Dentistry Review 4 (2024) 100092

Contents lists available at ScienceDirect

Dentistry Review

journal homepage: www.elsevier.com/locate/dentre

Update on the efficacy of the dermal apron technique: Increasing peri-implant mucosal thickness and tissue stability

Barry P. Levin *

Diplomate, American Board of Periodontology, Private Practice Limited to Periodontics & Dental Implant Surgery, 509 York Rd., Jenkintown 19046, PA, USA

ARTICLE INFO

Keywords:
Peri-implant mucosa
Immediate Tooth Replacement Therapy
Dental Implants
Dental Esthetics

ABSTRACT

Immediate tooth-replacement therapy can be a predictable method for treating anterior hopeless teeth. Preserving and augmenting both hard and soft tissues is critical for the physiologic and esthetic success of therapy. Utilizing a combined hard and soft tissue augmentation approach improves outcomes. Reducing morbidity associated with procuring autogenous grafts can be efficacious regarding short and long-term outcomes. The Dermal Apron Technique uses both bone and soft tissue allografts to increase soft tissue thickness around immediately placed and provisionalized implants. Studies demonstrate the increased soft tissue thickness produced by the technique. This article demonstrates the technique and discusses the clinical research supporting the use of this method for successful immediate tooth-replacement therapy.

1. Introduction

Successful immediate tooth-replacement therapy (ITRT) should result in esthetically-pleasing and healthy implant-supported restorations. Many factors must be accounted for in this pursuit. This begins with a proper diagnosis and case selection. In situations where significant hard and/or soft tissue deficiencies, acute infections [1] and proximity to vital structures exist, a staged-approach may be appropriate. In Class I sockets [1], demonstrating no loss of facial bone and mucosal height, ITRT may be selected. Even with favorable conditions, the negative physiologic changes that occur following extraction must be considered. The concept that implant placement alone will maintain ridge dimensions has been refuted [2], even when provisional restorations are delivered at time of implant placement [3,4]. Numerous studies demonstrate the positive ridge stability occurring when an augmentation-based approach is utilized [5,6].

Strategies accounting for the diminutive changes in 3-dimenstional ridge dimensions should be employed in ITRT. The Dermal Apron Technique [7] is geared towards preserving and increasing hard and soft tissue volume. The technique utilizes a "dual-zone" bone graft [8] combined with a dermal allograft in place of autogenous soft tissue graft. The dual-zone graft is modified using a composite particulate consisting of 4 parts cortical/cancellous FDBA to 1 part xenograft. A comparative case series, using historical controls of 15 cases restored without any augmentation [9] and 15 cases treated with the Dermal Apron Technique demonstrated the benefits in terms of increasing soft tissue thickness around the final restoration [7]. This comparison must be interpreted with caution, as different implant systems and operators in each cohort are evident. Soft tissue thickness measured at 2.0 mm apical to the mid facial gingival margin averaged 2.85 mm compared to 2.10 mm for the ungrafted controls of the prior study. It's been shown that thicker mucosa results in more favorable peri-implant bone height and thickness [10–12]. Additionally, thicker mucosa better conceals the "shine through" of sub-gingival abutments [13]. The purpose of this article is to demonstrate a less-invasive method, compared to utilizing an autogenous connective tissue graft, for increasing facial soft tissue volume in immediate tooth-replacement sites. The findings of 3 consecutive case series consistently increased soft tissue thickness with the Dermal Apron Technique. Clinicians may select this option of using a dermal allograft over sub-epthelial connective tissue grafts in Type I and even Type II [1] cases.

2. Description of technique

The Dermal Apron Technique begins with meticulous, flapless extraction of a hopeless tooth. Periotomes and narrow elevators separate the thin crestal bone from the coronal root surface, followed by forceps delivery of the extracted tooth. Thorough debridement of the socket of all PDL fibers and soft tissues is performed with ultrasonic and manual curettes. A slurry of doxycycline 100 mg and 1cc sterile saline is used to

* Corresponding author.
E-mail address: aperiodoc509@gmail.com.

https://doi.org/10.1016/j.dentre.2024.100092
Received 19 January 2024; Received in revised form 29 April 2024; Accepted 7 May 2024
Available online 6 July 2024

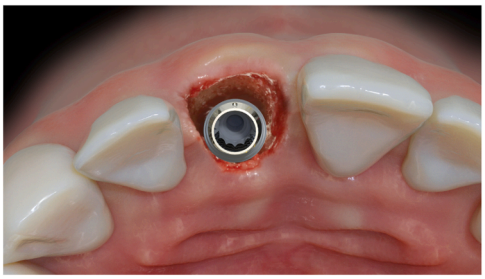


Fig. 1. Immediate implant placement is eccentrically positioned towards the palatal aspect of the extraction socket.

