Xenogeneic Collagen Matrix-Supported Vestibuloplasty to Increase Keratinized Gingiva around Dental Implants: A Literature Review and Case Report

Bushong Brandon[1], Haddow Munther[2,3], Agarwal Kiran[1], Kapoor Natasha[1], Kinaia Bassam[4,5]

[1]Periodontal resident, Department of Periodontology and Dental Hygiene, University of Detroit Mercy School of Dentistry, Detroit, MI, USA. [2]Clinical Faculty, Department of Periodontology and Dental Hygiene, University of Detroit Mercy School of Dentistry, Detroit, MI, USA. [3]Private practice, Southfield, MI, USA. [4]Graduate Program Director and Associate Professor, Department of Periodontology and Dental Hygiene, University of Detroit Mercy School of Dentistry, Detroit, MI, USA. [5]Private practice, Sterling Heights, MI, USA.

Abstract

Aim: Increase the amount of keratinized gingiva around dental implants using a xenogeneic collagen matrix at the time of vestibuloplasty as an alternative therapy to autogenous gingival grafting.

Methods: Vestibuloplasty using a xenogeneic collagen matrix was completed around implants in the maxillary left quadrant. Strapping suturing technique was employed for graft stabilization. The surgical site was followed for three months and clinically evaluated for the relative change in kratinized gingiva, tissue thickness, and vestibular deepening.

Results: There was a considerable increase in the width of keratinized gingiva, tissue thickness, and vestibular depth, at three months.

Conclusion: Xenogeneic collagen matrix is a reliable method to increase the amount of keratinized gingiva and achieve vestibular deepening, while maintaining esthetics. This method reduces morbidity when compared to gingival grafts.

Key Words: Vestibuloplasty, Graft, Collagen, Esthetic dental, Dental implant

Introduction

The stability of periodontal tissues around dental implants is an important factor for long-term success [1]. Anatomical factors such as the presence of aberrant frenal attachments and short vestibules can negatively impact the maintenance of periodontal health around implants [2,3]. Such anatomical factors may lead to inadequate oral hygiene resulting in inflammation and bone loss [2]. Similarly, short vestibules are often associated with reduced keratinized gingiva (KG) leading to increased plaque accumulations and higher gingival index scores around implants, regardless of the type of implant [4]. Therefore, eliminating these anatomical factors, combined with increased keratinized gingiva and vestibular depth is important to maintain healthy peri-implant tissues.

Generally, a soft tissue graft is used in combination with vestibuloplasty to limit alveolar bone exposure and tissue scarring [5]. Free gingival grafts (FGG) are often used to increase keratinized gingiva and is considered a predictable and simple procedure [3]. However, FGG requires a second surgical donor site, resulting in more morbidity and increased procedural time [6,7]. The presence of KG is a necessity to maintain periodontal health around implants, since it reduces plaque-induced inflammation and recession [8]. Due to the high morbidity and increased procedural time with FGG, alternative treatment methods such as allograft or xenograft materials present a viable treatment substitute.

Mucograft (Geistlich Pharma AG, Wolhusen, Switzerland) is a porcine-derived three-dimensional collagen matrix material comparable to free soft tissue grafts [9]. It is a xenogeneic bioabsorbable collagen matrix (XBCM) composed of types I and III collagen. It has a spongy and compact side, with the spongy side directed towards the alveolus, promoting vascularization and soft tissue cellular ingrowth into the superficial spongy aspect [9]. The use of Mucograft eliminates the need for a second donor surgical site and thereby reduces post-operative pain [10]. It also has a good color match [11] compared to FGG, where unaesthetic appearance and poor color match is common [12]. Further, it is readily available in unlimited amounts to meet the requirements of the recipient site [13]. Although autogenous soft tissue grafts are considered to be the gold standard for soft tissue grafting [14], several studies investigated the use of allograft or xenograft materials as alternatives [15,16]. McGuire et al. compared a bovine bi-layered cell therapy to autogenous soft tissue graft combined with vestibuloplasty and showed an increase in width of keratinized tissue for both groups but the gain was more for the autogenous tissue [17]. Further, a recent review paper evaluated the use of soft tissue grafts in comparison to XBCM and found a non-statistically significant benefit using soft tissue graft with regard to keratinized tissue gain and esthetics around natural teeth and dental implants [18]. Although the aforementioned studies show a benefit of autogenous soft tissue grafts over XBCM, a significant disadvantage of autogenous tissue is donor site morbidity [19]. Moreover, soft tissue grafts generally result in a less esthetic match when compared to XBCM [17]. In a recent clinical and histologic study, Schmitt et al. compared the efficacy of XBCM to FGG combined with mandibular vestibuloplasty around dental implants. Both groups of 7 patients each resulted in similar gains in keratinized tissue, regardless of graft type. Both groups had shrinkage of approximately 30% with similar histologic maturation throughout the three months follow-up [17] that is adequate for complete soft tissue healing [20]. The authors noted that the XBCM sites blended with the surrounding tissues with better esthetic results compared to FGG sites [17].

