

Periosteoplasty for Soft Tissue Closure and Augmentation in Preprosthetic Surgery: A Surgical Report

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Soft tissue closure is a critical factor in preprosthetic surgery and implant placement. In large transverse or vertical bone augmentations, there is often insufficient or very thin mucosa available. Soft tissue dehiscences and bone or implant exposure may result. Based on the application of a periosteal flap, the presented method solves this problem. The flap is prepared in the neighboring area and folded into the corresponding surgical area. It not only provides good soft tissue coverage but also results in soft tissue augmentation. Periosteoplasty has been successfully applied in over 60 patients over the last 2 years. (INT J ORAL MAXILLOFAC IMPLANTS 2001;16:851-856)

Key words: periosteum, preprosthetic oral surgical procedure, soft tissue augmentation, surgical flap

Appropriate soft tissue closure represents a critical factor in the success of preprosthetic surgery as well as implant placement, especially when simultaneous peri-implant bone augmentation is performed. Besides the simple closure of soft tissues, their thickness and positioning relative to the implants or remaining teeth is important with respect to esthetics. Often, with larger transverse and vertical bone augmentations, insufficient or very thin mucosa is available. This can either lead to difficulties with closure of the soft tissues, especially in the area of neighboring teeth, or the soft tissues can be overstretched, resulting in soft tissue dehiscence and resulting bone exposure.

Implant placement with simultaneous peri-implant bone augmentation, as in the case of immediate placement of implants into extraction sockets or where bone defects require a membrane technique, critically renders the procedure of soft tissue

closure with respect to esthetically pleasing final results. Rosenquist¹ defined 4 factors that are important for successful, esthetically satisfying results: (1) width and position of the attached gingiva, (2) buccal contour of the alveolar process, (3) level and configuration of the alveolar process, and (4) the size and shape of the papillae.

Different methods have been proposed to manage soft tissues, for example, during immediate implant placement. The Rehrman-plasty, free mucosal grafts, and pedicle grafts have been reviewed in detail by Rosenquist,¹ while Khoury and Happe² described the use of a palatal subepithelial connective tissue flap for soft tissue reconstruction and defect coverage associated with maxillary implant-supported restorations.

The Rehrman-plasty displaces the attached gingiva toward the top of the alveolar crest. It often leads to reduction in the buccal volume of the alveolar process and to an uneven mucogingival border line. The free mucosal graft works well only if placed onto blood-perfused soft or hard tissue. Therefore, it is not suitable for covering bone graft transplants. Furthermore, it creates additional soft tissue trauma. The pedicle graft is prepared vestibularly, where it might compromise esthetics by scarring. At the same time, the pedicle graft and the subepithelial connective tissue graft are suitable only for covering small areas on the alveolar crest,

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Figs 1a to 1d Periosteoplasty involving an onlay graft in the area of the maxillary incisors.

