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PET – NEW FRONTIER

Dental Science

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ABSTRACT

Aim: This study was aimed to review the role of Partial Extraction Therapies (PET's) in Prosthodontics, and mainly it's role in Implantology.
Methodology: A systematic literature search was performed electronically and also hand-searched with the terms of Partial Extraction Therapies (PET), PET's in dentistry, PET's in Prosthodontics, Socket shield technique. The search was restricted to full-text articles published in the English language. The search was carried out through Medline via Pubmed, Wiley online library, Ebscohost, Science Direct as well as the Google Scholar for articles published from 2000 to 2019. A total of 64 articles were found. Finally, a total of 57 articles were found relevant to the topic. Articles selected were critically appraised to evaluate their quality.
Results: Different articles described Partial extraction therapy in dentistry, especially in Implantology. The literature search revealed 21 articles in PMC and 28 in Google search. Additional 10 articles were identified by hand search.
Conclusion: Partial Extraction Therapy appears to be an advanced and conservative technique when compared with the existing methods for the treatment of preserving alveolar bone (buccal) in implantology.

KEYWORDS

Partial extraction therapy, socket shield technique, Implantology.

INTRODUCTION:

Ridge resorption, as a result of tooth loss, is well reported in the literature.[1] Ideally, a method for the prevention of alveolar ridge resorption after extraction should be cost-effective and minimally invasive. Various techniques of guided bone regeneration (GBR) have been described to retain the original dimension of the bone after extraction. All these procedures are cost-intensive and technique-sensitive. In contrast, Partial Extraction Therapies (PET) is cost-effective but still technique-sensitive.[2] It avoids the resorption of the bundle bone. The literature is abundant with guidelines to limit tissue loss (ridge preservation techniques) or restore the ridge architecture (bone and soft tissue augmentation).[3,4] However, none of these circumvent the primary cause of resorption, ultimately resulting in partial or total ridge collapse.[5] 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.

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 tough 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 specifically 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).

Tab1	Partial extraction therapies (PET) and their indications
PET	**Clinical situation(s) indicated**
Root Submergence[6]	• 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 • A 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[7]	• 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[2]	• 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[8]	• 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

CLINICAL TECHNIQUES:

The first step, common to all PET is the decoronation of a tooth indicated for extraction. In the root submergence technique, the entire root is retained below the alveolar bone and covered by the soft tissues. For the socket- and pontic-shield, the root is sectioned in the mesiodistal direction, the palatal fragment is carefully extracted, and the buccal piece is reduced below bone level and prepared as a concave, chamfered structure. For the socket-shield, the jump gap is grafted, followed by osteotomy preparation and implant placement. Lastly, for the pontic-shield, the socket is grafted and sealed, which usually includes a soft tissue graft(fig 1 & 2). Root submergence was the first PET, introduced in the 1950s, as a treatment strategy to maintain the volume of the alveolar ridge under full dentures. Later, the approach was further explored in pontic sites for fixed partial prosthesis and implant restorations. The concept evolved to test the retention of the buccal aspect in association with implant placement (socket-shield technique) and since then, more studies have been published to confirm the efficacy of PET.[9]

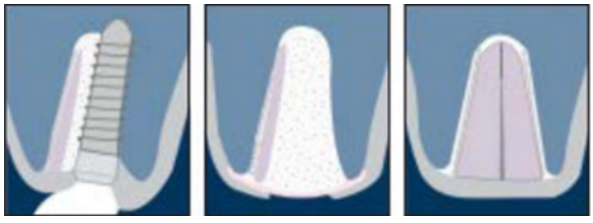

Fig 1: Illustration of the three types of partial extraction therapies (PETs): socket-shield (left), pontic shield (middle), and root submergence (right).

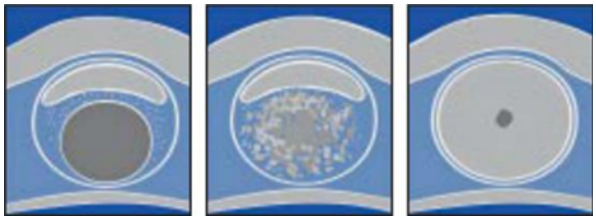

Fig 2: Illustration of the three types of partial extraction therapies (PETs), horizontal cross-section midway through the sockets of PET: socket-shield (left), pontic shield (middle), and root submergence (right).

