

RESTORATION OF FRACTURED ANTERIOR TOOTH BY IMMEDIATE IMPLANT PLACEMENT USING SOCKET SHIELD TECHNIQUE.

Dental Science

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ABSTRACT

Healing of the extraction socket leads to dimensional changes in the tissues that can affect the placement of implant as well as hamper the emergence profile in the anterior zone. The soft tissue and hard tissue in the replacement of an anterior tooth is important for longevity, better aesthetics and function. This case report represents a young male patient with fractured central incisor indicated for extraction followed by implant placement. To preserve the pink and white aesthetics in the anterior zone, a socket shield technique was implemented to support the thin buccal bone after viewing the cone beam tomography scan (CBCT). The buccal fragment of the tooth was retained followed by placement of implant palatal to the remaining root section and immediate provisionalization was done. Three months follow-up showed proper healing, healthy peri-implant and a good emergence profile making socket-shield technique with immediate implant placement a good alternative to preserve buccal cortical plate.

KEYWORDS

socket-shield, partial extraction therapy, anterior implant, immediate placement, provisionalization.

INTRODUCTION:

The implant therapy relies on restoration and stability of both hard and peri-implant soft tissue rather than just the osseointegration. More importantly, the soft tissue drape (cervical emergence zone) is the most difficult aspect of the treatment. The shape of the implant crown below the tissue and its emergence profile is unique for each restoration. Consequently, replacement of a maxillary anterior tooth is often a challenge in implant dentistry.

Nowadays, Immediate implant placement following a tooth extraction is a successful treatment option in the anterior region. Gingival biotype and the condition of the anterior extraction socket are the most important factors to consider when determining whether it is indicated, or the procedure should be delayed. The maintenance of height and width of facial alveolar bone is critical for better outcomes. A remaining thickness of at least 2mm of facial bone prevents any incidence of bone loss in the anterior region.

Though following extraction, the measure of resorption is progressively seen over the buccal aspect as in contrast with the lingual part of the alveolar ridge. At-least 1mm over the facial or buccal aspect of the tooth even after immediate placement. Thus, recession can be more pronounced in the anterior maxilla where aesthetics is a concern. It can be masked in areas such as low lip line or thick gingival biotype. Furthermore, in cases of thin gingival biotype, high lip line or multiple anterior tooth restorations, and papilla preservation such immediate implant therapy might cause an aesthetic failure as found in a study by Troiano et al [1-4]

Partial extraction therapies such as socket shield have been a promising treatment alone with immediate implant placement. The “socket shield technique”, a partial extraction therapy [5] has been demonstrated the potential to prevent buccal tissue from resorption in animal and clinical studies. It is assumed that retaining the root fragment attached to the buccal bone plate can avoid tissue loss after tooth extraction. The retention of the tooth root helps in the preservation of the bundle bone-periodontium complex and maintains the vascular supply. This prevents any tissue collapse in the anterior region. Also, it can create a better emergence profile by immediate provisionalization by enabling pontic site development or ridge preservation.

Hereafter, a case is presented where this socket shield technique following implant placement was carried out and the results from the case followed up at 1-year post-treatment demonstrate a good amount of facial ridge tissue preservation.

CASE REPORT:

A 28-year-old male patient presented for definitive treatment of a fractured left maxillary central incisor. [Figure 1] The patient was a non-smoker with a non-contributory medical history. The tooth had been root canal treated and after several years required frequent re-mentation of a post-core crown restoration. The patient had high

functional demands and aesthetic expectations. At the first visit the patient presented with a fractured restoration due to trauma. Upon examination, it revealed a horizontal fracture of the tooth 21 at the gingival margin. No residual ferrule existed in order to manufacture a new post-core retained crown and the patient was informed about the treatment options. It included -

- A) root submergence of tooth 21 with a fixed partial denture (FPD) or removable prosthesis,
- B) orthodontic extrusion of tooth 21 and reconstruction of the restoration,
- C) implant therapy with a crown restoration on 21 followed by immediate provisionalization.



