Guided bone regeneration of a fenestration complication at immediate implant placement simultaneous to the socket-shield technique

Howard Gluckman[1], Jonathan Du Toit[2], Maurice Salama[3]

Introduction

Recession subsequent to immediate implant placement is a certainty, be it 1 mm minimum or greater.[1] As the bundle bone is lost following the tooth's extraction, this recession is coupled to buccopalatal collapse and may see significant aesthetic failure.[2] Although immediate and delayed placement protocols demonstrate comparable success in the literature, the loss of bundle bone affects the long-term aesthetic outcome and is exacerbated in a thin gingival biotype, when the buccal plate is less than 1 mm, in buccally placed or inclined implants, multiple missing teeth, and so forth.[1, 3] The socket-shield technique (SS) may be critical to offset these risks and manage aesthetically challenging cases.[2] The principle of the technique is to prepare the root of a tooth indicated for extraction in such a manner that the buccal/facial root section remains in-situ with its physiologic attachment to the buccal plate intact and undisturbed. The periodontal attachment apparatus is to remain unharmed and vital so as to circumvent the expected post-extraction socket remodeling and subsequent tissue recession. Whilst SS is highly promising for managing the facial ridge tissues at immediate placement, little to no literature is available on its performance during everyday implant therapy complications. Hereafter a SS case with apical fenestration at immediate placement is presented and management of the complication by guided bone regeneration (GBR) is demonstrated with successful long-term postoperative follow up.

Case report

A 55 year old female patient presented with root treated maxillary central incisors that required frequent recementation of post-core crown restorations. The supporting tooth roots lacked adequate ferrules and had apical pathology. In the absence of tooth / root mobility, immediate implant placement with SS to support single screw

Figure 1: Post-core crown restorations removed, lack of ferrule is evident

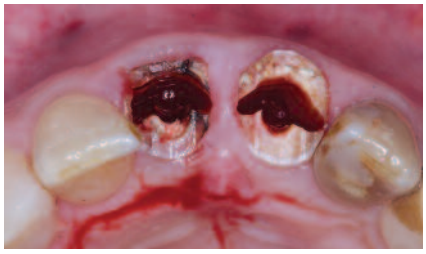

Figure 2: The roots of teeth 11 and 21 sectioned mesiodistally

[1] Howard Gluckman BDS, MChD (OMP).
Specialist in periodontics and oral medicine, director of the Implant and Aesthetic Academy, Cape Town, South Africa

[2] Jonathan Du Toit BChD, Dipl. Implantol., Dip Oral Surg, MSc Dent.
The Implant and Aesthetic Academy, Cape Town, South Africa

[3] Maurice Salama DMD.
Clinical Assistant Professor of Periodontics, University of Pennsylvania, Philadelphia, Pennsylvania; Medical College of Georgia, Augusta, Georgia; Private Practice, Atlanta, Georgia.

CORRESPONDING AUTHOR
Howard Gluckman BDS, MChD (OMP). Contact
email:docg@mweb.co.za
Telephone: 2721-426-2300.

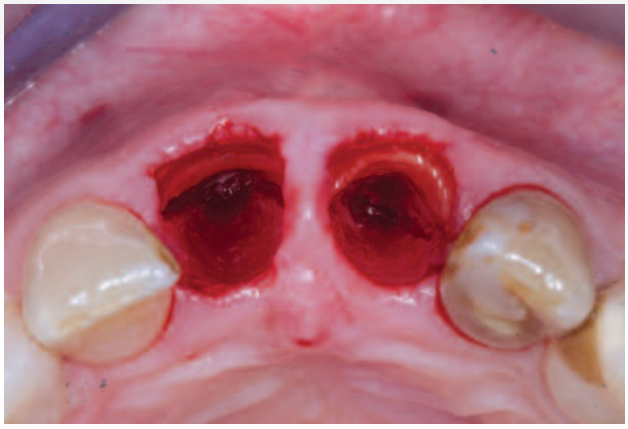

Figure 3: The fully prepared socket-shield within each socket

Figure 4: An esthetic buccal flap reflected with bony apical fenestrations at sites 11 and 21