Corresponding author: Bassam M. Kinaia D.D.S., M.S., 2700 Martin Luther King Jr. Blvd, Department of Periodontology and Dental Hygiene, University of Detroit Mercy, Detroit, MI 48208-2576, Tel: 1-248-953-7676; Fax: 1-313-494-6666; e-mail: kinaiaperio@gmail.com

The current case report presents the use of XBCM to deepen the vestibule, eliminate a high frenal attachment, and increase keratinized gingiva around dental implants. Thus, in order to increase the alternatives to gingival grafts available to patients and clinicians, the following report documents the use of a Mucograft® (Geistlich Pharma AG, Wolhusen, Switzerland) to increase the amount of keratinized tissue around dental implants during vestibuloplasty with three months follow-up.

Aim

This case report presents the use of a XBCM material as an alternative method to increase the amount of keratinized tissue combined with vestibular deepening around dental implants.

Case Report

Initial Presentation

A healthy 66 years-old African-American male with a non-contributory medical history, presented to University of Detroit Mercy Graduate Periodontal Clinic for comprehensive periodontal care. The patient is a former tobacco smoker, with a 30 pack years history, and quit smoking more than 10 years prior to his initial presentation. He takes no medications. The patient's chief concern was the replacement of his missing first mandibular molars, as well as the fractured and carious maxillary left central incisor through maxillary first premolar. The patient was diagnosed as having generalized severe chronic periodontitis, and had a history of minor restorative treatment to repair carious tooth structure. The patient elected to pursue implant therapy for the replacement of his missing and fractured teeth.

After completion of initial nonsurgical periodontal therapy, the patient began a three-month periodontal maintenance regimen to continue the management of his periodontal condition. The patient pursued limited orthodontic tooth movement to upright the mesially-tipped mandibular second molars, which prevented ideal implant placement at the first molar sites. While undergoing orthodontic therapy, the treatment of the maxillary arch continued. The patient received an upper left maxillary sinus lift and dental implant placement for the maxillary left lateral incisor, canine, first premolar, and second premolar sites, at the time of extraction of the left lateral incisor and canine. At the six months follow-up, the implants were osseointegrated but exhibited buccal fenestration defects, where additional bone grafting with coronally advanced flaps were performed. Due to the multiple surgical procedures performed, the patient presented with minimal keratinized tissue buccally, short vestibule, and high frenal attachment at the maxillary left canine *(Figures 1 and 2)*. It was recommended to the patient to receive a vestibuloplasty procedure using FGG or XBCM. The patient elected XBCM vestibuloplasty to avoid a second surgical donor site and consented to the treatment.

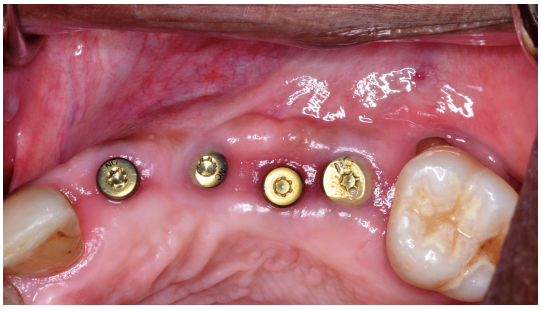

Figure 1. Occlusal clinical view at baseline, demonstrating inadequate keratinized gingiva around dental implants.

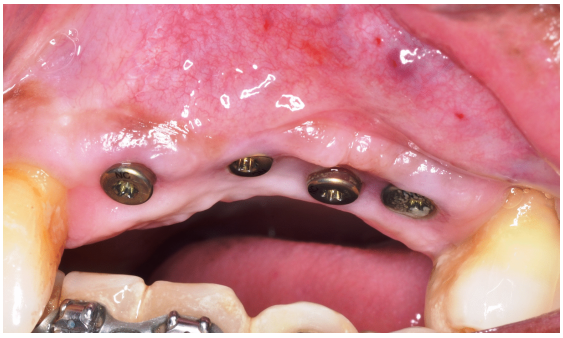

Figure 2. Buccal clinical view at baseline, demonstrating shallow vestibular depth around dental implants.