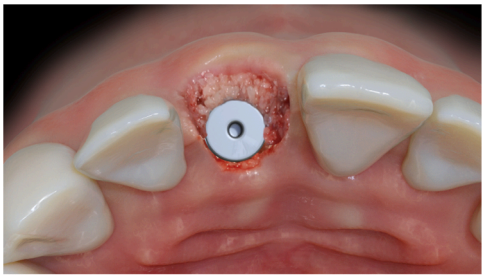


Fig. 2. Composite bone graft consisting of 4 parts cortical/cancellous FDBA and 1 part Xenograft obturating the gap between the implant and abutment surface and the abutment and soft tissues.

detoxify the alveolus prior to osteotomy preparation.

Implant insertion is done via a "palatal bias" Fig. 1. This is intentionally performed to create a larger space or gap between the implant and facial socket wall. This is critical in terms of preserving the facial bone dimensions [14,15]. Following implant placements (AstraTech EV in Part I Case Series, and Southern Implants Deep Conical, Co-axis in Parts II and III, a particulate bone graft is placed within both the hard and soft tissue zones, to the level of the gingival margin Fig. 2. Then a screw-retained, provisional crown is created. The temporary restoration must not be over-contoured in the sub-critical and critical contours [16]. This avoids excessive pressure on the marginal and proximal soft tissues, which can lead to early mucosal recession. In all cases, a titanium or PEEK temporary abutment is affixed to the implant and "picked up" using a vacuum-formed template with bis-Acryl temporary restoration material (Luxatemp; DMG America). A flowable composite resin (Beautiful Flow, RMH3 Dental) is used to complete fabrication of the provisional crown, with a concave or straight sub gingival contour, providing space for the bone graft material in the "tissue zone" of the site. A dermal allograft is trimmed to approximate it's sub-gingival and sub-periosteal insertion and pierced with a round biopsy punch for adaptation around the abutment portion of the provisional restoration Fig. 3. The basement membrane side of the dermis is oriented against the marginal 3–5 mm of facial bone and graft material in the soft tissue zone Figs. 4 and 5. After tightening the abutment screw to 30 Ncm using the surgical motor (W&H), a monofilament 5–0 suture (Monocryl; Ethicon) is used in a figure-8, horizontal mattress configuration Fig. 6.

3. Clinical example

A 44 year-old female patient presented with severe internal root resorption of her maxillary right central incisor Fig. 7a & 7b. Immediate tooth replacement therapy was selected as her treatment of choice. After administration of local anesthetic (Septocaine 4% with epinephrine 1/100,000 (Septodont), flapless extraction, preserving the thin facial bone, a 4.5 mm x 15.0 mm inverse-body design implant, with a 12º sub-crestal angle correction was placed Fig. 8, with primary stability, ie insertion torque value of 75 Ncm and ISQ values of 68 facial and 65 palatal using

Fig. 3. Dermal allograft trimmed, pierced and adapted around the abutment portion of a one-piece, screw-retained provisional crown.

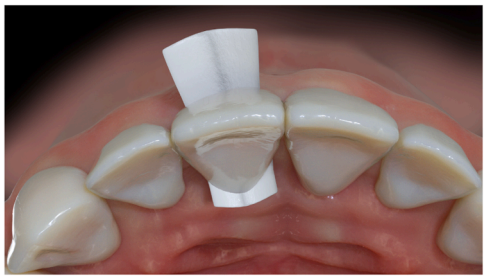


Fig. 4. Dermal allograft prior to insertion into facial and palatal sub-periosteal pouches created with blunt dissection. The lamina propria surfaces is facing outward, oriented facing the periosteum internally.