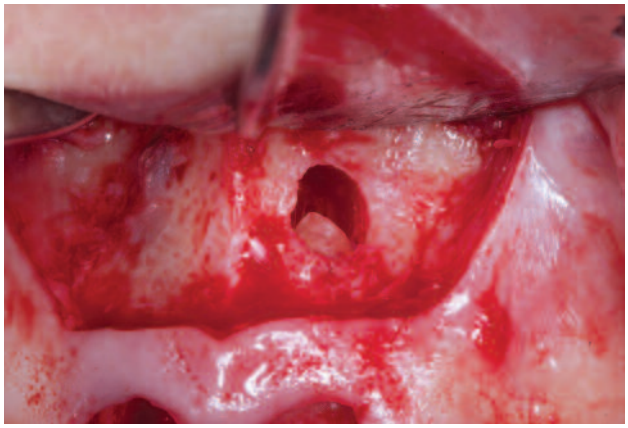

Figure 5: The fenestrations widened, bone shards and any remnants of infection removed

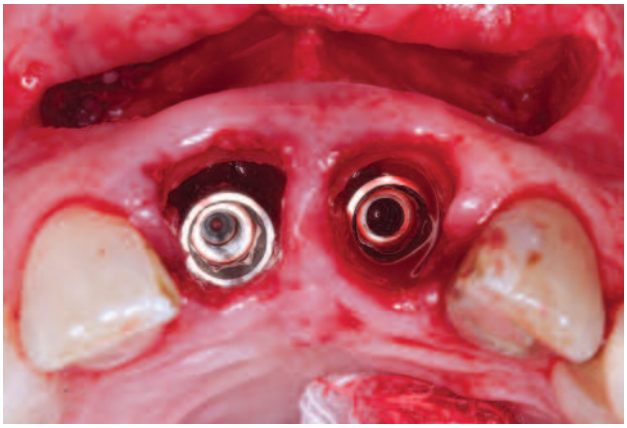

Figure 6: The implants inserted palatal to the socket-shields

retained restorations was planned for. Proximity of apices 11 and 21 to the facial bone plate with apical infection on conebeam computed tomography (CBCT) scans prompted for GBR planning to manage possible fenestrations. The crowns of both teeth were removed and the lack of ferrule could be appreciated (Fig. 1). The roots of teeth 11 and 21 were then sectioned as far apical as possible in a mesio-distal direction with a long shank root resection bur (Komet Dental, Germany) (Fig. 2). The palatal root sections with apices and pathology were carefully removed, and the facial root sections left intact and attached to the buccal plate. The remaining root sections were then reduced coronally to 1 mm above the alveolar crest, and thinned to no less than 2 – 3 mm using a long shanked round diamond bur (Komet Dental, Germany). The socket apices were then carefully curetted under magnification to remove any remnants of infection and each SS was checked for stability. With the SS fully prepared (Fig. 3) an aesthetic buccal flap was then raised to gain access to the apical fenestrations (Fig. 4). The fenestrations were widened to remove any bony shards and to access the apical portions of the SS to ensure complete removal of any infected tissue (Fig. 5). Osteotomies were then sequentially prepared and a 4.3 x 11 mm Nobel Active (Nobel Biocare, Switzerland) implant inserted at each site (Fig. 6). The fenestrations were grafted by collecting autogenous bone particulate with a separate suction and bone trap apparatus (Anthogyr, France), placing this directly on to the exposed implant surfaces, and then covering with a layer of