Surgical Procedure

The patient received 600 mg ibuprofen (Amneal Pharmaceuticals, Paterson, NJ, USA) one hour prior to the procedure, pre-rinsed with 15 mL of 0.12% Chlorhexidine Gluconate (Xttrium Laboratories, Inc., Mt. Prospect, IL, USA) for one minute, and local anesthesia was administered with 4% Articaine HCl with 1:100,000 epinephrine (Septodont, Lancaster, PA, USA). A horizontal incision was made at the mucogingival junction with partial thickness flap elevation apically releasing the frenum. Simple interrupted 4-0 Chromic GUT sutures (Ethicon US, LLC, Somerville, NJ, USA) were used apically to maintain a wide recipient bed, extending from the mesial of the left maxillary incisor implant to the mid-buccal of the maxillary left first molar with vertical releasing incisions at the lateral extents *(Figure 3)*.

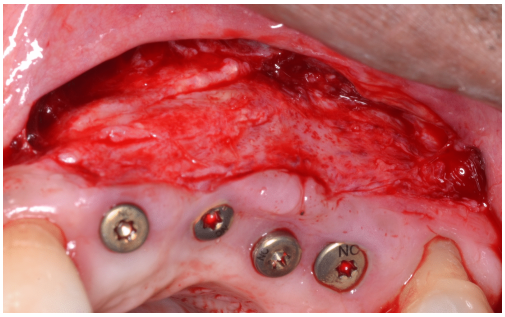

Figure 3. Intraoral view of the prepared recipient site.

XBCM Graft

After preparing the recipient bed, the XBCM was sized to match the mesial-distal dimension of 40 mm. The standard size XBCM of 15 x 20 mm was divided longitudinally, producing two 7.5 x 20 mm segments that were longitudinally connected with a 4-0 Chromic GUT (Ethicon US, LLC, Somerville, NJ, USA) interrupted mattress suture. Using the same resorbable suture material, the lateral and coronal margins were attached to the surrounding keratinized tissue with simple interrupted sutures. The XBCM was adapted and stabilized using 4-0 Chromic GUT in a crisscross strapping manner (Ethicon US, LLC, Somerville, NJ, USA) to the recipient bed *(Figures 4 and 5)*. Post-surgically, the patient received 500 mg Amoxicillin (Dr. Reddy's Laboratories, Princeton, NJ, USA) three times daily for 7 days, 800 mg ibuprofen (Amneal Pharmaceuticals, Paterson, NJ, USA) three times daily for 3 days, and rinsed with 15mL of 0.12% Chlorhexidine Gluconate (Xttrium Laboratories, Inc., Mt. Prospect, IL, USA) for one minute twice daily for one month. Specific oral hygiene instructions were given to the patient to avoid the surgical site. The patient resumed gentle brushing four weeks post-operatively.

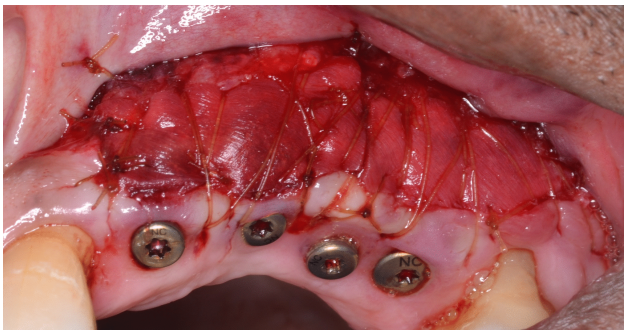

Figure 4. Buccal view of continuous periosteal mattress suturing in a crisscross strapping manner, stabilizing the Mucograft® on the recipient bed.

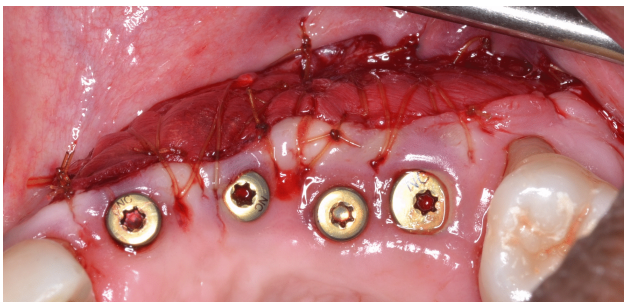

Figure 5. Occlusal view of the stabilized Mucograft®, with crisscross strapping continuous periosteal mattress suturing.

