

Partial Extraction Therapies (PET) Part 1: Maintaining Alveolar Ridge Contour at Pontic and Immediate Implant Sites



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Buccopalatal collapse of the postextraction ridge is a significant challenge in restorative and implant dentistry. A variety of ridge preservation techniques using tissue and augmentative materials have been proposed in the literature. A slightly different approach is to use the tooth itself. Root submergence has been reported in the literature for more than 4 decades, and it has been demonstrated that the submerged tooth root retains the periodontal tissues and preserves the bone in pontic sites or below dentures to retain the ridge. The socket-shield technique entails preparing a tooth root section simultaneous to immediate implant placement and has demonstrated histologic and clinical results that are highly promising to esthetic implant treatment. The pontic shield technique preserves the alveolar ridge at sites intended for pontic development where the root submergence technique is not possible. The aforementioned techniques collectively may be termed partial extraction therapies (PET), a term newly introduced into the literature and clinical environment. This article is a review of these ridge preservation therapies, providing a classification and a guide to their application. Int J Periodontics Restorative Dent 2016;36:681–687. doi: 10.11607/prd.2783

Ridge resorption as a result of tooth loss is well reported in the literature.¹ This loss of alveolar bone and change in ridge contour is the result of the bundle bone-periodontal ligament (BB-PDL) complex lost following the removal of a tooth.^{2,3} To restore an edentulous or partially dentate patient in many instances requires management of these resorbed sites by careful surgical intervention. The literature is abundant with guidelines to limit tissue loss (ridge preservation techniques) or restore the ridge architecture (bone and soft tissue augmentation).^{4,5} However, none of these circumvent the primary cause of resorption, ultimately resulting in partial or total ridge collapse.³ Partial extraction therapies (PET) represent a subgroup of precollapse interventions that collectively use the tooth itself to offset the loss of alveolar tissue. By retaining the tooth root and its attachment to bone, the BB-PDL complex with its vascular supply may be maintained. Root submergence has been demonstrated with success in the preservation of the postextraction ridge and development of pontic sites.^{6,7} However, the technique is limited by apical pathology and endodontic treatment requiring an alternative partial extraction therapy.

The socket-shield technique introduced by Hürzeler et al uses the

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Table 1 Partial extraction therapies (PET) and their indications

PET	Clinical situation(s) indicated
Root submergence ⁷	Unrestorable tooth crown or tooth indicated for extraction Absence of apical pathology Healthy amputated pulp or endodontic therapy completed Intention to preserve the alveolar ridge Planned removable full or partial prosthesis Planned pontic site beneath fixed prosthesis Cantilever pontic site as an alternative to two adjacent implants Actively growing young patient planned for implant treatment later Ridge preservation in conjunction with other PET
Socket-shield ⁸	Unrestorable tooth crown or tooth indicated for extraction Tooth root with or without apical pathology Intention to preserve the alveolar ridge, specifically to prevent buccopalatal collapse Immediate implant placement Ridge preservation in conjunction with other PET
Pontic shield ⁹	Unrestorable tooth crown or tooth indicated for extraction Tooth root with or without apical pathology Intention to preserve the alveolar ridge Planned pontic site(s) beneath fixed prosthesis Cantilever pontic site as an alternative to two adjacent implants Ridge preservation in conjunction with other PET
Proximal socket-shield ²³	Unrestorable tooth crown or tooth indicated for extraction Tooth root with or without apical pathology Intention to preserve interdental papillae Planned immediate implant placement sites of two or more adjacent implants Papillae preservation in conjunction with other PET

facial or buccal root section alone to maintain the tissues at immediate implant placement.⁸ A tooth planned for extraction with immediate placement is sectioned mesiodistally such that the facial and palatal root halves may be separated. The palatal root section is removed, leaving the facial root section to remain in situ. The root section is further refined and prepared while its attachment to the socket remains undisturbed. With an implant placed palatal to it this prepared socket-shield maintains

the attachment to bundle bone and its vascularity, thus maintaining the support of the ridge facial to the implant and the restoration.

