Pedicle Flap Designs for Soft Tissue Conditioning in the Therapy of Peri-implantitis

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Keratinized mucosa (KM) is regarded as a key factor in peri-implant health. A lack of KM has been associated with discomfort, higher plaque accumulation, and mucosal inflammation. Persistent inflammation might lead to progressive peri-implant bone loss. Several approaches to manage peri-implantitis have been advocated. Despite the effectiveness shown by surgical therapeutic modalities, soft tissue conditioning seems pivotal for long-term peri-implant health and stability. Free epithelial grafts have been demonstrated to efficiently augment the band of KM. Nevertheless, morbidity, dynamic soft tissue changes, and longer healing periods are shortcomings to be considered. The purpose of this technical note is to provide an alternative therapeutic modality for the surgical management of peri-implantitis combined with simultaneous soft tissue conditioning by means of pedicle flaps. Three main clinical scenarios are provided to conceive pedicle epithelial or connective tissue flaps, combined or not with collagen matrices, as predictable approaches to augment KM in the surgical therapy of peri-implantitis. Int J Periodontics Restorative Dent 2021;41:295–301. doi: 10.11607/prd.4988

Peri-implantitis has been defined as an inflammatory condition of the soft tissues characterized by the progressive loss of supporting peri-implant bone. A lack of keratinized mucosa (KM) has been regarded as a local factor in plaque accumulation, tissue inflammation, or mucosal recession. Recent evidence suggests that in peri-implant sites with deficient KM, the likelihood of patient discomfort and suboptimal plaque control increases, as do the probability of developing peri-implant marginal bone loss and bleeding on probing. KM has further been regarded as a risk indicator for the severity of peri-implant mucositis. In line with this finding, Schwarz et al demonstrated that, compared to sites with sufficient KM (≥ 2 mm), sites with insufficient KM experience a more aggressive onset of experimental mucositis that is less efficiently resolved after oral hygiene measures are resumed. In this sense, KM is pivotal in preventing peri-implantitis in erratic maintenance compliers.

Therefore, it seems reasonable to assume that surgical peri-implantitis therapy should aim to resolve inflammation and provide patients with better conditions for oral hygiene measures. These goals can be achieved by means of soft tissue grafting (ie, soft tissue conditioning) combined with therapeutic
modalities for the resolution of inflammation. One study showed that autogenous free epithelial graft combined with resective therapy resulted in complete disease resolution in 78.6% of patients and in 87.1% of implants with peri-implantitis. Nevertheless, the main drawbacks of this approach include the morbidity associated with the donor site and the dimensional changes during healing and adaptation.

Therefore, the present paper describes three clinical scenarios receiving soft tissue conditioning for the surgical therapy of peri-implantitis associated with a lack of KM.

Principles for Pedicled Flaps

The biologic foundation for using pedicle flaps in soft tissue reconstruction is its maintenance of the vascular blood supply from the donor site, unlike free grafts that restrain vascularity. Graft thickness is a significant factor in the dimensional changes and stability of the graft. Contrarily, the volumetric stability of pedicle grafts is more sustainable, as the blood supply is not arrested. Concerning the technical principles, pedicle grafts must be cautiously stabilized and guaranteed intimate attachment in a vascular bed. In this sense, the periosteum/connective tissue provides the most suitable surface for integration of the pedicle flap. This is attainable with tension-free flap stability. Therefore, it is of paramount importance to eliminate muscle attachments that could lead to relapse. Moreover, in order to minimize the risk of flap tearing, two principles should be considered: (1) the flap base should be approximately two times wider than the coronal aspect, and (2) the flap should include the lamina propria to provide flap consistency. Along these lines, it is important to note that for lateral sliding flaps, the marginal aspect of the flap should be secured in >3 mm of adjacent periosteum to support flap stability.

Implantoplasty for Surface Modification

Implantoplasty has been advocated for implant surface detoxification and structural modification in peri-implantitis displaying supracrestal components. The purpose is to smooth the contaminated surface in an efficient manner using carbide burs (Meisinger) followed by polishing burs (Meisinger) to prevent further biofilm adherence, thus minimizing disease recurrence.

