A METHOD USING VESTIBULO-SULCOPLASTY COMBINING A SPLIT-THICKNESS SKIN GRAFT AND A PALATAL KERATINIZED MUCOSA GRAFT FOR PERI-IMPLANT TISSUE SECONDARY TO ORAL CANCER SURGERY

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KEY WORDS
Implant
Keratinized mucosa graft
Split-thickness skin graft
Vestibulo-sulcoplasty

Twelve patients presented with oral submucosal fibrosis and loss of keratinized gingiva in a compromised vestibule of a severely deficient mandibular edentulous ridge secondary to oral cancer surgery. They received implant rehabilitation with a total of 49 fixtures without major bone graft augmentation. To overcome vestibular compromise, soft tissue management consisting of simultaneous vestibulo-sulcoplasty, split-thickness skin graft (STSG), and palatal keratinized mucosa graft (KMG) was performed as a second stage when healing abutment was transferred to replace the cover screw of the dental implant. Postoperative follow-up of all patients consisted of clinical and radiographic examinations for an average of 4 years, revealing good stability of implant fixtures with a 91.8% success rate and generally healthy peri-implant tissue, the latter with an average sulcus depth of 2.9 ± 0.6 mm. Satisfactory results were also demonstrated regarding improved morphology of the vestibule, cosmetics, and prosthetic functionality. Vestibulo-sulcoplasty combining STSG and palatal KMG offers a stable and convenient method for rebuilding peri-implant tissue without need for bone grafting in selected patients who have compromised atrophic ridges secondary to cancer surgery.

INTRODUCTION

The edentulous ridge with adequate bone and healthy mucosa is usually an excellent basis for successful implant prosthesis. However, rehabilitation with a dental implant can be severely compromised when the ridge is deficient secondary to resorption, trauma, or cancer surgery. Various reconstructive techniques have been proposed to improve bone volume in the severely atrophic ridge before placement of dental implants, including bone grafting, ridge augmentation, ridge splitting, and distraction osteogenesis. Meanwhile, soft tissue management is as important as hard tissue management in working with surgically compromised ridges. Healthy keratinized gingiva has long been recognized as
the preferred peri-implant soft tissue. However, the soft tissue status may be significantly worse in the compromised ridge because of scar formation, loss of vestibular depth, or lack of keratinized mucosa after cancer surgery, trauma, or resorption. Thus, vestibuloplasty is often required with or without bone grafting procedures. If the existing supporting bone is confirmed to be available to the surgeon by careful clinical and radiographic evaluation, bone grafting may not be necessary. However, soft tissue management should still be taken into consideration even when bone grafting is not required.

In Taiwan, betel-nut chewing is the major risk factor in over 90% of patients with oral cancer, a group who commonly present with a unique oral manifestation of severe oral submucosal fibrosis. This has the potential to be another significant hurdle involving soft tissue management or bone graft for dental implant rehabilitation. In this article, we describe our experience managing the rehabilitation of 12 patients with oral cancer who presented after their cancer surgeries with compromised soft tissue and bone in the mandibles. A major bone graft procedure was not considered for these patients. The method that was used consisted of vestibulo-sulcoplasty with split-thickness skin graft (STSG) and palatal keratinized mucosa graft (KMG) and is proposed as a model for implant rehabilitation in selected oral cancer cases.

**Patients and Methods**

**History and clinical examination**

The 12 patients (10 men and 2 women) had a history of squamous cell carcinoma (SCC) ranging from stage I to stage III per the American Joint Committee on Cancer TNM (tumor/node/metastasis) classification system at different locations on the mouth floor, gingivae, or labial or buccal mucosa. Panorally diffused submucosal fibrosis is generally seen in men, and all 10 men in this series had a history of betel-nut chewing (average >20 years) (Figure 1A). Initial cancer surgery involved a wide excision with a clinically safe margin of 1.5 to 2 cm combined with marginal resection of the mandibular alveolar ridge (Figure 1B). Functional neck dissection was performed in selected cases. One patient with cancer involving the floor of the mouth received postoperative radiotherapy (50 Gy). All cases had been followed without evidence of local recurrence or metastasis for minimum of 1 year, and each presented with a compromised edentulous ridge in the mandibular surgical site (Figures 1C and 2A). All patients had strong motivation for dental rehabilitation in regular follow-up.

All 12 patients denied any history of systemic disease that might contraindicate implant surgery. Laboratory data for routine blood and serum analysis were acceptable for implant surgery. Oral examination showed mucosal and submucosal fibrosis and scar tissue secondary to cancer surgery over the buccal and lingual mucosa at the retained edentulous mandibular surgical site, which might challenge implant rehabilitation. The severely compromised edentulous ridge spanned unilaterally or bilaterally at the mandible for 5 to 10 cm in length with the characteristics of loss of keratinized gingiva and presence of severe fibrosis (Figures 1A, 1C, and 2A). Routine follow-up by panoramic radiograph generally showed the edentulous ridge with resorption to the basal bone or following the margin of the mandibular resection during initial cancer surgery (Figure 2B). The observation for all 12 patients was that both soft tissue and bone conditions were unfavorable for implant surgery (Table).