An additional PET that borrows from both the aforementioned techniques is the pontic shield.⁹ This technique develops a pontic site and preserves the alveolar ridge by retaining the buccal or facial root section, applying ridge preservation materials to the site, and sealing the tooth socket. The root submergence technique for pontic site development is limited to sites with a

healthy tooth pulp or sites at which endodontic treatment of the tooth root is complete. The pontic shield, however, provides the clinician with an alternative method when apical pathology contraindicates root submergence. The vital periodontal tissues buccofacial to the root may be maintained to develop a pontic site with little or no collapse in the buccopalatal dimension.

PET classification

At present the concept of PET as a collective group of treatments to manage the postextraction ridge and its subsequent resorption does not exist. As a result, it may be difficult for a clinician to discern between the clinical indications for each therapy to select a treatment option. Root submergence has long been available in restorative and implant dentistry. The other PET treatments, however, are relatively new. Their indications overlap, but each therapy is suited to the final intention for the site. Two or more therapies can successfully be used simultaneously in the same patient, as each extraction site may be managed specific to the planned restoration, pontic, or implant. Combining several therapies when treating an arch or quadrant affords the clinician additional options to consider alternative treatment plans and placement strategies, restoration designs, placement sites, and so forth. A classification to guide the clinician is proposed and indicates the clinical scenarios suitable to each therapy (Table 1).

Clinical techniques

Common to all PET treatments is the decoronation of a tooth that is no longer restorable or that is indicated for extraction, and the preservation whole or in part of its root such that the periodontal tissues associated with it are preserved. Simplified outlines of each therapy are presented here as a step-by-step guide to their application. The reader is directed to additional literature on these therapies for a greater understanding.¹⁰

Root submergence

Root submergence when planning a pontic site beneath a conventional fixed partial denture (FPD) or implant-supported FPD (or any other indication) requires that the root be free of apical pathology, or that endodontic treatment first successfully be carried out. The tooth is decoronated at the level of the bone crest and the coronal root hollowed to mimic the future ovate pontic. Soft tissue closure is then achieved to ensure healing by primary intention. The attached gingiva may be advanced and sutured or, preferably, a soft tissue graft, connective tissue alone or epithelialized, is placed atop the submerged root for soft tissue closure and a bulk of tissue to later develop a pontic site. The site is to heal for a minimum of 3 months prior to any pontic pressure of the tissue overlying the tooth root.

Socket-shield

The socket-shield is created by preparation of a tooth indicated

for extraction at an immediate implant placement site, typically in the anterior maxilla. The tooth is decoronated at 1 mm above the bone crest, and the root is thereafter sectioned longitudinally into facial and palatal halves. The palatal root section is delivered and any pathology present is cleared from the tooth apex. The facial root section is then concaved slightly with a long shank dental bur. The implant is then immediately placed palatal to the socket shield (and the buccal gap preferably grafted with a slow-resorbing bone substitute material).

Pontic shield

The pontic shield involves identical preparation of the socket-shield and the extraction socket grafted with a slow-resorbing bone substitute material (or bone material of the clinician's choice). The socket must be sealed, preferably with a soft tissue graft. The site is left to heal for a minimum of 3 months, and thereafter pontic pressure may gradually be applied to develop the site.

Discussion

Postextraction ridge collapse with degrees of alveolar resorption has been extensively documented in the literature. These hard and soft tissue defects can negatively affect ideal planned implant placement with a potential for esthetic failure.¹¹ The clinician needs to be knowledgeable of the physiologic healing processes to best manage the

resorbing ridge. Following tooth extraction, the tissues resorb as a direct result of the destruction of the BB-PDL-tooth complex.² Bundle bone arises from a functionally loaded PDL and is lost following extraction, resulting in an almost certain collapse of the buccofacial tissues.¹² A healed ridge defect following tooth extraction may require extensive surgical intervention prior to definitive restorative treatment. These may involve guided bone regeneration (GBR) techniques by bone and/or bone substitute materials with a barrier membrane, bone block GBR procedures, ridge-split techniques, and so forth—all of which may provide hard tissue gains, though with limitations and with drawbacks such as increased morbidity, technique sensitivity, increased costs, and limited access to materials.¹³ Most notable are the soft tissue alterations that present with loss of papillae, scarring from the ridge augmentation procedure, and so on. The clinician should note that these techniques provide limited gains and will demonstrate protracted healing with shrinkage, and overcompensation is needed. Preventing ridge collapse before it occurs or limiting collapse as far as possible are beneficial to both patient and clinician.¹⁴