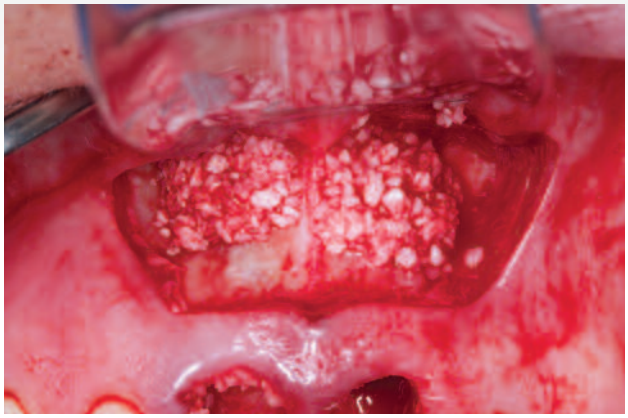

Figure 7: A layer of autogenous particulate bone placed directly atop the exposed implant surfaces, covered by a layer of xenograft particulate bone

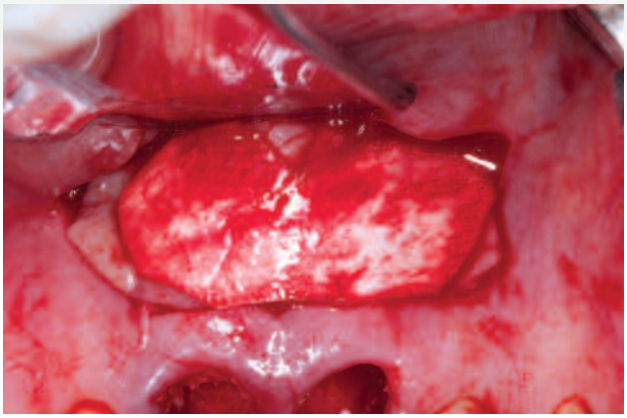

Figure 8: A-PRF membranes placed over the particulate bone, covered by a slow-resorbing xenogeneic membrane

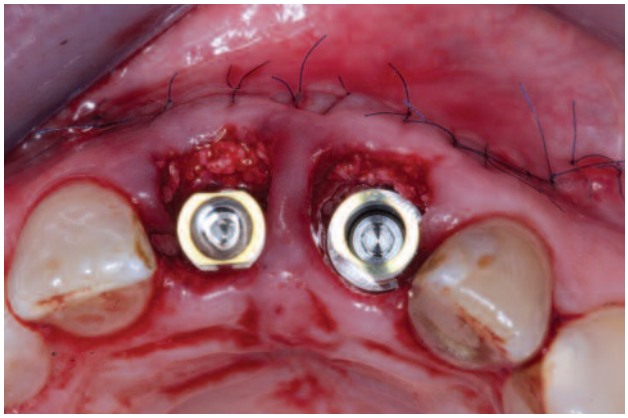

Figure 9: Occlusal view of the jump gaps augmented with xenograft particulate bone

Figure 10: Final closure and customized healing abutments fixed in place

particulate xenograft material (Osteobiol, Tecnoss) (Fig. 7). The particulate was covered with a layer of A-PRF membranes and then with a porcine pericardium membrane (Jason, Botiss) (Fig. 8). The flap was then sutured with 6/0 nylon simple interrupted sutures, temporary titanium abutment cylinders were fixed in place, and the jump gap was grafted with the same xenogeneic bone particulate (Fig. 9). The implant stability quotient (ISQ) of the implants was adequate for transgingival healing abutments but inadequate for immediate provisionalization. The abutments were fashioned with emergence profiles supporting the coronal tissues (Fig. 10) and an acrylic partial denture with adequate clearance of the implants temporarily restored the edentulous space for the duration of healing.