After careful explanation of surgical indications and treatment modalities, the patients agreed to a surgical approach without bone augmentation or bone grafting. The proposed procedure, a vestibulo-sulcoplasty with palatal KMG and STSG in conjunction with implant surgery, was explained to the patients. Before initiation of rehabilitation, each patient signed an informed consent for surgery, including the potential severe adverse events, such as implant loss.

**Table**

<table>
<thead>
<tr>
<th>Clinical features of 12 patients</th>
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<tbody>
<tr>
<td><strong>Age (y)</strong></td>
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<td><strong>Gender</strong></td>
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<td>Men</td>
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<td>Women</td>
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<td><strong>Location of fixtures (n = 49)</strong></td>
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<tr>
<td>Before mental foramen</td>
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<tr>
<td>Behind mental foramen</td>
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<tr>
<td><strong>Average ridge height (mm)</strong></td>
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<td>Before mental foramen</td>
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<tr>
<td>Behind mental foramen (above mandibular canal)</td>
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<tr>
<td><strong>Average depth of sulcus at this survey (mm)</strong></td>
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<td><strong>No. of fixtures with wound dehiscence with implant exposure at stage I operation</strong></td>
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<tr>
<td><strong>No. of implants with bone fenestration</strong></td>
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<tr>
<td>&lt;2 mm</td>
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<td><strong>No. of implants removed</strong></td>
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consent including information about prognosis, potential hazards, and complications.

**Surgical procedure**

In the stage I operation, fixtures (Implant Innovation Inc, Palm Beach Gardens, Fla) were inserted into the symphysis between the bilateral mental foramina or body area behind the mental foramen of the mandible as needed under general or local anesthesia. The surgeon noted compromised soft tissue with inadequate vestibular coverage and lack of keratinized gingiva for each patient (Figures 1C and 2A through C). Three months later, patients were admitted for soft tissue management together with the second-stage implant operation. The surgical management of soft tissue was performed with the patients under general anesthesia. Each patient was aseptically prepared in the peri-oral and intraoral regions, as well as the thigh. A combination of 10 mg Decadron, 3,000,000 U crystal penicillin, and 80 mg gentamycin was administered intravenously 30 minutes before surgery.

Through an incision on the ridge crest to carefully expose the fixtures, cover screws on top of the fixtures were also carefully exposed, retaining the periosteum in the periphery of fixtures as much as possible. Supraperiosteal dissection with a no. 15 sharp surgical knife and Matzenbaum dissector was performed toward both the buccal and the lingual sides to leave a layer of supraperiosteal connective tissue bed (Figure 3A and B). A horizontal mattress suture was used to connect the mucosal edges of both buccal flap and lingual flap circumferentially around the bottom of the mandible. The suture was tightened to create depth for the new vestibule and sulcus on both sides of the edentulous ridge. A connective-tissue supraperiosteal bed measuring 1.5 to 2 cm wide on the labial and 1 cm wide or less on the lingual side of abutments was created (Figure 2A and B). Focal areas of thick and dense fibrotic tissue were carefully excised from the exposed ridge to prevent exposure of nude bone (Figure 3C). A full-thickness layer of KMG was harvested from the hard palate by electromotor microdermatome. The size of harvested KMG for the mandible was primarily judged by the need for coverage at the peri-implant tissue. A 0.5- to 1-cm wide KMG for buccal site and a 0.5-cm wide...
KMG for lingual site were thought sufficient for all cases. The length of KMG that was needed fully depended on the specific indications of each case. The harvested KMG was carefully positioned with interrupted simple sutures at the peri-implant sites (Figure 3C). An STSG measuring 3 cm wide and varying length as required (with 0.025 mm thickness) was harvested from the ventral part of either thigh. The STSG was placed directly on top of the KMG in a manner that covered the whole area of the exposed supraperiosteal surface from the buccal to the lingual surface of the mandible. The STSG contacted the recipient bed as much as possible. A double-layered dermal graft was compressed by a preformed surgical stent with soft lining conditioner and was immobilized by circum-mandibular wiring fixation (Figure 3D). Copious amounts of normal saline were used to irrigate the wound afterward.

Nasal gastric intubation for feeding was continued for 5 days postoperatively. Strict oral hygiene was maintained by normal saline and chlorhexidine irrigation or gargling. The circum-mandibular wires and nylon mattress sutures were removed after 2 weeks, which left the surgical stent in removable condition. Each patient used the stent for an additional month to prevent scar contraction and to maintain the contour of the buccal vestibule and lingual sulcus. Afterward, the cover screws could be transferred to healing abutments. A gingivectomy was considered for the peri-implant tissues at this stage for some patients before the prosthetic procedure started (Figures 1D through F and 2D).

