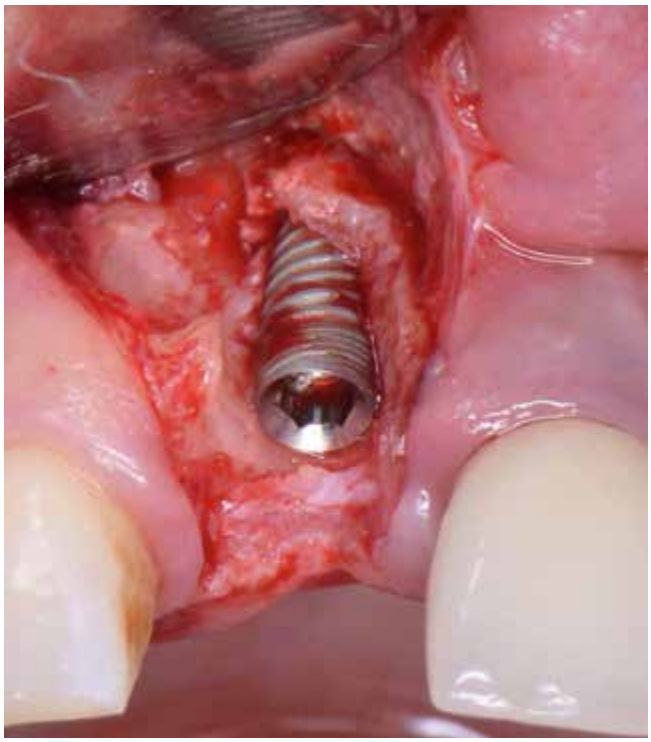
8 I Site specific, papillae sparing flap raised, revealing the bone defect.





9a & b I The surgical guide fitted on the adjacent teeth and a fully-guided osteotomy was carried out using the dedicated NSK handpiece (Nakanishi Inc., Tokyo, Japan).

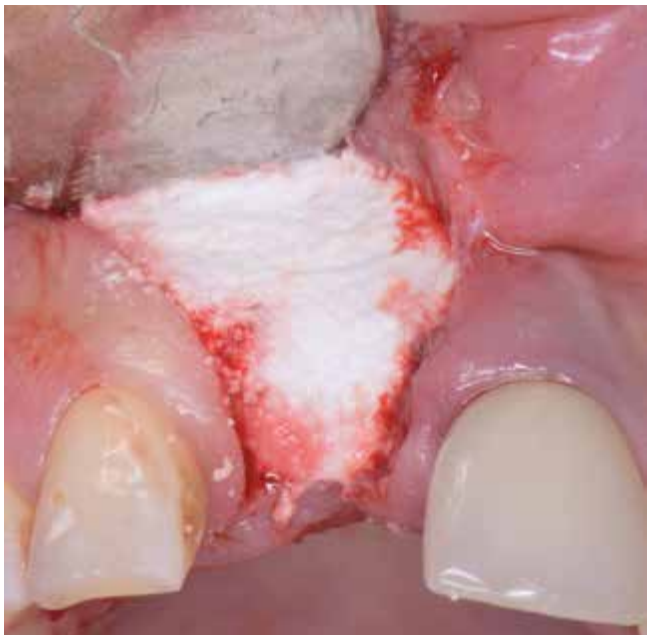




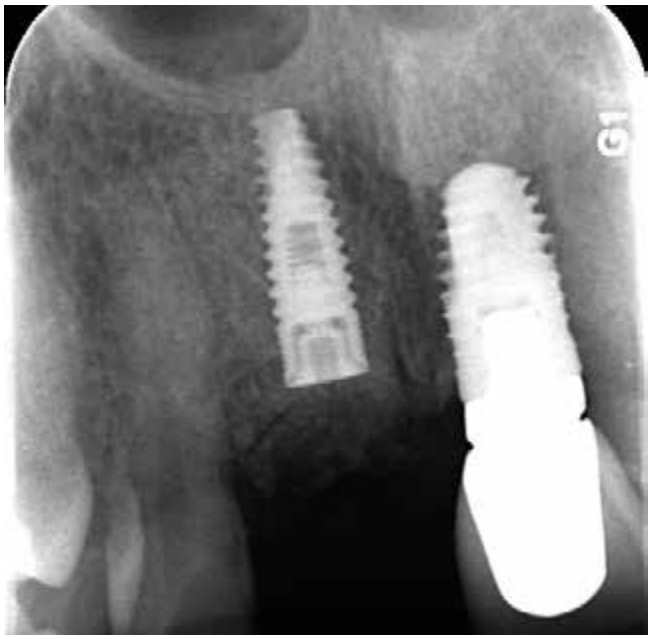
10a & b I Fully-guided accurate 3D placement of the implant