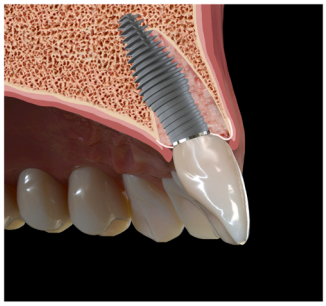


Fig. 5. Screw-retained provisional crown seated with dual-zone bone graft covered with the dermal allograft. The dermis is inserted into 3–5 mm deep sub-periosteal pouches facially and palatally.

an Osstell Beacon (Osstell). Dual-zone bone bone graft consisting of approximately 4:1 ratio of cortical/cancellous FDBA and xenograft was placed to the level of the gingival margin Fig. 9. A screw-retained provisional crown was fabricated, as previously described. The dermal allograft was customized and adapted around the abutment portion of the one-piece temporary crown. Using a small periosteal elevator (Buser elevator; H and M) approximately 3–4 mm apical to the facial crestal bone level, the dermis graft was inserted into sub-periosteal spaces created via blunt dissection. The abutment screw was tightened to 35 Ncm and the cingulum access channel was obturated with sterile teflon tape and clear bite registration material (DSI Ultrasil, WholeDent). The occlusion was such that no contact with the mandibular anterior was present Fig. 10. A post-operative radiograph is obtained to confirm complete seating of the temporary restoration Fig. 11. The patient was instructed to avoid incising food with her anterior teeth for at least 10 weeks.

At 12 weeks, the temporary crown was disconnected for the first time and follow-up ISQ values were recorded as 68 from the facial and palatal

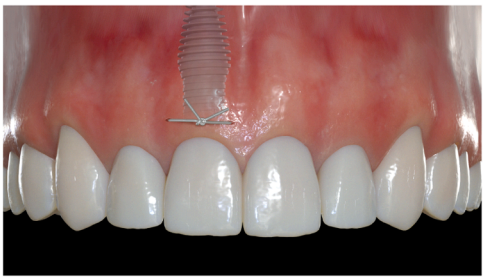


Fig. 6. Monofilament, Fig. 8 horizontal mattress suture for mild compression of peri-implant soft tissues and dermal allograft. The immediate implant is depicted approximately 3–4 mm apical to facial gingival margin.

directions using the Osstell Beacon (Osstell) (Fig. 12). The peri-implant soft tissue demonstrated robust thickness and a scalloped morphology. An open-tray impression was taken and a CAD/CAM (Atlantis; DentsplySirona) custom abutment was fabricated and a porcelain-fused-to-metal crown was cemented onto the abutment forming a one-piece, screw-retained restoration. This crown was delivered and the abutment screw was tightened to 35 Ncm Figs. 13a and 13b. A radiograph Fig. 14 confirmed complete seating of the screw-retained crown and the significant tooth-implant dimensions facilitated by the narrow, cylindrical portion of the implant coronally.

4. Discussion

Implant selection can play a significant role in terms of synergy of implant platform design and the Dermal Apron Technique. The author demonstrated increased soft tissue thickness when an implant with a sub-crestal angle correction is compared to uniaxial implants, with SAC implants achieving 3.74 +/- 1.05 mm compared to 2.79 +/- 0.47 mm [17]. This can be attributed to several factors. Interestingly, both periodontal phenotype patients, thick and thin, achieved greater soft tissue thickness in the SAC group compared to the uniaxial implant groups, with thinner phenotypes demonstrating greater volume than thick phenotypes treated with straight implants. Uniaxial implants are often angled towards the incisal edge or facial surface of the restoration. This necessitates an angle correction originating at the implant platform, causing pressure on the facial soft tissue and recession [18]. Implants with a sub-crestal angle correction result in abutments emerging in a more palatal direction, alleviating pressure created by the abutment within the soft tissue zone. This implant design also provides a longer abutment-implant distance or platform-switch, compared to uniaxial implants. This concept is referred to as a "variable platform switch". The concept of platform-switching has been associated with more favorable marginal bone levels and soft tissue thickness compared to butt-joint prosthetic connections [19,20].

More recently, an inverted-body design implant, with the identical prosthetic connection, and a variable platform-switch has been

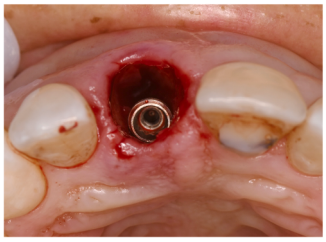


Fig. 8. Palatal placement of an inverted-body design implant to the palatal aspect of the extraction socket.