A multitude of ridge preservation techniques have been proposed in the literature with a large variety of materials and methods, leaving the clinician unclear as to which is best suited for ridge management. Not all of these, however, are able to treat the underlying cause of the resorption—the loss

Table 2 Available literature reporting on the socket-shield technique or modifications thereof

Year	Author(s)	Study
2016	Gluckman et al ⁹	10 case series of the pontic shield
2016	Mitsias ²⁵	Case report: The root membrane technique
2015	Bäumer et al ¹⁷	Animal histology of 3 cases of socket-shield with vertical fractures
2015	Gluckman et al ¹⁸	Case report: Socket-shield at immediate placement, 1-year follow-up
2014	Siormpas et al ¹⁹	46 case series of the root-membrane technique with follow-up varying 2 to 5 years
2014	Holbrook ²⁰	Case report: Guided implant placement with socket-shield
2014	Cherel and Etienne ²¹	Case report: Modified socket-shield for papillae preservation
2014	Glocker et al ²²	3 case series: Modified socket-shield for ridge preservation, delayed placement
2013	Kan and Rungcharassaeng ²³	Case report: Proximal socket-shield for papillae preservation
2013	Chen and Pan ²⁴	Case report: Socket-shield with immediate implant placement
2010	Hürzeler et al ⁸	Animal histology of 1 case of socket-shield technique, and 1 human clinical case of implant restoration with socket-shield

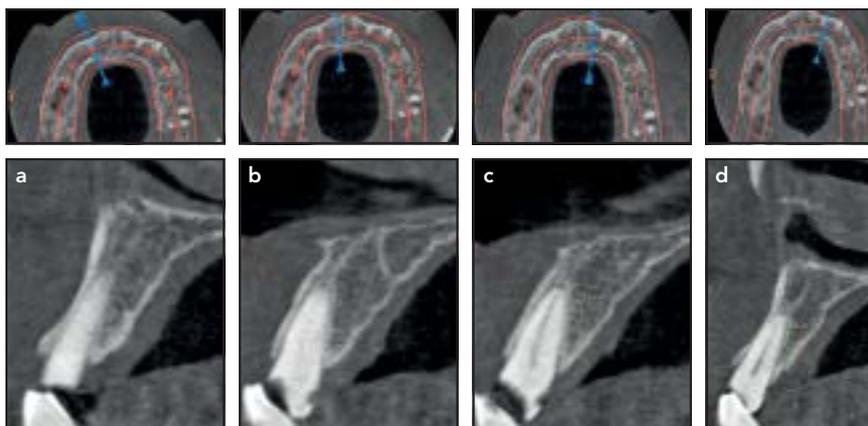


Fig 1 Case 1. Preoperative CBCT scan of the maxillary (a) right lateral incisor, (b) right central incisor, (c) left central incisor, and (d) left lateral incisor.

of the tooth. Root submergence was originally introduced as a technique to preserve alveolar ridge volume beneath removable full prostheses.¹⁵ Malmgren et al, more

than 3 decades ago, reported successful bone regeneration around submerged tooth roots, that bone forms coronal to such submerged teeth, and that new cementum and

connective tissue may form coronally over submerged teeth.¹⁶ Later, the concept of submerging a tooth root for the development of pontic sites beneath FPDs was reported. Preserving the entire attachment apparatus for complete preservation of the alveolar ridge for pontic site development has been demonstrated.⁷ This concept has evolved and has been applied to the socket-shield technique and the pontic shield, with root submergence collectively known as PET. Current literature to support some of these approaches is very poor. Six case reports, three case series (one with follow-up of 2 to 5 years), and two animal histology reports represent the only current studies (Table 2). Obviously, a randomized controlled study is highly recommended to support the use of these techniques. While literature reporting on these is lacking, PET treatments are hugely promising in the improved management of the postextraction ridge. These techniques preserve the supracrestal fibers and support the peri-implant tissues, as Hürzeler et al demonstrated histologically.⁸ The BB-PDL-tooth complex remains undisturbed, and the soft tissue frame for a pontic site or implant placement site can better be supported. In no way do the PET treatments yet supersede established ridge preservation techniques. It is, however, this working group's intention to demonstrate the techniques carried out and the results that have been gained (Figs 1 to 16) and inspire prudent scientific inquiry that may produce the long-term data required to confirm their validity.