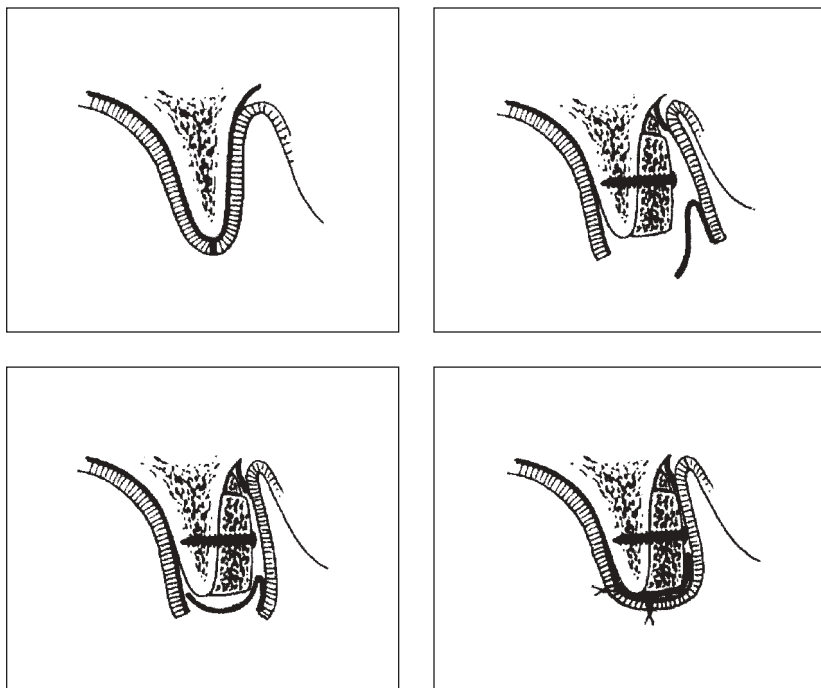


Fig 1a After an incision is made over the alveolar crest, a mucoperiosteal flap is elevated on the labial side.

Fig 1b The bone grafts are fixated with screws and the periosteal flap is resolved from the connective tissue down to the level of the attached gingiva.

Fig 1c The periosteal flap is then reflected over the alveolar crest and inserted into a palatal pocket, where it is fixated by means of sutures.

Fig 1d At the end of the procedure, the soft tissues are closed by means of a multilayer technique.

such as an extraction site. Through their geometry, these types of flaps are insufficient to cover larger grafted areas.

The purpose of this article was to introduce and explain the technique of utilizing a periosteal flap to solve the aforementioned problems and also to allow for coverage of larger areas of the alveolar ridge. The technique was inspired by the periosteoplasty used in congenital cleft lip and palate surgery³ and has been applied successfully in over 60 patients for preprosthetic and implant surgery.

METHODS AND APPLICATIONS

The basic idea of the periosteoplasty in preprosthetic or implant surgery is the preparation of a periosteal flap at the site of the augmentation that is then folded into the coronal area of the treated site, where it helps to cover and augment the area where the implants will later emerge. Preparation of the coronally pedunculated flap is done by 2 vertical cuts and 1 horizontal cut. Therefore, it is important that only the mucosa is cut through and that the preparation remains absolutely supraperiosteal to avoid any

harm to a nerve or nerve branch. By the use of this technique, not only is the wound closure improved and problems with sufficient soft tissue closure are alleviated, but also the required soft tissue thickness is created that can later serve for the creation of esthetically pleasing peri-implant soft tissues.

Figures 1a to 1d illustrate the periosteoplasty schematically for the example of an onlay graft in the area of the maxillary incisors. After an incision is made over the atrophic alveolar crest (Fig 1a), a mucoperiosteal flap is elevated on the labial side. The bone grafts are fixated with screws and the periosteal flap is prepared down to the level of the attached gingiva (Fig 1b). Then, the periosteal flap is reflected over the alveolar crest and inserted into a palatal pocket, where it is loosely fixed by means of sutures (Fig 1c). At the end of the procedure, the soft tissues are closed by means of a multilayer technique (Fig 1d).

Figures 2a to 2f demonstrate the application of periosteoplasty to implant placement with simultaneous bone augmentation incorporating the membrane technique. Two implants are required to replace missing anterior maxillary incisors (Fig 2a). Because of the large bone defect in the corresponding area,

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Fig 2a Replacement of maxillary incisors with 2 implants. Because of labial exposure, bone augmentation with the membrane technique was planned.



Fig 2b The buccal area around the implants is augmented with a non-resorbable membrane.



Fig 2c The periosteal flap side is prepared from the elevated soft tissues on the vestibular side.



Fig 2d The flap is reflected to cover the whole grafted area. It is inserted and sutured into a palatal pocket, with care taken to fixate the flap tightly around the adjacent teeth.



Fig 2e At the end of the procedure, the soft tissues are closed with a multilayer technique.



Fig 2f At second-stage surgery (membrane removal and abutment connection), the soft tissues appear very favorable, with a nice margin around the neighboring teeth.