Tarnow in 2014 [2] and carefully raised, revealing a large 3-wall bony defect with completely missing buccal plate (Fig. 8). The site was then debrided of all soft tissues; the surgical guide was fitted and all the drilling steps were carried out in a fully-guided manner (Fig. 9). A 3.75 X 11.5 tapered implant (Paltop Advanced Plus, Paltop Dental Solutions Ltd, Israel) was placed in the planned 3D position (Fig. 10). After placing the cover screw, the site was grafted (Fig. 11) utilizing a self-hardening resorbable synthetic bone grafting material (EthOss, Ethoss Regeneration Ltd, Silsden, UK), consisting of β-TCP (65 %) and CS (35 %), as described by the authors in previous publications [1, 3, 4]. No barrier membranes were used. The flap was repositioned and sutured without tension (Fig. 12) with 5-0 monofilament sutures (SKD Mono, Miromed, Lainate, Italy) and a periapical x-ray was taken (Fig. 13). Antibiotic therapy consisting of 500 mg amoxicillin every 8 hours for 5 days and mouth rinsing with oxygen-releasing mouthwash (bluem, Zwolle, Netherlands) every 8 hours for 10 days were prescribed. The sutures were removed one week post-op (Fig. 14).

After 12 weeks, the healing was uneventful (Fig. 15). A periapical x-ray showed excellent osseointegration of the implant and consolidation of the grafting material (Fig. 16). A linear crestal incision was made to access and remove the cover



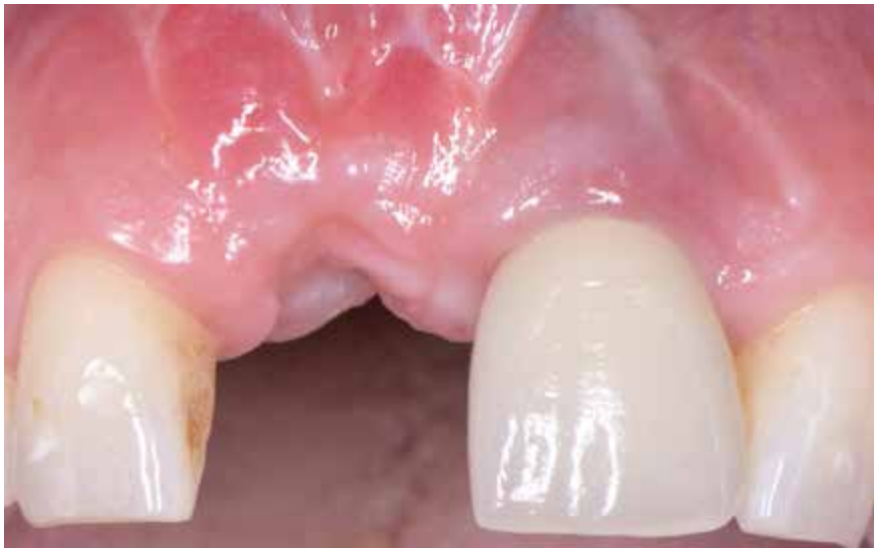
11 I The area was grafted with 0.5cc β-TCP/CS (EthOss). No membranes were used.



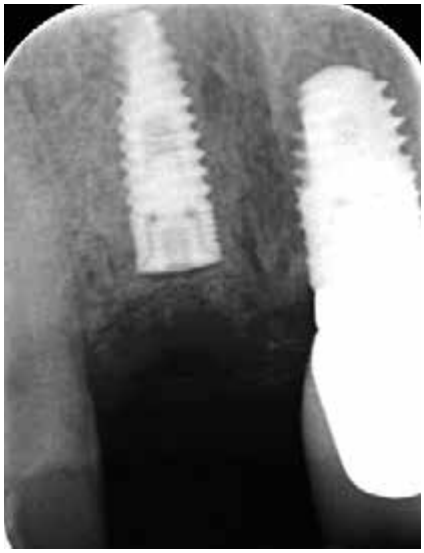
12 I Periapical x-ray immediately post-op.