Follow-Up

During the follow-up at two weeks, the graft exhibited good vascularization and granulation tissue formation *(Figure 6)*. At four weeks follow-up, tissue maturation was evident with increased keratinized gingiva, deepened vestibule, and without frenal attachment *(Figure 7)*. At three months post-operatively, the grafted area exhibited an esthetically pleasing result, blending with the surrounding tissues *(Figure 8)* with adequate tissue thickness *(Figure 9)*. The deepened vestibular depth and increased keratinized gingiva remained stable compared to the pre-operative presentation. There were no post-operative complications, and the patient described the pain as minimal to nonexistent.

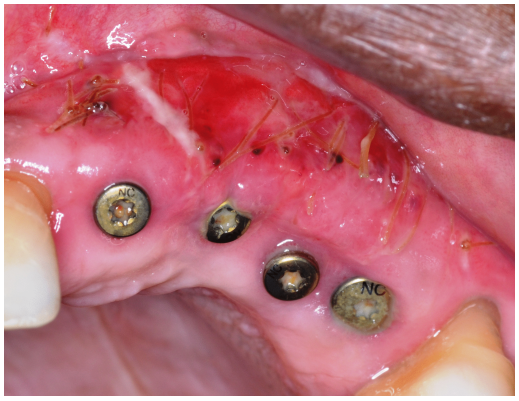

Figure 6. Occlusal clinical view two weeks post-operatively, with initial stages of epithelialization and ongoing resorption of the suture material.

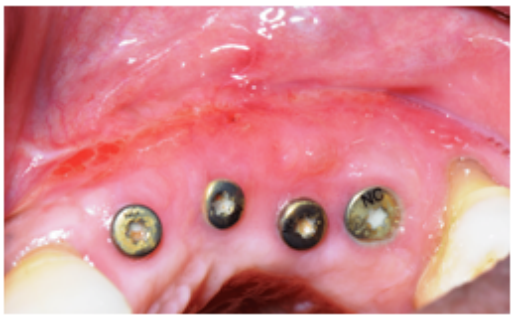

Figure 7. Occlusal clinical view four weeks post-operatively, demonstrating notable improvement in keratinized tissue.

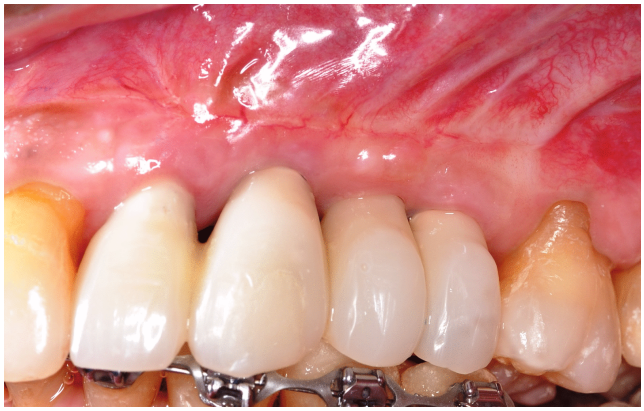

Figure 8. Buccal clinical view at three months post-operatively, with provisional implant restorations and an appreciable increase in vestibular depth.

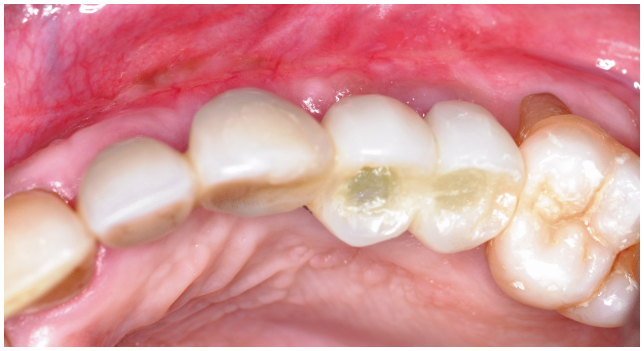

Figure 9. Occlusal clinical view at three months post-operatively, with provisional implant restorations and a significant band of keratinized tissue around all dental implants.

Discussion

In this case report, a XBCM in combination with vestibuloplasty was performed as an alternative to autogenous free gingival grafting. The goals of increasing the vestibular depth and amount of keratinized tissues around dental implants were accomplished. The patient is now able to perform adequate oral hygiene and better avoid plaque-induced inflammatory conditions [8]. The gingival esthetics were maintained following soft tissue healing.