Interventions for Soft Tissue Conditioning by Means of Pedicle Flaps

Nonsurgical therapy with or without adjuncts such as chemical or pharmacologic agents must be performed >6 weeks prior to the surgical intervention. Regardless of the therapeutic modality for soft tissue conditioning, the ultimate goal is to eliminate clinical inflammation and pathogenic pockets >5 mm deep. These techniques do not attempt soft tissue coverage of the implants exposed as a result of pathogenic bone loss, but rather to apically displace the newly formed band of KM.

The Palatal Connective Tissue Rotated Flap

This technique is indicated for scenarios of peri-implantitis presenting supracrestal defect configurations associated with the lack of KM in the buccal aspect of maxillary posterior implants.

Technical description

After the therapeutic goals for peri-implantitis surgery (including osteoplasty/ostectomy, surface modification, and granulation tissue debridement) have been fulfilled, the dimensions of the area demanding KM should be identified and outlined. The dimension has to be mirrored in the palatal aspect adjacent to the implants, considering a flap size sufficient to roll over across the implants. The area outlined must be deepithelialized using a round bur or a 15c scalpel blade. Subsequently, a split-thickness flap must be elevated and rolled over the implants, toward the buccal aspect. Using resorbable sutures, a subperiosteal cross-suturing technique should be applied to stabilize the flap at the buccal side, adjacent to the implants. Finally, the mucosal flap should be apically repositioned using a vertical mattress suture, preferably nylon 5-0 sutures (Resorba Sutures, Osteogenics Biomedical). The donor site can be protected using a collagen matrix or other wound dressing (Figs 1 and 2).
The Lateral Epithelial Sliding Flap

This technique is indicated for peri-implantitis situations presenting supracrestal defect configurations associated with the lack of KM in the buccal aspect of mandibular implants.

Technical description
The first step is resolution of the peri-implantitis lesion. Once this has been accomplished, a split-thickness flap should be created, laterally extending the diameter of the implants plus 3 mm, then secured in the adjoining deepithelialized periosteum. Two vertical oblique incisions are then made: The incision adjacent to the area to be mobilized should extend straight down, beyond the mucogingival margin, and the incision bordering the pedicle must be slightly obliquely oriented toward the area to be conditioned. Blunt dissection must be performed at the base of the flap. This flap design leaves a freely movable flap. Nonresorbable sutures, preferably nylon, should be used, starting from the base of the flap and eventually stabilizing the edge along the adjacent mucosa at the coronal portion (Fig 3).

The Epithelial Sliding Flap Combined with a Collagen Matrix

This technique is indicated for peri-implantitis scenarios presenting adjacent maxillary or mandibular implants where KM is unevenly present. The goal is to utilize the scaffolding function of collagen matrices and the source of cells supplied by the epithelial pedicle flap to condition the peri-implant tissues while eradicating pathogenic pockets.

Technical description
In peri-implant areas presenting KM, the incision for the primary flap must be performed in accordance with the lesion depth while maintaining ≥ 2 mm KM within the flap. In the area(s) lacking KM, an intrasulcular incision must be performed. A full-thickness flap is recommended to visualize and contour hard tissue topography. Beyond the mucogingival margin, the flap should leave the periosteum attached. Subsequently, the therapeutic goals for peri-implantitis surgery (including osteoplasty/ostectomy, surface modification and granulation...
tissue debridement) must be accomplished. For soft tissue conditioning of the KM-deficient area(s), a pedicled epithelial flap should be mobilized from the adjacent area and secured apically at the periosteum using resorbable sutures. Likewise, the primary flap should be apically sutured using resorbable sutures. At

Fig 2 (a) Implants in the anterior maxilla presented with peri-implantitis and a lack of peri-implant KM on the facial side. (b) Implantoplasty was performed with carbide and polishing burs. (c) A pedicled sliding flap was raised from the palatal aspect and rolled over the implant. (d) Clinical outcomes at 30 months show resolution of the peri-implant disease and the increased KM.

Fig 3 (a) Implants in the anterior mandible with peri-implantitis. (b) The implant surface following implantoplasty and preparation of the pedicled flap from the adjacent site. The arrow indicates flap displacement. (c) The pedicled flap was rotated and sutured in the implant’s facial aspect, with a xenogeneic collagen matrix applied and stabilized over the donor site. (d) The 20-month follow-up showed resolution of the disease and an increase in peri-implant KM.
the area of exposed bone, a porcine collagen matrix (Mucograft, Geistlich Pharma) should be placed and secured using nonresorbable sutures (5-0 nylon). This provides the patient less morbidity at the surgical site and allows space for soft tissue repair at the area desired to increase the band of KM (Fig 4).