13 I Repositioning of the mucoperiosteal flap and suturing with 5-0 monofilament sutures.

14 I Uneventful healing of the site one week post-op.



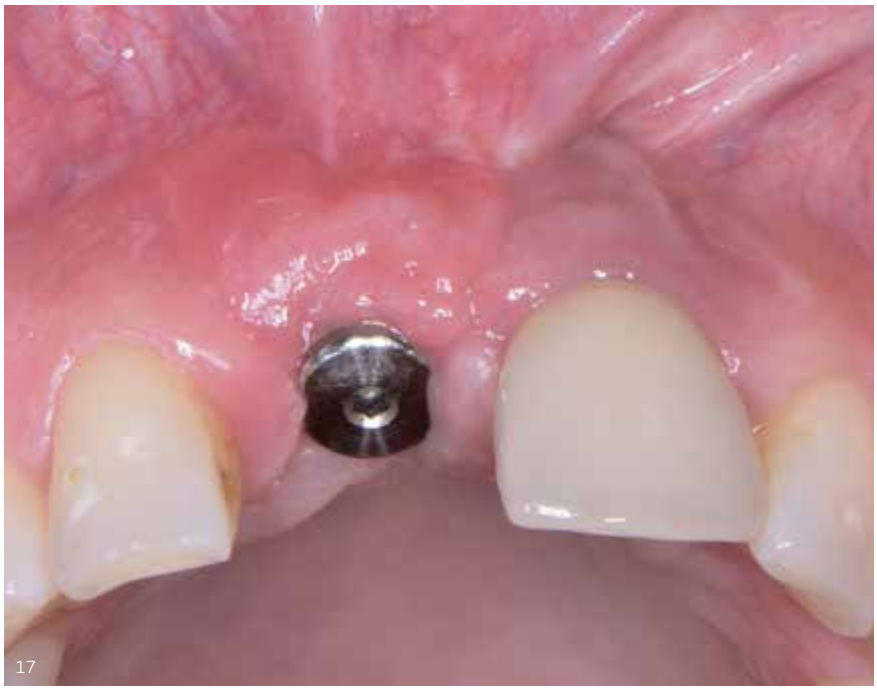
15 I Clinical view 12 weeks post-op. The architecture of the area has been successfully restored. Note the zone of thick keratinised soft tissues that have been regenerated by the host to cover the reconstructed high quality bone around the implant.

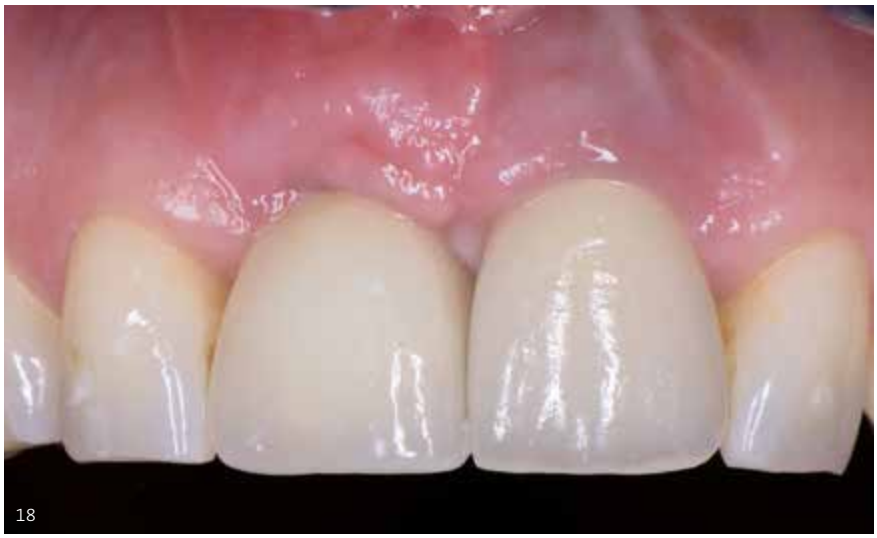


16 I Periapical x-ray 12 weeks post-op.

screw, and the secondary stability of the implant was measured by resonance frequency analysis (PenguinRFA, Integration Diagnostics Sweden AB, Goteborg, Sweden). An ISQ-value (Implant Stability Quotient) of 75 was recorded, demonstrating high stability. A healing abutment was placed, and after allowing the soft tissues to mature for two weeks (Fig. 17), an open-tray impression was taken and the final screw-retained crown was fitted resulting to a successful outcome, regarding esthetics and function (Figs. 18 and 19).