Instruments and materials required for PET:

- **Root submergence**

1. Irrigated surgical motor
2. Contra-angled surgical fast handpiece
3. Extra-large round diamond head bur (for reducing coronal aspect root into concavity)
4. SM 69 blade (or other suitable microblade, mandatory for split-thickness dissection of facial and palatal pouches to tuck CTG into)
5. 6/0 nylon sutures

- **Socket-shield**

1. Long shank root resection bur
2. Extra-large round diamond head bur (to reduce inner aspect of the shield into concavity).
3. End-cutting diamond head bur (to reduce coronal aspect of the shield)
4. Gingival protector
5. Irrigated surgical motor
6. Contra-angled surgical fast handpiece
7. Microperiotomes
8. Microforceps

- **Pontic shield** - As for socket-shield, plus:

1. Socket grafting instruments: plugger, particulate graft spoon, crucible
2. SM 69 blade (or other suitable microblade, mandatory for split-thickness dissection of facial and palatal pouches to tuck CTG into)
3. 6/0 nylon sutures

Socket shield technique:

One of the primary aims of prosthetic rehabilitation is to achieve and keep the harmony between the white and pink zones, especially in the esthetic areas. Atraumatic extraction of a tooth with implant(immediate) placement was found to result in the deprivation of buccal bone, both horizontally & vertically as well as flattening of the interproximal bony scallop resulting in a complicated rehabilitation.[10] The deprivation of supporting bone followed by the apical migration of soft tissue results in unesthetic black triangles between teeth. The socket shield technique(SST) provides a promising treatment modality to manage these risks and preserve the postextraction tissues in esthetically challenging cases. The principle is to make ready the root of a tooth, which is indicated for extraction, in that fashion that the buccal/facial root section remains in place. This technique was first described by Hürzeler et al.[7] SST, also known as partial extraction therapy,[2] root membrane technique,[11] and partial root retention.

Procedure of SST:

Steps included as follows:

Step 1: Trim the crown horizontally at the gingival level [Fig 3].

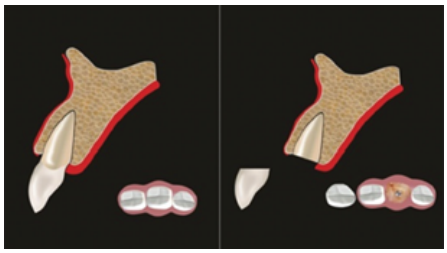

Fig 3: Horizontal section of the crown at gingival level

Step 2: Bisect the root vertically in such a way that palatal half is removed along with the apex. The length of the buccal shield should be kept at two-third of the root length. This step requires a lot of patience, practice, & time. The buccal part is then remoulded such that the buccal shield width is about 1.5–2 mm. The buccal shield should be shortened to the bone level. A bevel or S-shaped profile on the inner side of the shield is given to housing the restorative components [Fig 4].

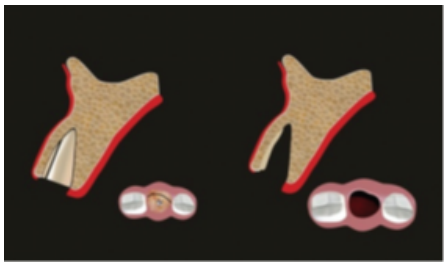

Fig 4: Vertical bisection of root

Step 3: Placement of implant in the correct three-dimensional (3D) position [Fig 5].

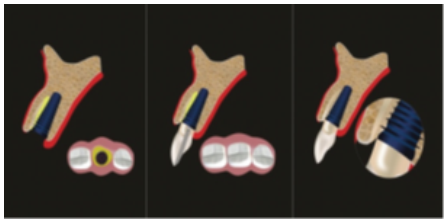

Fig 5: Implant placement

The optimum area between shield and implant is 1.5 mm or more. A bone graft is indicated if the gap is greater than 3 mm. A interim crown

or a customized healing abutment is given immediately after the implant placement will help in maintaining the soft-tissue contours. The choice of the prosthesis for the final restoration is a screw-retained crown or a cement-retained crown with a restorative margin that can be easily accessed for cement clean up.