Figure 1 : Intra-oral View Of The Fractured Central Incisor (21)

In consultation with the patient considering costs, duration of treatment and prognoses, implant therapy was opted for. To prevent the expected post-extraction ridge resorption the Socket Shield technique with immediate provisionalisation was decided. Preoperative cone beam computed tomography (CBCT) indicated sufficient width palatal to the planned facial root section to accommodate a 3.5 x 11 mm implant with the option for screw retention. [Figure 2]

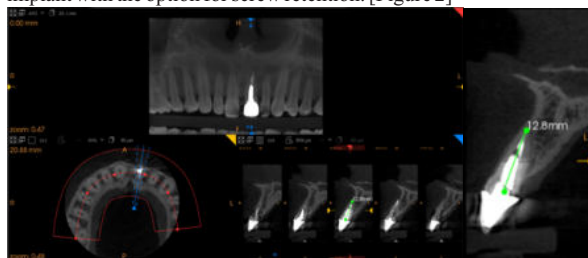


Figure 2 : CBCT Of The Maxillary Arch, Specific To Fractured Central Incisor (21)

A surgical risk assessment⁶ (Simple Advanced Complex Tool) was performed in order to classify the procedure accordingly and to assess possible complications that may arise. The complete procedure was discussed with the patient and consent was obtained. [Figure 3]

Assessment of Surgical Cases: Single-tooth gap			ITC
Defining Characteristics: One missing tooth to be replaced by one implant.			
Placement protocol	Immediate implant placement		✓ Life Line ✓ Exposure of papilla ✓ Gingival Remaps ✓ Medium-walled, medium-thick ✓ Shape of Tooth Crown ✓ Rectangular ✓ Infection of Implant Site - None
Socket integrity	Sufficient, with intact bone walls		
Tooth site	Maxillary incisor or canine		✓ Bone Level at Adjacent Tooth ✓ 2 mm to contact gap
Socket morphology	Single-root socket		✓ Restorative Status of Neighboring Teeth ✓ Veneer ✓ Width of Edentulous Space
Anatomic Risk	Ethnicity Risk	Complexity	Risk of Complications
Low	High	Moderate	High



Figure 3 : Simple ,Advanced ,Complex (SAC) Classification - ITI

Surgical Phase:

Following local anaesthesia at the treatment site, the root was then sectioned in a mesiodistal direction along its long axis as far apical as was possible using a long shank root resection bur using a hydrated high-speed handpiece. [Figure 4] Sectioning divided the tooth root into facial and palatal halves with the intention of preserving the facial root section and attached to the tooth socket. Periostomes were then inserted between the palatal root section and the alveolar socket wall to sever the periodontal ligament and this section of root was then removed in an atraumatic way so as not to disturb the facial root section. [Figure 5]



Figure 4 : Mesio-distal sectioning of the root stump.



Figure 5 : Atraumatic removal of palatal root

The remaining root section was then reduced coronally to 1 mm above the alveolar crest and thinned slightly to a concave contour by careful application in an apico-coronal and mesiodistal direction with a long-shanked round diamond bur. The tooth socket's palatal wall and apex were then curetted to remove any tissue or infective remnants and the root section was checked for immobility with a sharp probe. With the preparation steps complete, the tooth root hereafter was known as the socket-shield (SS). The shield prepared is a Type 1- Buccal shield according to Kumar et al [7] as it covers the buccal part of the socket between proximal line angles of the tooth. An osteotomy was then sequentially prepared and a 3.5 x 11 mm internal conical connection implant (Narrow Sky, Bredent) was inserted palatal to the shield with the implant table 2 mm below the facial crest. [Figure 6]



Figure 6 : Portion of the labial root retained in the socket followed by implant place with 21

Restorative Phase:

A provisional resin-inforced fixed partial denture [Figure 7] was then constructed chairside with an emergence profile to support the coronal tissues whilst ensuring adequate space between the SS and the provisional to allow soft tissue to grow. Healing was uneventful with no signs of infection or other complication at the 1 week and 1 month follow up visits. After 1 month of healing, the second stage surgery was planned and the implant was then restored with a temporary abutment and restoration. The provisional were screw-retained, depending on the case. Following the procedure, intra-oral peri-apical radiographs

and OPG was taken to assess the healing. [Figure 8,9] A careful check of the occlusion with articulating paper (less than 10µm with shimstock) completed the provisional prosthetic phase: light and well distributed static contacts were left, and care was taken to remove any possible overloading. The provisional crowns remained in situ for a period of 3-4 months, after that they were replaced by the definitive ceramic (zirconia ceramic) restorations; the final restorations were cemented. [Figure 10]



Figure 7 : Immediate Provisionalization With Resin Inforced Fixed Partial Denture



Figure 8 : IOPA And OPG After Implant Placement & Provisionalization



Figure 9 : Follow Up After 1 Week



Figure 10: Removal Of Cover Screw And Placement Of The Temporary Abutment, Provisionalization Done

The healing of extraction sockets is characterized by bone formation within the socket and loss of alveolar ridge in a stepwise manner. Following the extraction, the resorption rate of the alveolar ridges is faster during the first six months and proceeds at an average of 0.5-1.0% per year. During the first phase, bundle bone resorbs followed by alveolar bone causing a horizontal and vertical tissue contraction. This

causes reduced vertical height and more palatal in relation to the original tooth position according to J. Piotrowski et al [8-10]. The buccal plate undergoes more resorption because it is generally thinner, averaging approximately 0.8mm in anterior teeth and 1.1mm in premolar sites.



Figure 11: Definitive Restoration With 21.

Moreover, as the bone formation is a naturally occurring event, the alteration of the ridge can compromise the restoration of the implant which requires a three-dimensional implant positioning and stability of the surrounding tissues [11]. In the aesthetic region, the height and thickness of facial and interproximal bone walls are the important factors for successful outcomes during implant placement following an extraction, which are made up by color, shape, and character of the marginal peri-implant mucosa and presence of interdental papilla.

Though, various modalities have been described in the literature to negate the consequences of tooth extraction conventionally such as two-staged delayed approach, correcting the existing defect, hard and soft tissue augmentation with guided bone regeneration (GBR), bone grafts following extraction with or without immediate implant placement with augmentation of jump gap. However, immediate implant placement still does not prevent buccal bone resorption as it is a biological phenomenon.

Araujo and Lindhe et al [12] suggested that following extraction of the tooth, the supply of blood vessels in the thin bone walls are severed, causing bone resorption facially.

Thus, it can be assumed that retaining a root may alter the occurrence of facial bone resorption to a moderate level and increase the success of the restoration. The buccal plate mainly consists of bundle bone and receives its majority of blood supply from the periodontal ligament apparatus. When a tooth is extracted, the bone and the periodontal ligament apparatus are lost. As the bundle bone extends into the tip of the buccal bone wall, the buccal bone plate and covering soft tissues will be thinned and even reduced in height. Because the coronal aspect of the maxillary anterior teeth often consists solely of bundle bone, its loss will not only lead to thinning but also complete resorption of the buccal bone.

The revolutionary 'socket-shield' technique was introduced in 2010 through series of progress from old concepts that entailed ridge and tissue alterations following extraction.

Evidence from previous studies showed that an alternative technique for ridge preservation is the retention of root fragments in-situ. The decoronated root fragments maintained the bone volume and helped in bone growth towards the coronal direction.