At follow-up one year post-operative, the architecture and the volume of the site had been successfully restored and the ridge buccally was covered by thick regenerated keratinized soft tissues (Fig. 20). A CBCT at this point showed that the buccal bone was successfully regenerated (Fig. 21).



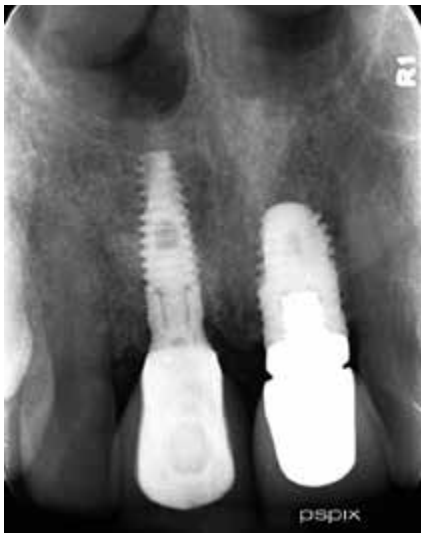


17 I Two weeks after uncovering the implant. 18 I Final result.

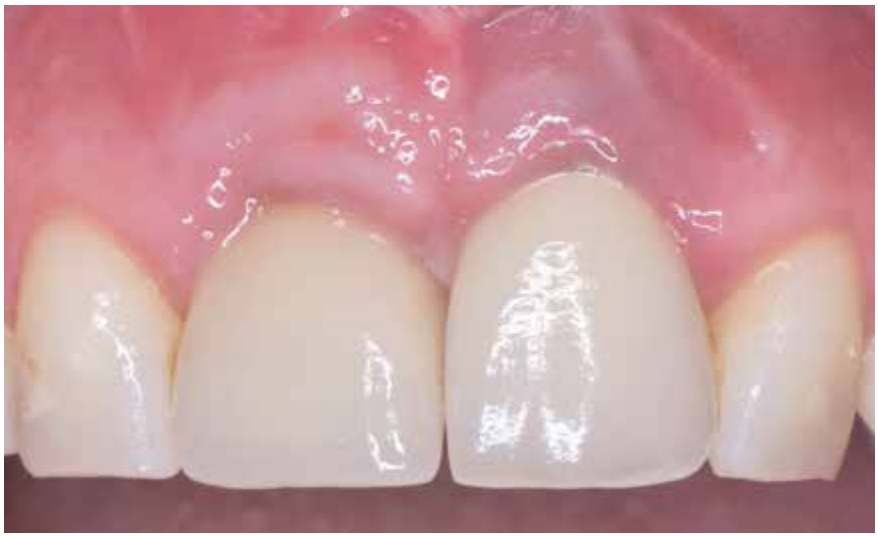
Discussion

In the presented case, a routine simplified staged approach was followed in order to replace the failed implant and to reconstruct the missing hard and soft tissues in a minimally invasive, safe and predictable way. The first step consisted of a simple non-surgical removal of the failed implant without performing any kind of soft and/or hard tissue augmentation. This allowed the area to heal spontaneously for the next 6 weeks. This initial healing period was of great clinical importance as it enabled the host to regenerate new soft tissues that covered the buccal dehiscence, as well as the crestal area of the site, while allowing at the same period of time the immune system to remove any remnants of local infection. As a result, there was sufficient volume of soft tissues during the second stage of the treatment to cover the placed new implant and the graft, without the need to advance the flap or use additional soft tissue grafting, which would increase the morbidity, length, complexity and cost of the procedure.