RESULTS

All 12 patients received the first-stage implant surgery at the retained ridge of the mandible. Of total 49 fixtures, 41 were distributed at the mandibular symphysis area and 8 were distributed behind the mental foramen. The average ridge height from the lower border of the mandible at the symphysis area was 21 mm. The average ridge height (above mandibular canal) supporting implant fixtures behind the mental foramen was 11 mm. Varied lengths (8.5–15 mm) and diameters (4 or 5 mm) of implant fixtures were used according to the need at each individual location. Wound dehiscence with implant exposure at stage I operation occurred at 7 fixtures. Three months after the first-stage implant surgery, all patients received soft tissue management with a vestibulo-sulcoplasty procedure combining STSG and palatal KMG with surgical stent fixation by circum-mandibular wiring. Four loosened fixtures were removed during or after the second-stage surgery for soft tissue management, and 9 fixtures had bone fenestration within 2 mm of the superficial crestal bone around the fixtures. Postoperatively, shallow vestibules with scar band or fibrosis were found significantly improved. All patients had improved contours of the buccal and labial vestibule and lingual sulcus at the surgical site with coverage of keratinized gingiva at the peri-implant area (Figures 1D and 2D). Prostheses were designed as a clip-and-bar overdenture supported by fixture abutments and casting connector or as a casting bridge with screw fixation to the fixtures (Figures 1E and F and 2D). After delivery of prostheses, all patients had close and regular follow-up for denture
adjustment and oral hygiene maintenance. Five patients with overgrowth of peri-implant tissue had minor surgery (e.g., gingivectomy). With an average of 4 years of follow-up, all 45 preserved fixtures were firm and stable, with a mean probing depth of peri-implant gingival sulcus of less than 2.9 ± 0.3 mm. The retention, stability, function, and cosmetic appearance of the dentures were satisfactory (Figures 1F and 2D; Table).

**DISCUSSION**

Patients with severely atrophic ridges as a result of age resorption, maxillofacial injury, or previous excision of an oral tumor usually are in a compromised condition for prosthetic rehabilitation by dental implants. Such patients may need an improvement of bone, soft tissue, or both by a comprehensive surgical management before dental rehabilitation can be achieved. Conventional methods that augment surgically compromised ridges with either alloplastic material or autogenous bone graft have been reported. However, compromised soft tissue condition at atrophic ridges raises another important consideration. The severely resorbed atrophic edentulous ridge often presents a sharp and thin contour with a high connection of frenum or high attachment of mentalis muscle, buccinator muscles, and mylohyoid muscle. These conditions often require vestibuloplasty or vestibulo-sulcoplasty. Maxillofacial injury and excision of oral tumors present a similar but even more complicated and compromised condition in bone and soft tissue. Furthermore, the patients in our study presented with extreme compromised conditions of oral submucosal fibrosis, loss of keratinized gingiva, and severe scarring in the edentulous ridge secondary to oral cancer surgery. These are the rare conditions of implant rehabilitation in the greatest need of soft tissue management.

Vestibuloplasty with an STSG as covering tissue may suffice for conventional removable prostheses. However, previous experience indicates to us that considerable difficulties are associated with maintenance of oral hygiene for the STSG area. The likelihood of other deficits such as donor-site morbidity and cosmetic concerns for an STSG as denture-supporting tissue in the anterior alveolar ridge is another issue in the use of conventional STSG methods. On the other hand, the STSG technique is common because of ready availability and is very useful in repairing large defects in the vast majority of patients. Of all available autogenous dermal locations, palatal KMG can best meet this expectation of maintenance of hygiene at the peri-implant tissue, which is critical for the stability of dental
implants. Therefore, we propose the described vestibuloplasty-dermal grafting procedure critical to rehabilita-
on outcome, but also persistent postoperative mouth-opening ex-
ercise and use of a surgical stent to maintain vestibule morphology for a longer period of time is equally important as the surgical procedure. The recovery period of patients should be regularly and cautiously monitored because of the natural tendency toward relapse of oral mucosal or submucosal fibrosis.

In summary, this surgical approach provides several advantages. It improves morphology and cosmetics of the labial vestibule and lingual sulcus without the need for another procedure for bone graft. Also, the preserved KMG serves as excellent peri-implant tissue, and maximal STSG coverage is on the alveolar ridge. This approach provides a straightforward method and satisfactory result with vestibulo-sulcoplasty combining palatal KMG and STSG for implant rehabilitation in severely compromised edentulous ridges for patients who have had cancer surgery involving the mandible.

ACKNOWLEDGMENTS

This work was supported by grant VGH-C 230-93 and NSC93-3112-B-075-003, CL-93-7, Taipei, Taiwan, ROC.

REFERENCES

2. Jensen J, Sindet-Pedersen S. Autogenous mandibular bone grafts and osseointegrated implants for reconstruc-