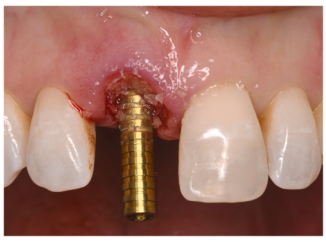


Fig. 9. Dual-zone bone graft consisting of 4 parts cortical/cancellous FDBA and 1 part xenograft placed in the bone and soft tissue zone. A Titanium temporary abutment is in place for fabrication of a screw-retained provisional crown.

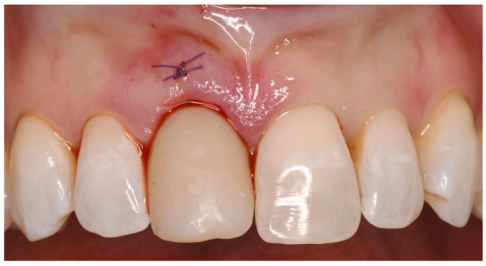
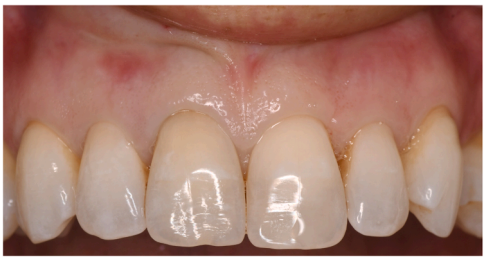


Fig. 10. Screw-retained provisional crown, out of occlusal contact is delivered and the dermal allograft is gently inserted into facial and palatal subperiosteal pouches.



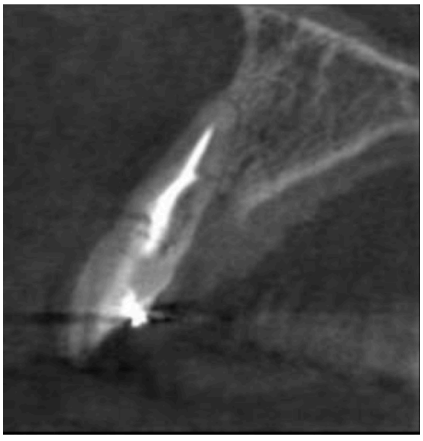


Fig. 7. a. Initial presentation of the maxillary right central incisor with internal root resorption. b. Cross-sectional view of tooth #8 (#11 FDI) demonstrating severe internal root resorption.

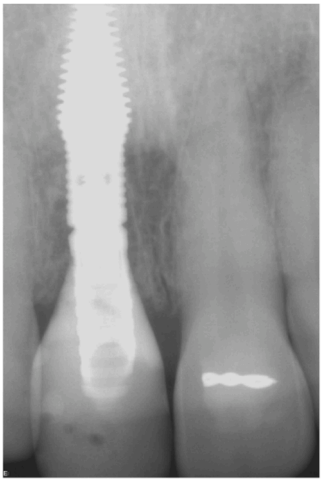


Fig. 11. Post-operative radiograph confirming complete seating of the provisional restoration and the dual-zone bone graft is visible mesially and distally.

introduced for immediate placement and provisionalization [21]. In a clinical and radiographic study [22], greater tooth-implant distance and preservation of the facial osseous plate was demonstrated. The narrow coronal portion of this implant is cylindrical and 1.0 mm narrower in diameter compared to the widest portion of the tapered, apical half. This increases insertion torque value and ISQ compared to parallel-walled implants [23], making immediate temporization more predictable. A clinical comparative study [24] measured peri-implant mucosal thickness using this inverted-body design, SAC implant in similar sites to the 2 previously mentioned studies. Soft tissue thickness at 2.0 mm apical to the facial, free gingival margin measured 3.70 mm, with a range of 2.37–5.71 mm). This increase was nearly identical to the cohort receiving standard SAC implants, but still approximately 1.0 mm thicker soft tissue compared to the uniaxial group.