Classification:
It is proposed that the classification12 of SST technique will help in understanding the clinical implementation of this technique depending on the position of the shield in the socket.

Type I: Buccal shield
A case can be classified as a buccal shield when the shield lies only in buccal part of the socket, (between proximal line angles of the tooth). It is indicated in single edentulous site with both mesial and distal tooth present (Figure 6).

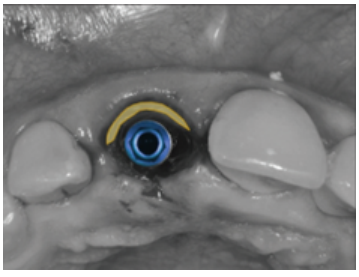

Fig 6: Buccal shield

Type II: Full C buccal shield
A case can be classified as Full C Buccal shield when the shield lies in buccal part and the interproximal part on both sides of the socket.

This shield design is recommended for the following clinical scenarios:
- Existing implant on either side of the proposed site (Figure 7).
- Missing tooth on either side without an implant.
- Having implant on one side and a missing tooth on the other side.

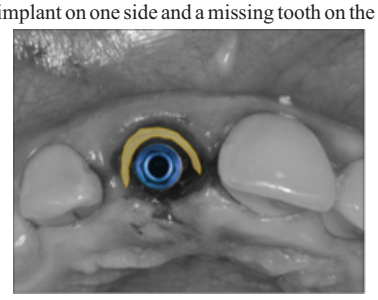

Fig 7: Full C buccal shield

Type III: Half C buccal shield
A case can be classified as half C buccal shield when the shield lies in buccal part and one of the interproximal part. This design is recommended when there is a tooth on one side and implant or a missing tooth on the other side (Figure 8).

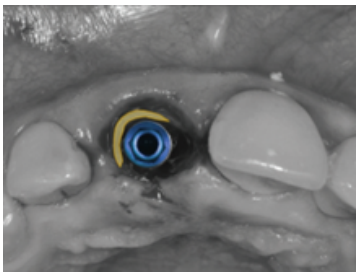

Fig 8: Half C buccal shield

Type IV: Interproximal shield
A case can be classified as an interproximal shield when shield lies only in the mesial or distal part of the socket. This design is indicated when there is buccal bone resorption requiring graft, and there is an adjacent side with a missing tooth or an implant. Extraction of the complete tooth in such cases may lead to loss of the valuable interproximal bone (Figure 9).

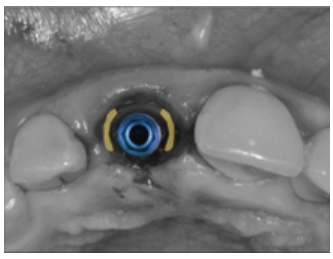

Fig 9: Interproximal shield

Type V: Lingual-palatal shield
A case can be classified as Lingual-Palatal shield when the shield lies on the lingual or palatal side of the socket. This type of shield design has few indications but could be considered for maxillary molars (Figure 10).

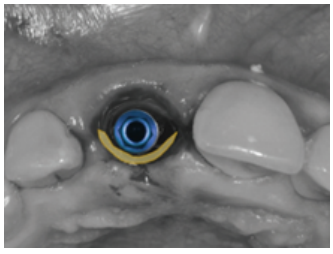

Fig 10: Lingual-palatal shield

Type VI: Multiple buccal shields
A case can be classified as multiple buccal shields when it has two or more shield in the socket. It is indicated in cases with a vertical root fracture. There is evidence to show bone deposition in between fractured roots which could assist in holding the two fragments in place (Figure 11).