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the implants are partially exposed on the labial side. Therefore, a simultaneous augmentation is done using the membrane technique with a nonresorbable membrane (Fig 2b). From the vestibular side the periosteal flap is prepared from the elevated soft tissues (Fig 2c). This flap covers the whole grafted area and is inserted into and fixed to a palatal soft tissue pocket (Fig 2d) while the flap is fixed closely to the adjacent teeth. Finally, multilayer closure is achieved with corresponding soft tissue augmentation (Fig 2e). Examination at the time of second-stage surgery shows healthy soft tissues, with a nice margin around the neighboring teeth (Fig 2f).

Figures 3 and 4 illustrate the application of periosteoplasty to preprosthetic bone augmentation in a completely edentulous atrophic maxilla. The present situation required augmentation of the atrophic maxilla with labial onlay grafts in the form of autologous bone blocks transplanted from the iliac crest. This technique restores an appropriate maxillomandibular relationship to compensate for the centripetal atrophy (ie, resorption of the labial alveolar surface in a palatal direction) after loss of the dentition. In the area of the zygoma, a sinus impression was required (Fig 3) to provide an appropriate

position for the onlay graft for later implant placement. In contrast to sinus elevation, sinus impression requires less elevation of sinus mucosa and does not create an unnecessary dead space on the palatal side.

The blocks are fixed to the remaining alveolar process by means of bone screws and protected with a titanium mesh (Fig 4a). Then, on both sides of the midline, a periosteal flap is prepared (Figs 4b and 4c) and reflected over the bone grafts and the titanium mesh. Flap preparation is accomplished with the help of scissors through a vertical incision in the midline (Fig 4b). The flap is inserted into a palatal pocket (Fig 4d) and there fixed to the palatal soft tissues. Figure 4e shows coverage of the grafted maxilla with periosteal flaps on both sides of the midline. Finally, multilayer closure of the vertical and the horizontal incisions is completed (Fig 4f). If the periosteal flap cannot be completely covered by the rest of the elevated soft tissues, secondary epithelization seems to occur.

Finally, Figs 5a to 5f show the application of periosteoplasty to an orthodontic/periodontal problem. Figure 5a depicts the mandibular incisors of a patient that were protruded orthodontically to such

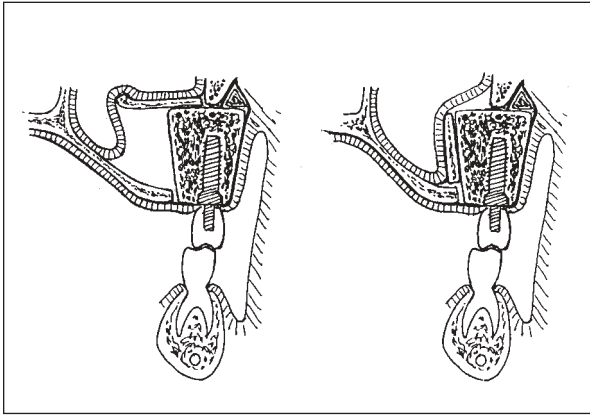


Fig 3 Technique of sinus impression as used in the area of the zygoma, in comparison to sinus elevation. (Left) The sinus elevation requires a larger elevation of the sinus mucosa. The buccal placement of the bone graft, as required by the prosthetic needs, leads to an unnecessary dead space on the palatal side. (Right) With sinus impression, the buccal bone plate is impressed in the median direction, and an autologous bone graft is fixed on the area of the sinus impression to obtain sufficient bone width and to provide an adequate maxillomandibular relationship.



Fig 4a Augmentation of a completely edentulous atrophic maxilla. Onlay grafts from the iliac crest are placed buccally to restore a correct maxillomandibular relationship. The grafts are fixed with bone screws and protected with a titanium mesh.



Figs 4b and 4c The periosteal flap is prepared in 2 parts, on both sides of the midline.



Fig 4d The single parts of the flap are then reflected over the grafts and inserted into a palatal pocket, where they are sutured.



Fig 4e Before final closure of the soft tissues, the augmented areas are completely covered by the periosteal flap.



Fig 4f The soft tissues are closed with a multilayer technique.

a degree that the roots were becoming exposed and the attached gingiva had become very thin. The treatment plan was to gradually move a bony anterior block containing the 4 incisors forward and at the same time augment the labial soft tissues with a periosteoplasty.