The goal of immediate tooth replacement therapy (ITRT) is to inconspicuously as possible, replace a hopeless tooth throughout the treatment process and for years afterwards. Preserving hard and soft tissues, as well as performing augmentation at time of ITRT is critical for success [25]. Preservation of the alveolus requires a minimally-invasive approach. Often, flapless surgery is combined with hard and/or soft tissue grafting. Reducing morbidity associated with secondary, palatal soft tissue donor sites is preferred if possible. When soft tissue height is favorable at the initiation of treatment (Type I sockets), a dermal allograft can be selected as a substitute for autogenous connective tissue. Yoshino et al [26], demonstrated the efficacy of using autogenous soft tissue grafts to better preserve soft tissue levels following ITRT. The same group [27], group also showed that initial peri-implant soft tissue at 2.0 mm apical to the gingival margin measured approximately 1.0 mm. Their study demonstrated that when both groups received a composite bone graft, similar to the graft recommended for the Dermal Apron Technique, into the bone zone, soft tissue thickness increased slightly, but when a sub-epithelial connective tissue graft was added, the soft tissue thickness more than doubled, at 2.61 mm. This similarity to the soft tissue thickness recorded with uniaxial implants and the Dermal Apron Technique is critical. The only dissimilar steps between the two studies were employing a dual-zone bone graft, with particulate graft particles occupying the bone and soft tissue zone, and the substitution of autogenous connective tissue with a dermal allograft. It can therefore be hypothesized that in Class I extraction sockets, the Dermal Apron Technique delivers favorable results, quite similar to more invasive surgical techniques.

Increasing the volume of peri-implant soft tissue has several benefits [28] demonstrated with immediate implants, the short term benefits regarding ridge dimensions comparing sites with and without receiving

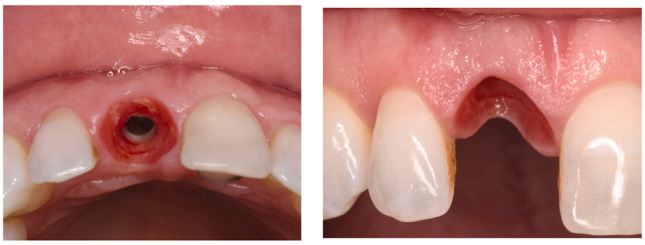


Fig 12. a and b. First disconnection of the provisional crown at 12 weeks demonstrating thick, healthy peri-implant mucosa. The original scallop of the gingiva is preserved via immediate provisionalization.

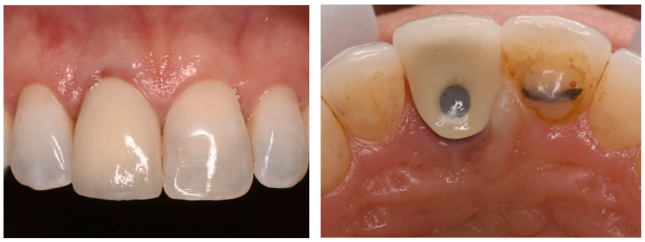


Fig. 13. a, b. Delivery of the screw-retained, PFM crown attached to a gold-coated, titanium CAD/CAM abutment.

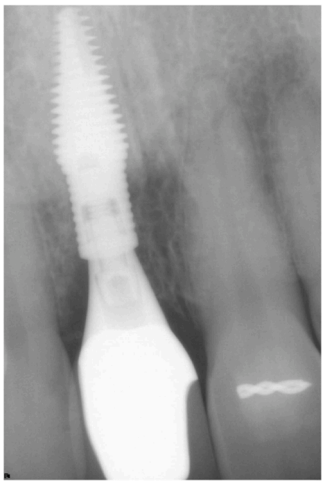


Fig. 14. Radiograph at time of crown-delivery. The narrow coronal portion of the implant increases space between the implant and adjacent teeth.

autogenous connective tissue grafts. In healed sites, where soft tissues were less than 2.0 mm thickness, the failure of platform-switching alone, to preserve marginal bone levels in humans [29]. The same group demonstrated without platform switching, that naturally-occurring thick soft tissues were compared to thin tissues augmented with a dermal allograft and thin tissues. Both the naturally thick and augmented soft tissues demonstrated significantly less marginal bone loss radiographically compared to sites with soft tissues measuring less than 2.0 mm. In a recent, systematic review [30], it was concluded in healed sites, that peri-implant bone remodeling due to initial soft tissue thickness was correlated, whereas sites with thin mucosal thickness demonstrated greater marginal bone remodelling compared to sites with thicker mucosa. Caution should be exercised extrapolating the findings of healed sites compared to immediate implants. However, the dimensions of peri-implant soft tissues should be considered at time of treatment to avoid negative hard and soft tissue changes. A pro-active approach considering tissue preservation and less-invasive hard and

soft tissue augmentation may produce more favorable results compared to non-grafted protocols [31].