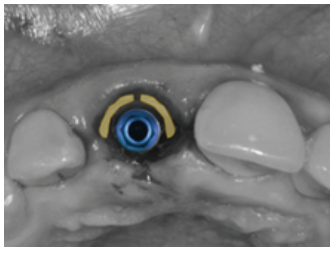

Fig 11: Multiple buccal shields

Advantages:
- A minimally invasive surgical procedure - maintaining hard and soft-tissue contours.
- Minimizes the need for soft and hard tissue grafting procedures - shortens the overall treatment duration.
- With adjacent implants - interdental papilla can be preserved by preparing interdental socket shield.
- It Maintains pink and white esthetics.
- Not only conserves but also helps to maintain the soft & hard tissues, in future, as long as the shield is intact.

Disadvantages:
- Not yet reliable or predictable.
- No long-term data is available yet.
- Technique sensitive.

DISCUSSION:
In the restorative & implant dentistry, buccopalatal collapse of the postextraction ridge is a significant challenge. A variety of ridge preservation techniques using tissue and augmentative materials have been proposed in the literature. A slightly different method is to use the tooth itself. These techniques are collectively grouped as PARTIAL EXTRACTION THERAPIES (PET). Root submergence technique has been reported in the literature for more than four decades, and it has been denoted that the submerged tooth root maintains the periodontal tissues and maintain the bone in pontic sites or under dentures to retain the ridge. Attaining successful long-term esthetic outcomes in implant

dentistry height and width of the facial & buccal alveolar bone wall & subsequently, the peri-implant tissues are to be maintained. PET's have shown promising results for the development of immediate implant placement and pontic site development, both histologically and clinically.

The new technique known as "socket shield" or "Root Membrane" is becoming more popular. It is thus increasingly used by clinicians around the world as a strategy to preserve the buccal bone plate after placement of post extractive implants in the aesthetic area of the anterior maxilla[13]. Clinically, this technique appears to guarantee better results with high implant survival rates and a low incidence of complications[11,14-19]. Nevertheless, it should be noted that, in the present literature, only two clinical studies have been published which include a adequate number of patients and a adequately long follow-up[11,14]. Although the clinical results obtained through the SS technique can be considered promising, it is essential to note that only a careful histological assessment can confirm the validity of this technique, that is, the ability of the socket shield to protect the fragile buccal bone plate from resorption, in the medium and long term[13]. Unfortunately, to date, only a few histological studies on the RM technique are available in the literature[7,14,20]. All of these are animal studies, and only one is based on an adequate number of samples[20], since the others are reports of single cases[7,14]. Also, there are no histologic studies available with a more extended follow-up period, as all the researches present in the literature are mostly based on specimens retrieved only three to four months after implant placement[13].

A retrospective study done was by Gluckman et al.[21] on 128 patients from a private practice database with a follow-up of 4 years. The distribution of sites treated was as follows: maxillary incisors (64%), premolars (22%), canines (14%) maxilla (89.9%), and mandible (10.1%). 123/128 implants osseointegrated and survived 1–4 years following restoration (survival rate 96.1%). A combined complication rate of 25/128 implants occurred (19.5%). Five implants failed to osseointegrate and were removed. The remaining 20 complications were all managed or observed without management, with implants surviving at mid-term follow-up. This series matched our observation that a socket shield is a competitive technique with its survival as compared to conventional immediate and delayed implant placement. A recent systematic review by Mourya et al. .[22] included 11 case reports, 6 case series, one human randomized control trial (RCT), one technical report, and two animal RCT. Recent modifications in Socket-Shield Technique, along with long follow-up studies with increased sample size, provided promising results. The recommendations still required a higher level of evidence and advised not to use this procedure as a routine clinical practice.

Socket shield technique looks like a safe surgical procedure with predictable and impressive preliminary results without the use of unpredictable regenerative surgeries and expensive biomaterials. However, it still needs to be assessed for long-term prognosis as very few RCTs have been reported. Hence, we may conclude that further investigations with increased patient numbers and long-term follow-up should be performed.

CONCLUSION:

PETs may be observed as more conservative ridge preservation strategy in teeth planned for extraction.

Retention of all or part of the tooth for enhancement of pontic/implant site, with preservation of papillae or labial tissues, has demonstrated promising results.

If the proper clinical requirements are met, and the technical handling of the operator is appropriate, these techniques could minimize buccal tissue resorption and make the procedure more patient-friendly.

More abundant histologic evidence and proof of long-term clinical success are still required.

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