The technique of anterior block distraction has been described in detail by Triaca and coworkers.⁴ Two vertical osteotomies mesial to the canines, plus

a horizontal connecting osteotomy below the roots of the incisors, define an anterior block that is then gradually rotated toward the anterior about an MDO-H hinge-joint bone plate (Orthognathics Ltd, Wallisellen, Switzerland) positioned in the middle of the horizontal osteotomy with a hinge-joint axis parallel to the osteotomy. Figure 5b shows the osteotomy and the achievable movement on a model.

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Fig 5a (Right) Application to an orthodontic/periodontal problem. Because of a slight skeletal Class II situation, the mandibular incisors were orthodontically protruded too far, such that the roots were partially exposed and the attached gingiva became very thin. The plan was to augment the soft tissues and advance an anterior bone block including the teeth in a distraction, thus later enabling retrusion of the teeth into the bone.



Fig 5b Illustration of the anterior block distraction on a model. Note the osteotomy, the hinge-joint bone plate in the midline, and the orthodontic appliance containing the distraction screw.



Fig 5c Initially, marginal incisions bring the required vertical release of the soft tissues.



Fig 5d Soft tissue preparation was done prior to the osteotomy.



Fig 5e After the osteotomy and placement of the hinge-joint plate (note its upper part in the midline), the periosteal flap was prepared from the lower border of the elevated soft tissues.



Fig 5f The periosteal flap was fixed around the teeth, augmenting the soft tissues at the height of the roots.



Fig 5g Closure of the soft tissues. Tight adaptation around the teeth is important.

At the start of the procedure, marginal incisions are accomplished to achieve a vertical release (Fig 5c). After subperiosteal preparation (Fig 5d), the roots are exposed. The osteotomies are then performed and the segment fixed with the hinge-joint bone plate. The periosteal flap is then prepared from the lower border of the elevated soft tissues (Fig 5e). The deflected periosteal flap is fixed around the teeth and the whole segment temporarily

stabilized by means of acrylic resin (Fig 5f) before insertion of the orthodontic distraction appliance. Finally, multilayer closure is performed and the gingival tissues are augmented (Fig 5g).

Clinical Applications

The periosteoplasty approach has been used in 65 patients: in 31 for coverage and augmentation in completely edentulous areas of the maxillary alveolar

ridge, in 32 for coverage of augmentations simultaneous with implant procedures, and in 2 periodontal cases. While 2-year success rates with this method have been highly satisfactory and no infections noted, long-term results remain to be documented. In a few cases a vestibuloplasty was required, but usually a normal vestibule and attached gingiva have been achieved with the procedure.

DISCUSSION

A method was introduced for the treatment of congenital cleft lip³ and palate patients. Periosteoplasty can alleviate many of the difficulties that other similar techniques have in common, such as resulting esthetic problems, problems with reduced areas that can be covered, and problems with closely covering neighboring teeth such that esthetically pleasing papillae can be created. The method avoids the introduction of additional soft tissue trauma. Primary applications are in preprosthetic surgery, when reconstruction of the alveolar ridge with bone grafts is required or when implant placement requires simultaneous bone augmentation, for example, using the membrane technique.

The procedure itself is easy to perform and appears to be safe in its application. For preprosthetic bone augmentation, periosteoplasty has the potential to improve healing, reduce the incidence of dehiscence, and generally improve the success rate. In the case of bone grafts protected with titanium mesh, the resulting thick layer of soft tissue has the additional advantage that the patients experience less pain with their overdentures during

healing and consolidation of the bone augmentation. Another advantage of periosteoplasty seems to be retention of a vestibule and the corresponding attached gingiva. This may be influenced by the way that tension is applied to the soft tissues.

In addition to preprosthetic surgery, perioplasty seems to offer options in periodontal applications; for example, improving coverage of roots or soft tissue esthetics. The method has been used to treat periodontal problems resulting from orthodontic treatment. While short- to mid-term results seem to be promising, long-term outcomes need to be assessed to confirm the long-term viability of newly created soft tissue coverage.

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