5. Conclusion

Case selection regarding immediate tooth-replacement therapy is critical. In sites demonstrating favorable hard and soft tissue architecture, and available apical and palatal bone for achieving primary stability, utilizing the Dermal Apron Technique is efficacious in producing physiologic and esthetic outcomes, resistant to future complications. As the evidence is based on studies using smaller sample sizes, more, larger-scale research should be performed to further validate the conclusions of this article.

Disclosure

The author reports no financial relationship to any companies. The author has received honoraria for speaking on behalf of Southern Implants.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] Elian N, Cho SC, Froum S, Smith RB, Tarnow DP. A simplified socket classification and repair technique. Pract Proced Aesthet Dent 2007;19(2):99–104.
[2] Chen ST, Darby I. The relationship between facial bone wall defects and dimensional alterations of the ridge following flapless tooth extraction in the anterior maxilla. Clin Oral Implants Res 2017;28(8):931–7.
[3] Roe P, Kan JYK, Rungcharassaeng K, et al. Horizontal and vertical dimensional changes of peri-implant facial bone following immediate placement and provisionalization of maxillary anterior single implants: a 1-year cone beam computed tomography study. Int J Oral Maxillofac Implants 2012;27(2):393–400.
[4] Tarnow DP, Chu SJ, Salama MA, et al. Flapless postextraction socket implant placement in the esthetic zone: part 1. The effect of bone grafting and/or provisional restoration on facial-palatal ridge dimensional chang - a retrospective cohort study. Int J Periodontics Restorative Dent 2014;34(3):323–31.
[5] Chu SJ, Salama MA, Garber DA, et al. Flapless postextraction socket implant placement, part 2: The effects of bone grafting and provisional restoration on peri-implant soft tissue height and thickness - A retrospective study. Int J Periodontics Restorative Dent 2015;35:803–9.
[6] Cardaropoli D, Bellow M, Tamagnone L, Leonardi R. Bone and soft tissue modifications in immediate implants versus delayed implants inserted following alveolar ridge preservation: a randomized controlled clinical trial Part II: radiographic outcomes. Int J Periodontics Restorative Dent 2022;42(4):487–94.
[7] Levin BP. The dermal apron technique for immediate implant socket management: A novel technique. J Esthet Restor Dent 2016:18–28.
[8] Chu SJ, Salama MA, Salama H, et al. The dual-zone therapeutic concept of managing immediate implant placement and provisional restoration in anterior extraction socket. Compend Contin Educ Dent 2012;33(7):524–34.
[9] Levin BP, Chu SJ. Changes in peri-implant soft tissue thickness with bone grafting and dermis allograft: A case series of 15 consecutive patients. Int. J Periodontics Restorative Dent 2018;38.
[10] Thoma DS, Gil A, Hammerle CHF, Jung RE. Management and prevention of soft tissue complications in implant dentistry. Periodontology 2022;88:116–29. 2000.
[11] Linkevicius T, Apse P, Grybauskas S, Puisys A. The influence of soft tissue thickness on crystal bone changes around implant: A 1-year prospective controlled clinical trial. Int J Oral Maxillofac Implants 2009;24:712–9.
[12] Puisys A, Linkevicius T. The influence of mucosal thickening on crystal bone stability around bone-level implants. A prospective controlled clinical trial. Clin Oral Implants Res 2015;26:123–9.
[13] Jung RE, Holderegger C, Sailer I, Khraisat A, Suter A, Hammerle CH. The effect of all-ceramic and porcelain-fused-to-metal restorations on marginal peri-implant soft tissue color: A randomized controlled clinical trial. Int J Periodontics Restorative Dent 2008;28:357–65.
[14] Pluemsakunthai W, Le B, Kasugai S. Effect of buccal gap distance on alveolar ridge alteration after immediate implant placement: A microcomputed tomographic and morphometric analysis in dogs. Implant Dent 2015;24(1):70–6.
[15] Vignoletti F, de Sanctis M, Berglundh T, Abrahamsson I, Sanz M. Early healing of implants placed into fresh extraction sockets: An experimental study in the beagle dog II: ridge alterations. J Clin Periodontol 2009;36:688–97.