Fig 2 Case 1. Patient with rampant caries lesions that required multiple extractions in the maxilla.



Fig 3 Case 1. Root submergence technique of the maxillary lateral incisors, and socket-shield technique at the central incisors.

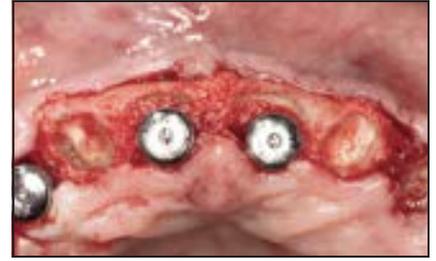


Fig 4 Case 1. Implants were inserted as per immediate placement protocol, as far palatal as possible, and the buccal gap was grafted with xenograft particulate bone.

Fig 5 Case 1. The final restoration at the 1-year recall. Note the bulk of tissue preserved, negating the need for disguising with pink restorative materials.



Fig 6 Case 1. CBCT scans at the 1-year recall of the partial extraction therapies at the maxillary (a) right lateral incisor, (b) right central incisor, (c) left central incisor, and (d) left lateral incisor.

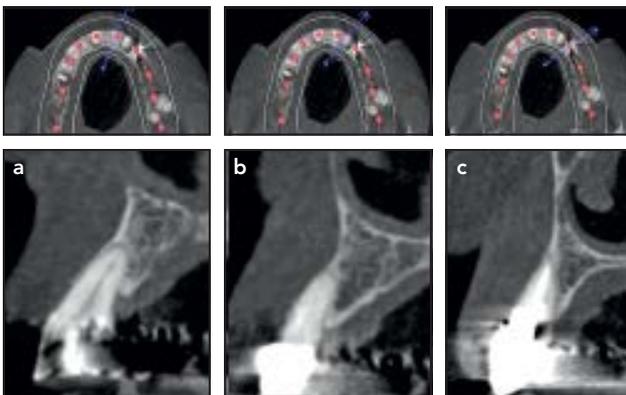
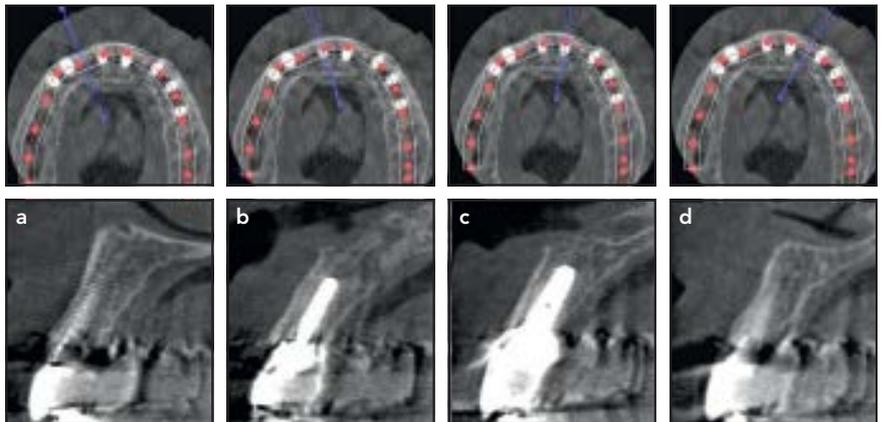


Fig 7 Case 2. Preoperative CBCT scan of the maxillary (a) left central incisor, (b) left lateral incisor, and (c) left canine.



Fig 8 Case 2. Preoperative clinical view.



Fig 9 Case 2. At stage 1, the socket-shield technique was carried out at the site of the maxillary left lateral incisor (left). The pontic shield was carried out at the maxillary left canine, the healing abutment was fixed in place at the maxillary left lateral incisor, and connective tissue graft closure of the site of the maxillary left canine was performed (middle). At stage 2, immediate implant placement was done at the site of the right central incisor (right) and root submergence was performed at the left central incisor.