Healing was uneventful with no signs of infection or other complication at the 1 week and 1 month follow up. Integration assessment was completed at 4 months (Fig. 11) with ISQ in the 80s for both implants. These were then restored with zirconium abutments which were cemented to the crowns extra orally and then screw retained (Fig. 12). At the 2-year follow-up no signs of infection, complication, nor re-exposure of either implant was noted. Radiographic investigation demonstrated the maintenance of the interproximal bone peak between the implants (Fig. 13), and CBCT scans demonstrated a bulk of tissue facial to both implants (Fig. 14). The soft tissues facial to the implants remained healthy and free of recession, and a pleasing, aesthetic treatment outcome was maintained at the 2-year follow-up (Fig. 15).

Discussion

The need for management of the post-extraction ridge has been highlighted in an abundance of research that notes the dimensional changes following tooth removal and these changes being detrimental to implant therapy.[4] Most relevant to the aesthetic zone, hard and soft tissue deficiencies negatively impact on ideal, prosthodontically planned implant placement with potential aesthetic compromise.[5] Tissue loss at a post-extraction site is a direct result following interruption of the bone-periodontal ligament-tooth complex, and is exacerbated by traumatic removal, extensive surgical treatment, infection and other pathology.[3] In routine extraction, bundle bone born from a functionally loaded PDL is lost and sees an almost certain recession of residual buccofacial tissues.[2,6] Numerous studies show that implant placement is successful in terms of achieving osseointegration in fresh extraction sockets but it does not counteract post-extraction tissue alterations.[7] It has become well purported in the literature that ridge preservation is a valuable adjunct to implant treatment to offset this tissue loss.[8] However techniques to subdue tissue recession at immediate placement are limited, and possibly not entirely reliable nor predictable.[7] This case report confirms the proof-of-principle reported by Hürzeler and coworkers that retention of the buccofacial root section simultaneous to immediate implant placement can achieve osseointegration without resorptive response of the ridge buccofacial to the implant. The technique offers an exciting solution to help circumvent the complications associated with immediately placed implants. First reported in 2010, SS was built upon previous concepts that the retention of a tooth limits tissue alterations following extraction. More than three decades ago the literature already reported successful bone regeneration around submerged tooth roots, that bone forms coronal to such submerged teeth, and that even new cementum and connective tissue may form coronally over submerged teeth.[9] Malmgren, 1984, was possibly the first to propose the concept of ridge preservation by decoronation of ankylosed teeth with root retention, and it has been demonstrated in numerous reports since.[10-12] It has been shown that the retention of part of the tooth contiguous with the PDL, its fibers and reticulate vascularity interconnected with bundle bone, eludes the physiological remodeling of the extraction socket and alveolar crest. Thus, these delicate tissues – PDL, bundle bone, buccofacial plate, and overlying keratinized mucosa, can be preserved.[13] The retention of roots in the alveolar process does maintain ridge volume. Root submergence for pontic site development where the entirety of the attachment apparatus was preserved with complete preservation of alveolar ridge has been demonstrated.[14] More recent than these are reports of cases having dental implants inserted in contact with ankylosed root fragments with no pathological complication after loading.[15] These concepts collectively form the rationale for maintaining buccofacial aesthetics by inserting an immediate implant lingual to a prepared tooth root – viz. the socket-shield technique.[2]

Hürzeler and coworkers demonstrated histologically a retained attachment of the SS to the buccal plate via a