[16] Su H, Gonzalez-Martin O, Weisgold A, Lee E. Considerations of implant abutment and crown contour: Critical contour and subcritical contour. Int J Periodontics Restorative Dent 2010;30:335–43.
[17] Levin BP, Saito H, Reynolds MA, Ch SJ. Changes in peri-implant soft tissue thickness with bone grafting and dermis allograft. Part II: A comparative retrospective case series using a subcrestal angle correction implant design. Int J Periodontics Restorative Dent 2020;40:539–47.
[18] Le BT, Borzabadi-Farahani A, Pluemsakunthai W. Is buccal angulation of maxillary anterior implants associated with crestal laabial soft tissue thickness? Int J Oral Maxillofac Surg 2014;43:874–8.
[19] Canullo L, Fedele GR, Iannello G, Jepsen S. Platform switching and marginal bone-level alterations: The results of a randomized-controlled trial. Clin Oral Implants Res 2010:115–21.
[20] Saito H, Chu SJ, Zamzok J, et al. Flapless postextraction socket implant placement: The effects of a platform switch-designed implant on peri-implant soft tissue thickness - A prospective study. Int J Periodontics Restorative Dent 2018;38 (suppl):s9–15.
[21] Nevins M, Chu SJ, Jang W, Kim DM. Evaluation of an innovative hybrid macrogeometry decal implant in immediate extraction sockets: A histomorphometric pilot study in foxhounds dogs. Int J Periodontics Restorative Dent 2019;39:29–37.
[22] Ostman PO, Chu SJ, Drago C, Saito H. Clinical outcomes of maxillary anterior anterior post extraction sockets implants with immediate provisional restorations using a novel macro-hybrid implant design: An 18- to 24-month single-cohort prospective study. Int J Periodontics Restorative Dent 2020;40:355–63.
[23] Levin BP, Chu SJ, Saito H, Nevins M, Levin JP. A novel implant design for immediate extraction sites: Determining primary stability. Int J Periodontics Restorative Dent 2021;41. 357-354.
[24] Levin BP, Saito H, Chu S, Rubin J, Chu SJ. Changes in peri-implant soft tissue thickness with bone grafting and dermis allograft. Part III: A case series using a novel, hybrid implant design with a subcrestal angle correction. Int J Periodontics Restorative Dent 2022;42:723–9.
[25] Grunder U. Crestal ridge width changes when placing implants at the time of tooth extraction with and without soft tissue augmentation after a healing period of 6 months: Report of 24 consecutive cases. Int J Periodontics Restorative Dent 2011; 31:9–17.
[26] Yoshino S, Kan JY, Rungcharassaeng K, Roe P, Lozada JL. Effects of connective tissue grafting on the facial gingival level following single immediate implant placement and provisionalization in the esthetic zone: A 1-year randomized controlled prospective study. Int J Oral Maxillofac Implants 2014;29:432–40.
[27] Rungcharassaeng K, Kan JYK, Yoshino S, Morimoto T, Zimmerman G. Immediate implant placement and provisionalization with and without a connective tissue graft: An analysis of facial gingival tissue thickness. Int J Periodontics Restorative Dent 2012;32:657–63.
[28] Linkevicius T, Apse P, Grybauskas S, Puisys A. Influence of thin mucosal tissues on crestal bone stability around implants with platform switching: A 1-year pilot study. J Oral Maxillofac Surg 2010;68:2272–7.
[29] Linkevicius T, Puisys A, Linkeviciene L, Peciuliene V, Schlee M. Crestal bone stability around implants with horizontally matching connection after soft tissue thickening: A prospective clinical trial. Clin Implant Dent Rel Res 2013:1–12.
[30] Bressan E, Guazzo R, Tomasi C, Gutierrez Pena T, Galindo-Moreno P, Caponio VCA, Sbricoli L, Canullo L. Influence of soft tissue thickness on marginal bone level around dental implants: A systematic review with meta-analysis and trial-sequential analysis. Clin Oral Implants Res 2023;34:405–15.
[31] Crespi R, Cappare P, Castaldi G, Gherlone EF. Buccal-lingual bone remodeling in immediately loaded fresh socket implants: A cone beam computed tomography study. Int J Periodontics Restorative Dent 2018;38:43–9.