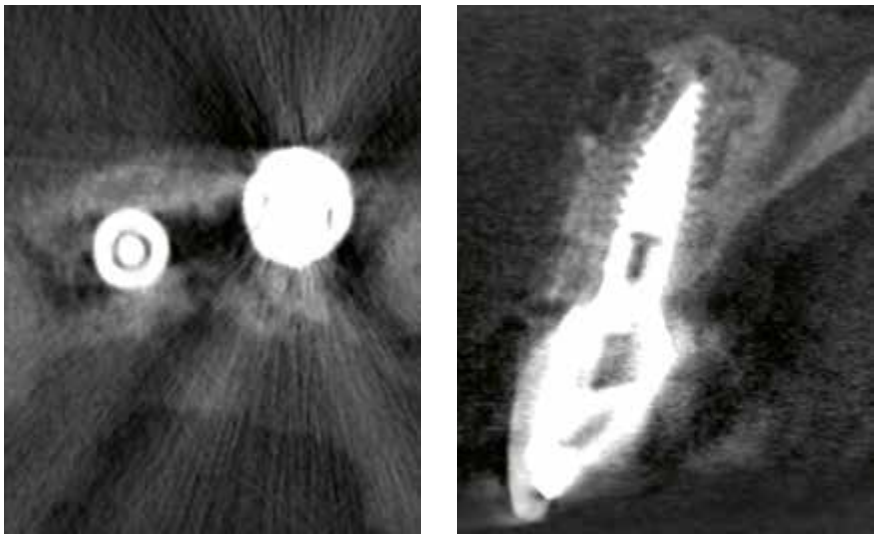
The hard tissue reconstruction was achieved utilizing a synthetic fully resorbable grafting material (EthOss) consisting of β-TCP (65 %) and CS (35 %), that has been extensively researched in preclinical and clinical studies conducted and published by the authors [1, 3–8], and documented in thousands of similar cases of failing teeth that are treated according to the published protocol [1]. Such biomaterials can accelerate and enhance the regeneration of high quality vital bone around placed implants in such localized osseous defects, without the need for the use of additional barrier membranes. The bioactive β-TCP element, apart from being osteoconductive, shows an osteoinductive potential which might further improve the bone healing process [9–11], while the CS element is bacteriostatic and produces an in situ self-hardening scaffold that does not need additional stabilization with the use of collagen membranes or other meshes. In this way, the CS acts as an "integrated barrier membrane", halting the ingrowth of soft tissue during the early phases of bone regeneration. Both CS and β-TCP are fully resorbable biomaterials, having an appropriate resorption time in relation to bone formation [5, 6], leading to the fast regeneration of vital host bone without the long-term presence of residual graft particles. The CS element will resorb over a 3- to 6-week period, thus increasing the porosity in the β-TCP scaffold for im-



19 I Periapical x-ray after fitting the screw-retained implant crown. The grafting material is turning over, being replaced by the regenerated bone.



20 I Clinical view one year post-op revealing a stable outcome and further maturation and adaptation of the soft tissues.



21a & b I CBCT one year post-op showing the regeneration of the buccal bone.

proved vascular ingrowth and angiogenesis, while the β-TCP element resorbs by hydrolysis and enzymatic and phagocytic processes, usually over a period of 9 to 16 months [12–16].

In the presented case, virtual dental implant planning allowed not only for a prosthetically driven approach, but also for the selection of the appropriate implant diameter and its precise positioning into the bony envelope, which are fundamental parameters for the successful reconstruction of the missing bone buccally [17, 18]. In this case, the wrong positioning of the failed implant, and its wide diameter seem to be the most important factors that resulted in the severe biological and esthetic complications of the initial treatment 10 years ago.

In conclusion, this case highlights the benefits of early implant placement with simultaneous bone augmentation for the management not only of extraction sites, but also for the treatment of more demanding cases of failing implants with soft and hard tissue deficiencies. The specific selection of materials and methodology, which is routine practice for the authors, enabled the minimally invasive, safe, cost-effective and successful regeneration of the soft and hard tissues in the presented case, without the need of utilizing soft tissue grafting and barrier membranes. Although a resorbable biphasic β-TCP/CS graft was used for bone regeneration, the architecture and dimensions of the ridge were preserved one year after loading of the new implant. The loading of the implant 12 weeks after placement enhanced the metabolic activity, and triggered the remodeling of the surrounding regenerated vital bone, as described by Julius Wolff in 1892 [19]. This biological activation of the reconstructed high quality vital bone seems to be a key factor for long-term site volume stability, which in turn provides a stable healthy bony scaffold over which the new soft tissues will further mature and thicken, as documented, published and observed in these treatment scenarios by the authors. Working with the host healing allows us to understand the synergetic regeneration of the hard and soft tissues, thus achieving predictable and successful outcomes.

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

Contact address

Dr. Minas Leventis
67 Earls Court Road, Kensington
W8 6EF London
United Kingdom
dr.minasleventis@gmail.com