**Preliminary Results**

Four different scenarios involving implants diagnosed with peri-implantitis (according to the 2017 World Workshop on Periodontal and Peri-implant Diseases) were included (Table 1). None of the implants exhibited progressive bone loss after therapy. Resolution of inflammation was achieved in all cases (probing pocket depth ≤ 5 mm; ≤ 1 site displaying bleeding on probing; no suppuration; arrestment of bone loss). The mean KM gain at reevaluation was 2.7 ± 0.4 mm.

**Discussion**

Regardless of the therapeutic modality used to manage peri-implantitis, the goal must be prevention of pockets > 5 mm consistent with inflammation within the soft tissues, which might be conducive to progressive bone loss. Although there does not seem to be a consensus on the significance of KM on peri-implant diseases, it is reasonable to assume that having a band of KM can assist patients’ oral hygiene and maintain long-term peri-implant health.

Free gingival/epithelial grafts have demonstrated effectiveness in augmenting the band of periodontal and peri-implant KM. Nevertheless, disadvantages of free soft tissue grafts have been described, including the need for a second surgical site, increased patient morbidity, longer surgical times, color mismatch, and risk of complications such as injury to the greater palatine artery, postoperative bleeding, and sensory dysfunction. The present article described different therapeutic strategies for increasing KM and tissue thickness. They are all graftless techniques, and the advantages of using pedicled flaps include reduced patient morbidity, sustained blood supply, faster healing, and less tissue shrinkage. Implant surface detoxification together with the accurate outline of flap design, the achievement of a flat bone architecture, and the adequate stability of the flap onto the recipient site are considered key factors for success using these approaches.
Three different pedicle flap designs for soft tissue conditioning in the surgical management of peri-implantitis associated with a lack of KM were described. These approaches demonstrated effectiveness in augmenting KM in the surgical therapy of peri-implantitis. Nevertheless, these designs should be validated in randomized clinical trials.

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Table 1 Soft Tissue Outcomes at Pretreatment and Reevaluation

<table>
<thead>
<tr>
<th>Case scenario</th>
<th>Follow-up time</th>
<th>Pretreatment</th>
<th>Reevaluation</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>PPD, mm</td>
<td>BOP sites, %</td>
</tr>
<tr>
<td>Palatal rotated connective tissue flap no. 1</td>
<td>12 mo</td>
<td>6.6 ± 0.7</td>
<td>84</td>
</tr>
<tr>
<td>Palatal rotated connective tissue flap no. 2</td>
<td>30 mo</td>
<td>6.1 ± 0.3</td>
<td>100</td>
</tr>
<tr>
<td>Lateral epithelial sliding flap</td>
<td>20 mo</td>
<td>5.6 ± 0.9</td>
<td>100</td>
</tr>
<tr>
<td>Epithelial sliding flap with collagen matrix</td>
<td>24 mo</td>
<td>5.3 ± 0.4</td>
<td>83</td>
</tr>
</tbody>
</table>

PPD = probing pocket depth; BOP = bleeding on probing; SUP = suppuration; KM = keratinized mucosa. Values are shown as mean or mean ± SD.

Conclusions

Three different pedicle flap designs for soft tissue conditioning in the surgical management of peri-implantitis associated with a lack of KM were described. These approaches demonstrated effectiveness in augmenting KM in the surgical therapy of peri-implantitis. Nevertheless, these designs should be validated in randomized clinical trials.

References


Erratum for Gandhi et al, 2019

In the article “Effectiveness of Adjunctive Use of Low-Level Laser Therapy and Photodynamic Therapy After Scaling and Root Planing in Patients with Chronic Periodontitis” (Gandhi KK, Pavaskar R, Cappetta EG, Drew HJ. Int J Periodontics Restorative Dent 2019;39[6]:837–843), it should have been noted that the study described was carried out at Goa University in partial fulfillment of Dr Gandhi’s requirements for the Master of Dental Surgery in Periodontics. It also should have been indicated more specifically that the study protocol was approved by Goa University’s institutional review committee for human subjects.

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