The clinical outcome of vestibuloplasty with XBCM was predictable and comparable to vestibuloplasty with FGG. The patient noted minimal discomfort throughout the healing phase, and the final appearance of the surgical site esthetically blended into the adjacent tissues. These are similar findings to what has been reported in the literature as advantages of XBCM over autogenous grafts. Decreased patient morbidity represents progress in patient care, and is made possible with XBCM, compared to the use of FGG and the required second surgical site [16,21]. Additionally, patients and clinicians prefer the final appearance of a XBCM, compared to that of a FGG [18,22]. When considering patient preferences for less pain and improved esthetics, it is reasonable to substitute XBCM for FGG in vestibuloplasty procedures around dental implants.

The manufacturer of XBCM recommends not compressing the graft to obtain the maximum volume gain and tissue thickness, which would also improve the final esthetics. In this case report, however, the XBCM was intentionally compressed against the periosteal bed using a continuous periosteal mattress suturing (CPMS) technique, and the results were satisfactory. Likewise, a recent study used XBCM with vestibuloplasty around implants and a surgical stent, instead of sutures, to protect and stabilize the graft sites, which would inevitably compress the XBCM [17]. Thus, the use of the CPMS technique is a reasonable alternative to a surgical stent for graft immobilization. Given the positive outcomes of this case report, patient morbidity and surgical time could be further decreased by determining the most minimal approach for XBCM immobilization. Just as practitioners explored and solidified the sutureless FGG [23] to decrease surgical time and manipulation, additional approaches to XBCM immobilization should be attempted. Additional benefits to less XBCM manipulation and compression would possibly be increased final tissue thickness, improved healing, and further decreased patient morbidity.

Studies continue to point towards XBCM as being comparable to autogenous soft tissue grafting. Yet, a recent randomized, controlled, split-mouth study of 30 patients requiring free gingival grafting for inadequate keratinized tissue around teeth demonstrated that XBCM resulted in an average gain of 1.5mm less keratinized tissue than an autogenous free gingival graft. It is important to question the clinical significance of such a finding, in light of the fact that 29 of the 30 test sites resulted in a gain of at least 2mm. While there may have been less of an absolute gain in keratinized tissue, as mentioned prior, 70% of study participants desired the appearance of the XBCM grafted sites, compared to the control sites [22].

As implants are becoming a more popular treatment option for our patients today, it is imperative that the gingival tissues around them are healthy [24]. Inadequate vestibular depth, presence of an aberrant frenum, and lack of keratinized gingiva are crucial factors that may attribute to the patient's inability to keep one's implants stable [2]. The procedure reported here, which involved preparing a recipient bed, removing an aberrant frenal attachment, and securing XBCM to the recipient site has shown clinically acceptable and predictable results [17]. The clinical outcomes included an increased amount of keratinized gingiva and a deeper vestibule, while preserving the patient's soft tissue esthetics. The use of XBCM, instead of FGG, significantly reduced the surgical time required and eliminated the need for a second surgical site, which are distinct advantages in a clinical setting. Still, the subject of XBCM as a replacement for FGG during vestibuloplasty is an area that needs to be further delved into, indicating the need for large scale randomized controlled clinical trials.

Conclusions

Within the limits of this case report:

- XBCM is a predictable procedure to increase keratinized tissue and vestibular depth around implants.
- Esthetically pleasing tissues are obtainable with XBCM without donor site morbidity.
- Compression of the XBCM via the CPMS technique does not appear to limit the gain in keratinized tissue.

References

1. Palacci P, Nowzari H. Soft tissue enhancement around dental implants. *Periodontology 2000*. 2008; **47**: 113-132.

2. Corn H. Technique for repositioning frenum in Periodontal problems. *Dental Clinics of North America*. 1964.

3. Cohen, Edward S,Ullrich, Robert. Atlas of cosmetic and reconstructive periodontal surgery. 3rd edition ed. Hamilton: BC Decker; 2007. p. Chapter 6, page 83.

4. Chung DM, Oh T, Shotwell JL, Misch CE, Wang H. Significance of keratinized mucosa in maintenance of dental implants with different surfaces. *Journal of Periodontology*. 2006; **77**: 1410-1420.

5. Rose LF, Mealey BL, Genco R, Cohen D. Periodontics: medicine, surgery, and implants. : Mosby; 2004. p. Chapter 21, page-422.