Fig 10 (left) Case 2. Grafting of the buccal gap at the maxillary right central incisor, connective tissue graft coverage of root submergence at the left central incisor, healed socket-shield at the left lateral incisor, and healed pontic shield at the left canine.

Fig 11 (right) Case 2. Day of delivery of the final prostheses. Note the symmetry between the left and right sides of the arch from the premolars anteriorly with excellent health and bulk of the soft tissue.



Fig 12 Case 2. Final prostheses at the 1-year recall.

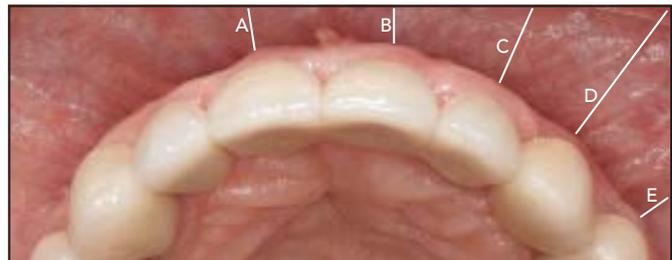


Fig 13 Case 2. Occlusal view at 2-year follow-up. Immediate implant placement (a), root submergence and pontic (b), socket-shield (c), pontic shield (d), and implant with ridge split (e). Note the maintenance of soft tissue profile and lack of collapse.

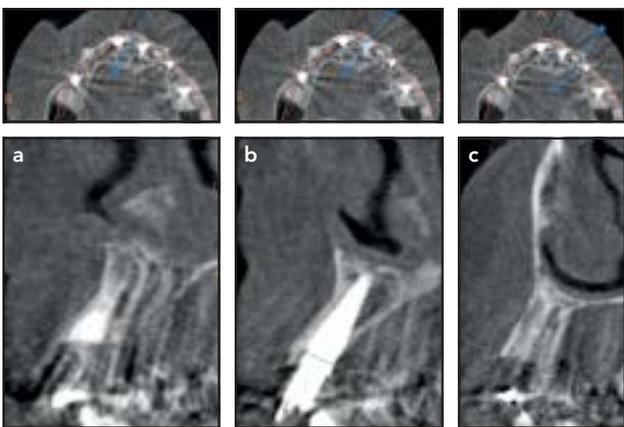


Fig 14 Case 2. CBCT scans at the 1-year recall at the maxillary (a) left central incisor, (b) left lateral incisor, and (c) left canine.

Conclusions

PET may be considered a more conservative ridge preservation strategy for teeth slated for extraction. Retention of all or part of a tooth for the enhancement of a pontic site or preservation of papillae or labial tissues at immediate or delayed implant placement has demonstrated promising results. It is the opinion of the authors and the reviewers of this article that before the socket-shield and PET are further advocated in daily clinical practice, more abundant histologic evidence and proof of long-term clinical success need to be presented. This article is the first proposition of a collective term and classification of these techniques.

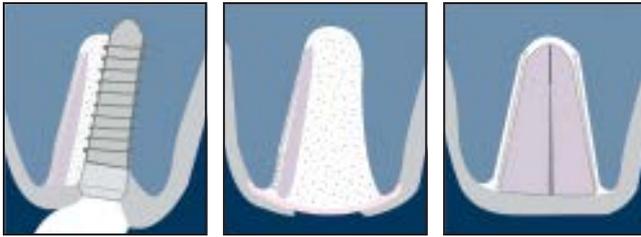


Fig 15 Diagrammatic representation of the partial extraction therapies (buccopalatal axial view): socket-shield (left), pontic shield (middle), and root submergence (right).

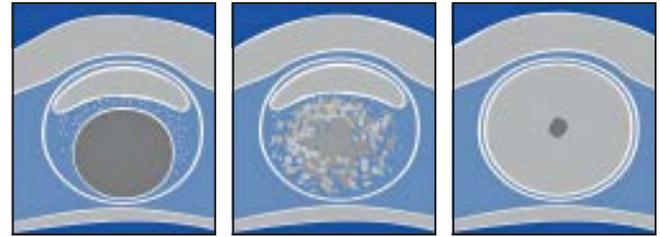


Fig 16 Horizontal cross-section midway through the sockets of partial extraction therapies; socket-shield (left), pontic shield (middle), and root submergence (right).

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