A pilot study by Casey and Piotrowski et al [13-14] of 3 cases simultaneously was documented to prove alveolar ridge preservation depending on retaining sub-epithelial root fragments. As implant placement was intended, the buccal root fragment was left in place and preserved. With such an approach it was attempted to enable the maintain of the quantity of bone at the prospective implant site, while the buccal bundle bone, which is extremely thin and consequently at high risk of resorption, was retained. The lingual portions of the bundle bone are dense and less at risk of atrophy.

This present clinical case study results are in convergence with the original work by Hürzeler et al [15] and co-workers who were the first to demonstrate the socket-shield technique in a study on one beagle dog. The study consisted of hemi-sectioning the premolar and a buccal fragment of the distal root was retained 1mm corona to buccal bone plate followed by implant placement lingually with the retained root fragment buccally.

The clinical study of Hürzeler et al [15], suggests that the retention of roots of the hopeless teeth may avoid tissue alterations following tooth extraction. Therefore, the purpose of this proof-of-principle experiment was to histologically evaluate partial root retention (socket

shield technique) in addition to immediate placement of the implant.

The results of this study demonstrated that the implants were thoroughly osseointegrated without any surrounding inflammatory reaction clinically as well as histologically. On the buccal side, the fragment was left in place attached to the PDL apparatus, but on the lingual side, a newly formed cementum was found. Whereas, the areas over the placed implant showed cementum deposited over the implant surface. The comparative analysis showed a significantly higher success rate than with longitudinal data on immediate implant placement after complete root extraction.

The clinical study of Gluckman et al [16-18] et al demonstrates the pontic-shield technique. This technique was viable where the root submergence was not possible. The research continued till 2017 with a concept which proposes a paradigm shift away from the extract and augments toward partly retaining the tooth root to preserve the ridge and prevent Bucco-palatal collapse.

A case report conducted by Chen & Pan et al [19] using socket shield technique protocols, in which a failing upper right second premolar was treated by replacing it with a screw-retained single implant. Leaving a partial root fragment at the buccal side in-situ with an immediate implant placement lingual to the retained fragment was performed. Clinical assessment after 4 months of installation showed healthy peri-implant soft tissue and the ridge was well preserved. A maximum amount of horizontal resorption at the buccal side was 0.72mm approximately.

Kan and Rungharassang et al [20] used a proximal socket shield procedure (PSS) in conjunction with immediate implant placement and provisionalization on a failing tooth besides an implant restoration. The procedure was to leave a portion of the root fragment adjacent to existing implant restoration, the idea was to preserve the proximal bone, the presence of a coronal portion of the root fragment with supra-crestal cementum (2 mm above the proximal bone), where dento-gingival fibers are attached, also contributes to the preservation of the level of the inter implant papilla.

LIMITATIONS OF THE SOCKET-SHIELD TECHNIQUE:

The case selection is vital for the success of this procedure. The clinician needs to be specially trained and need to have a high level of clinical skills. The procedure is time-consuming as well as technique sensitive. The intactness of the shield is a major factor in attaining stability of the implant placed. If there is mobility during surgery, it is removed, and the conventional immediate implant placement or the grafting procedure is to be done and the treatment is delayed. The technique is not recommended in mobile teeth, teeth that are out of the arch, and teeth with large periapical lesions.

CONCLUSION:

The socket-shield technique is gaining popularity among the clinicians across the world, this minimally invasive technique is very promising for the preservation of hard and soft tissues in cases of extraction and immediate implant placement, giving ultimate aesthetic outcome imitating the natural emergence profile, preserving the soft and hard tissue volume, lack of bone loss, additional material cost, no comorbidity, single surgery.