6. Farnoush A. Techniques for the protection and coverage of the donor sites in free soft tissue grafts. *Journal of Periodontology*. 1978; **49**: 403-405.

7. Griffin TJ, Cheung WS, Zavras AI, Damoulis PD. Postoperative complications following gingival augmentation procedures. *Journal of Periodontology*. 2006; **77**: 2070-2079.

8. Warrer K, Buser D, Lang N, Karring T. Plaque-induced peri-implantitis in the presence or absence of keratinized mucosa. An experimental study in monkeys. *Clinical Oral Implants Research*. 1995; **6**: 131-138.

9. Willershausen I, Barbeck M, Boehm N, Sader R, Willershausen B, Kirkpatrick CJ, et al. Non-cross-linked collagen type I/III materials enhance cell proliferation: in vitro and in vivo evidence. *Journal of Applied Oral Science*. 2014; **22**: 29-37.

10. Sanz M, Lorenzo R, Aranda JJ, Martin C, Orsini M. Clinical evaluation of a new collagen matrix (Mucograft® prototype) to enhance the width of keratinized tissue in patients with fixed prosthetic restorations: a randomized prospective clinical trial. *Journal of Clinical Periodontology*. 2009; **36**: 868-876.

11. Nevins M, Nevins ML, Kim SW, Schupbach P, Kim DM. The use of mucograft collagen matrix to augment the zone of keratinized tissue around teeth: a pilot study. *International Journal of Periodontics & Restorative Dentistry*. 2011; **31**: 367-373.

12. McGuire MK, Scheyer ET. Xenogeneic collagen matrix with coronally advanced flap compared to connective tissue with coronally advanced flap for the treatment of dehiscence-type recession defects. *Journal of Periodontology*. 2010; **81**: 1108-1117.

13. Herford AS, Akin L, Cicciu M, Maiorana C, Boyne PJ. Use of a porcine collagen matrix as an alternative to autogenous tissue for grafting oral soft tissue defects. *Journal of Oral and Maxillofacial Surgery*. 2010; **68**: 1463-1470.

14. Kim DM, Neiva R. Periodontal soft tissue non–root coverage procedures: A systematic review from the AAP regeneration workshop. *Journal of Periodontology*. 2015; **86**: S56-S72.

15. Hashemi H, Parhiz A, Ghafari S. Vestibuloplasty: allograft versus mucosal graft. *International Journal of Oral and Maxillofacial Surgery*. 2012; **41**: 527-530.

16. Orsini M. Mariano Sanz, Ramón Lorenzo, Juan J. Aranda, Conchita Martin and. *Journal of Clinical Periodontology*. 2009; **36**: 868-876.

17. Schmitt CM, Tudor C, Kiener K, Wehrhan F, Schmitt J, Eitner S, et al. Vestibuloplasty: porcine collagen matrix versus free gingival graft: a clinical and histologic study. *Journal of Periodontology*. 2013; **84**: 914-923.

18. Fu J, Su C, Wang H. Esthetic soft tissue management for teeth and implants. *Journal of Evidence Based Dental Practice*. 2012; **12**: 129-142.

19. Fickl S, Fischer KR, Jockel-Schneider Y, Stappert CF, Schlagenhauf U, Kebschull M. Early wound healing and patient morbidity after single-incision vs. trap-door graft harvesting from the palate—a clinical study. *Clinical Oral Investigations*. 2014; **18**: 2213-2219.

20. Wilderman MN, Wentz FM. Repair of a Dentogingival Defect with a Pedicle Flap. *Journal of Periodontology*. 1965; **36**: 218-231.

21. Thoma DS, Buranawat B, Hämmerle CH, Held U, Jung RE. Efficacy of soft tissue augmentation around dental implants and in partially edentulous areas: a systematic review. *Journal of Clinical Periodontology*. 2014; **41**: S77-S91.

22. McGuire MK, Scheyer ET. Randomized, controlled clinical trial to evaluate a xenogeneic collagen matrix as an alternative to free gingival grafting for oral soft tissue augmentation. *Journal of Periodontology*. 2014; **85**: 1333-1341.

23. Hoexter DL. The sutureless free gingival graft. *Journal of Periodontology*. 1979; **50**: 75-78.

24. Lin G, Chan H, Wang H. The significance of keratinized mucosa on implant health: a systematic review. *Journal of Periodontology*. 2013; **84**: 1755-1767.