Figure 11: Sites 11 and 21 at 4 months of healing

Figure 12: The final restorations in place

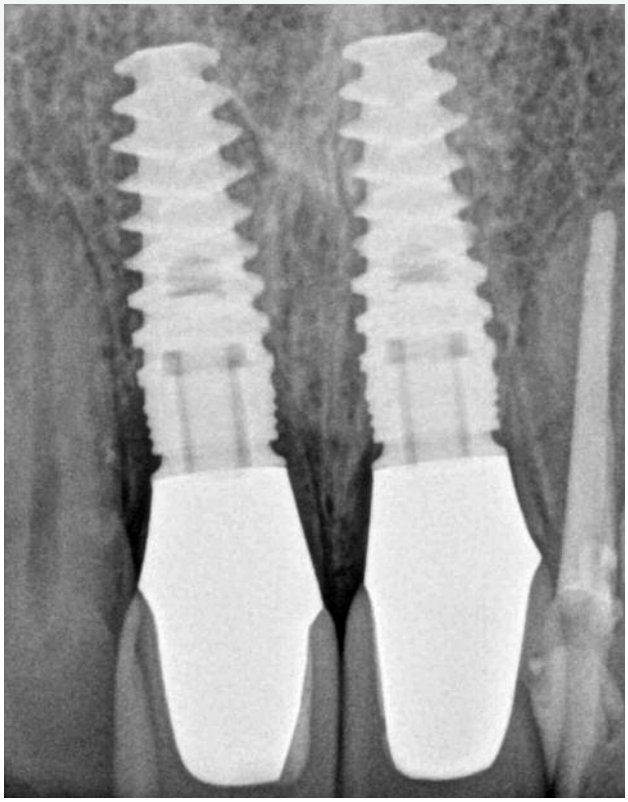

Figure 13: Periapical view of the implant restorations at the 2-year follow-up

physiologic PDL free of any inflammatory response. The buccal plate crest showed an absence of osteoclastic activity and the clinical outcome of the report demonstrated successful osseointegration of the implant placed simultaneous to the SS and a restoration with an aesthetic outcome indistinguishable from the adjacent maxillary central incisor. Whilst the authors reported preservation of the buccofacial tissues, it should be noted that absolute preservation has not yet been shown. In Baumer and coworkers 2013 study they found a mean loss of 1 mm in a labial direction after the placement of the final restorations.[7] Chen and coworkers in their case report measured 0.72 mm of buccal resorption.[16] Therefore, however exciting the prospects of SS may be, to safely apply a newly introduced technique, long-term clinical studies and objective histological findings are required and at present this data is absent. A single publication by Siormpas and coworkers comes 4 years after the first histological and clinical data of SS were reported.[17] The authors are the first to provide long-term data (follow up inconsistent but minimum 24 months) on this root section retention methodology, as well as on a significant number of implant sites and patients (n=46). Their results showed 100 % osseointegration in all cases. The case series measured crestal bone height mesial and distal at the extraction sites, and showed crestal bone loss as little as 0.18 ± 0.09 and 0.21 ± 0.09 mm respectively. Data to demonstrate a lack of buccopalatal collapse was however not reported on. Most important to note is also the difference in methodology. Siormpas and coworkers had prepared the implant osteotomy site by drilling through the existing intact tooth root. After preparation of the osteotomy buccal and lingual root sections were separated. This differs from the methodology in the original SS technique and with the case reported here. It may be postulated that drilling through the tooth root is detrimental to the implant drills, and more importantly may damage the attachment of the SS to the buccal bundle bone. Whilst Siormpas and coworkers report no complication in this regard the authors of this case report suggest always first fully preparing the SS.

Currently little to no data exists on how SS performs in a variety of clinical situations either. The expected and known complications associated with implant dentistry such as infection, failure of osseointegration, recession, fenestration / dehiscence with implant exposure, etc. and SS carried out concurrent to the placement of such an implant are wholly unknown. Only a single publication exists reporting on a modified SS technique applied to single rooted teeth with vertical root fractures in 3 beagle dogs.[7] This case reported here is possibly the first to demonstrate immediate implant placement with SS that required GBR of a fenestration complication apical to two implants in an area of highest aesthetic value. Systematic review of the literature attests that treating fenestrations and dehiscence as complications of implant treatment with GBR to having a success rate (mean) 95.7%.[18] This case report demonstrates that in the event of such a fenestration, that the ridge defect may successfully be grafted by accepted GBR procedures, and that it may have no detrimental impact on the outcome of the SS nor the