DECLARATION OF PATIENT CONSENT:

We, the authors certify that we have obtained all appropriate patient consent forms. In the form the patient(s) has given his consent for his images and other clinical information to be reported in the journal. The patient understands that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

REFERENCES:

1. Chen ST, Buser D. Esthetic outcomes following immediate and early implant placement in the anterior maxilla—a systematic review. *Int J Oral Maxillofac Implants.* 2014;29 Suppl:186-215
2. Troiano M, Benincasa M, Sánchez P, Calvo-Guirado J. Bundle bone preservation with Root-T-Belt: case study. *Ann Oral Maxillofac Surg.* 2014;2(1):7
3. Siompaas KD, Mitsias ME, Kontsiotou-Siormpa E, Garber D, Kotsakis GA. 2014; Immediate implant placement in the esthetic zone utilizing the 'root-membrane' technique: clinical results up to 5 years postloading. *Int J Oral Maxillofac Implants.* 2008;29(6):1397-1405.
4. Mitsias ME, Siompaas KD, Kontsiotou-Siormpa E, et al. A step-by-step description of PDL-mediated ridge preservation for immediate implant rehabilitation in the esthetic region. *Int J Periodontics. Restorative Dent.* 2015;35(6):835-841.
5. Gluckman H, Salama M, Du Toit J. Partial Extraction Therapies (PET) Part 1: Maintaining Alveolar Ridge Contour at Pontic and Immediate Implant Sites. *Int J*

- Periodontics Restorative Dent. 2016;36(5):681–687.
6. Jokstad, Asbjørn. (2011). The SAC Assessment Tool.
 7. Kumar PR, Kher U. Shield the socket: Procedure, case report and classification. *J Indian Soc Periodontol*. 2018;22(3):266–272.
 8. J. Pietrokovski and M. Massler, "Ridge remodeling after tooth extraction in rats," *Journal of Dental Research*, vol. 46, no. 1, pp. 222–231, 1967.
 9. Herd JR. The retained tooth root. *Aust Dent J*. 1973;18(3): 125–131.
 10. Fickl S, Zuhr O, Wachtel H, Stappert CF, Stein JM, Hürzeler MB. Dimensional changes of the alveolar ridge contour after different socket preservation techniques. *J Clin Periodontol*. 2008a;35(10):906–913.
 11. Dolanmaz D, Senel FC, Pektaş ZÖ. Dental implants in posterior maxilla: diagnostic and treatment aspects. *International journal of dentistry*. 2012;2012.
 12. Araújo MG, Sukekava F, Wennström JL, Lindhe J. Ridge alterations following implant placement in fresh extraction sockets: an experimental study in the dog. *J Clin Periodontol*. 2005;32(6):645–652.
 13. Casey, D.M.; Lauciello, F.R. A review of the submerged-root concept. *J. Prosthet. Dent*. 1980, 43, 128–132.
 14. Pietrovski, J.; Massler, M. Alveolar ridge resorption following tooth extraction. *J. Prosthet. Dent*. 1967, 17, 21–27.
 15. Hürzeler MB, Zuhr O, Schupbach P, Rebele SF, Emmanouilidis N, Fickl S, et al. The socket-shield technique: A proof-of-principle report. *J Clin Periodontol* 2010;37:855–62.
 16. Gluckman H, Du Toit J, Salama M. The socket-shield technique to support the buccofacial tissues at immediate implant placement. *Int Dent Afr Ed* 2015;5:3.
 17. Mitsias ME, Siompas KD, Kotsakis GA, et al. The root membrane technique: human histologic evidence after five years of function. *Biomed Res Int*. 2017; doi: 10.1155/2017/7269467.
 18. Lagas LJ, Peppinkhuizen, JJFAA, Bergé SJ, Meijer GJ. Implant placement in the aesthetic zone: the socket-shield-technique. *Ned Tijdschr Tandheelkd*. 2015;122(1):33–36.
 19. Chen CL, Pan YH. Socket Shield Technique for Ridge Preservation: A Case Report. *J Prosthodont Implantology*. 2013;2(2):16–21.
 20. Kan JY, Rungcharassaeng K. Proximal socket shield for interimplant papilla preservation in the esthetic zone. *Int J Periodontics Restorative Dent* 2013;33: e24–e31.