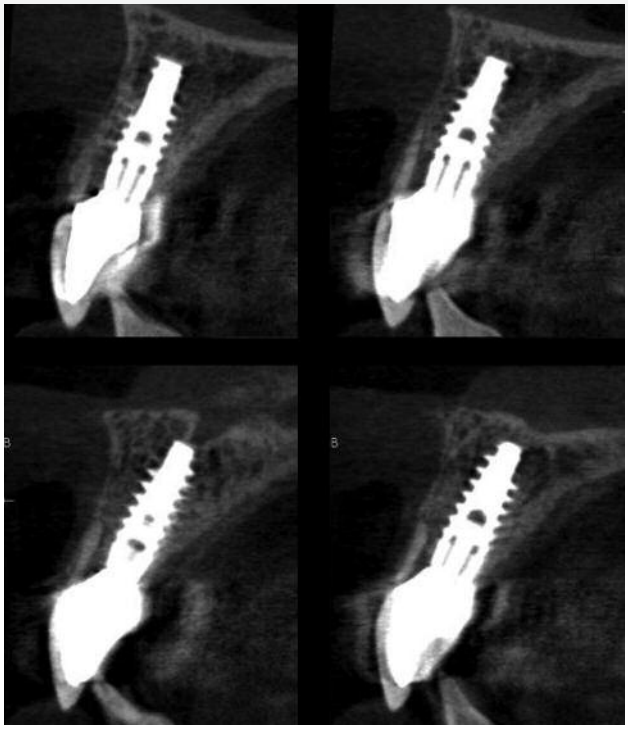

Figure 14: CBCT scans of the 2-year follow-up, site 11 above, site 21 below

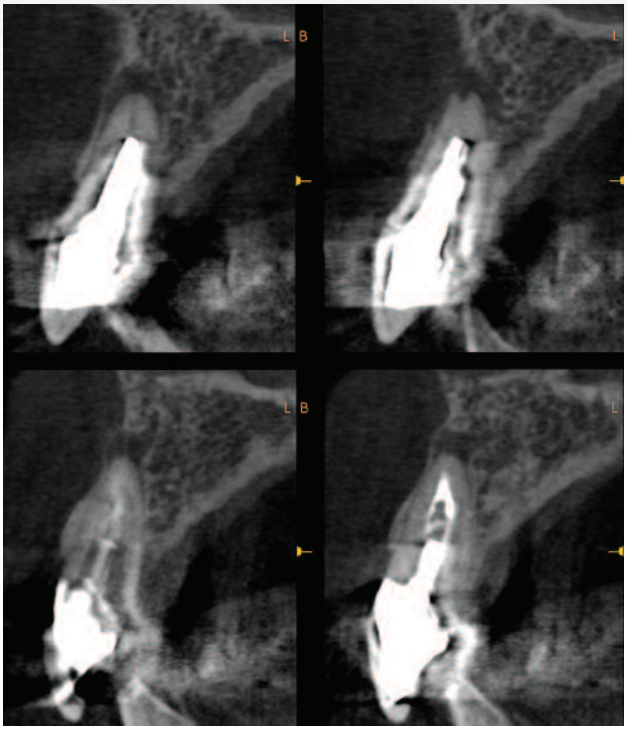

Figure 15: Preoperative CBCT scan for comparison

implant restoration's success. In this case, the grafts healed, both implants showed successful osseointegration with ISQ values in the 80's at restorative phase, and a clinical presentation at final day of treatment as well as at 2-year recall with sound, healthy, and aesthetic peri-implant tissues.

Figure 16: Maintained soft tissue aesthetics at the 2-year follow-up

Concluding remarks

The socket-shield technique offers an exciting solution to the difficulties encountered in managing the post-extraction tissues, ridge preservation and site development. The implant dentist is to expect complications in daily practice, though the impact of complications on this technique are unknown. This case report demonstrates its diversity of application. The void in the literature reporting on the management of complications and its long-term success requires urgent participation of clinicians practicing the technique so as to contribute to the knowledge base before being routinely prescribed.

Declaration

The authors declare no conflict of interest.

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