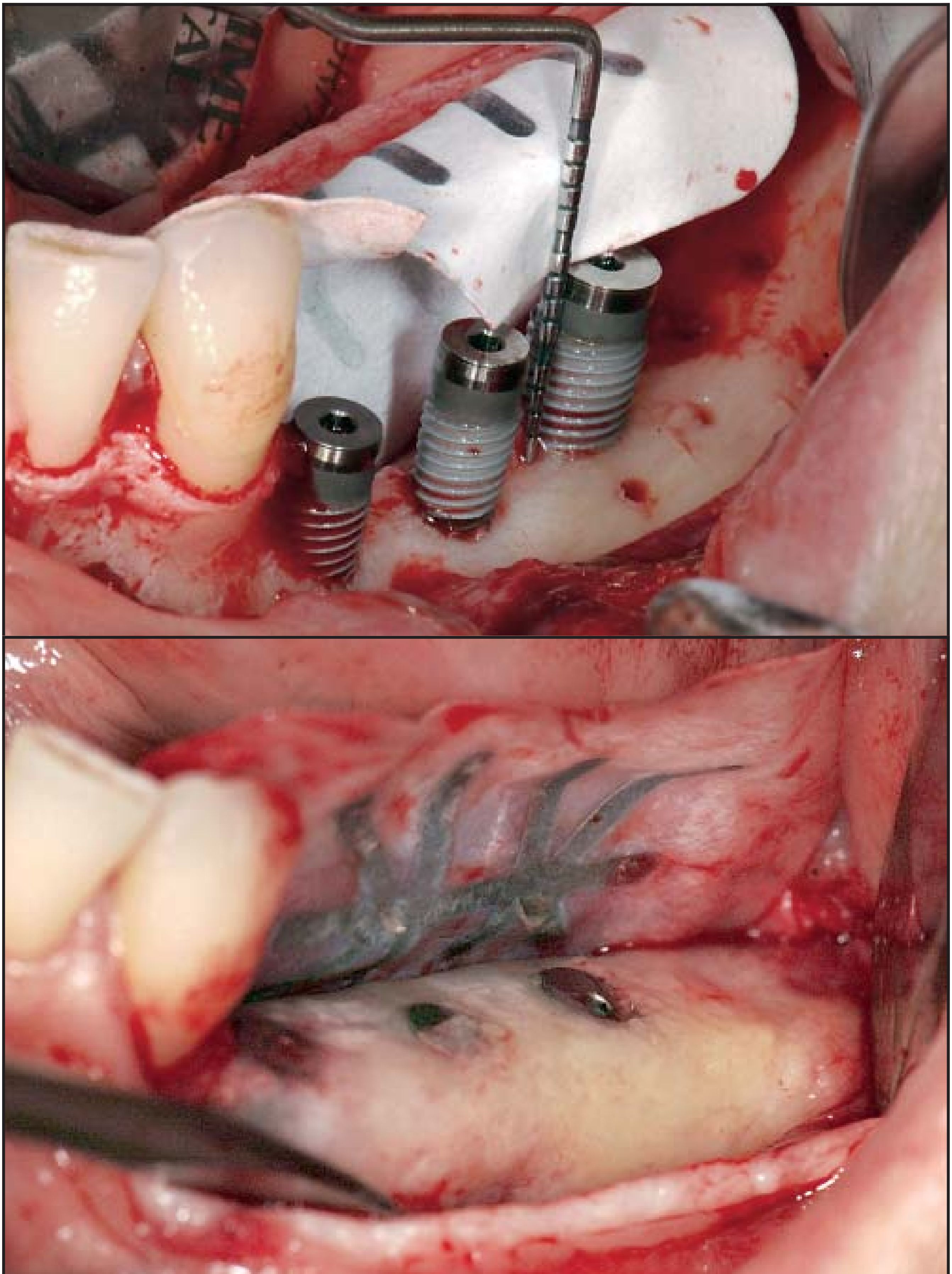

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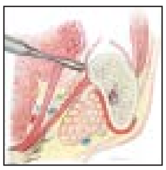
Management of a Coronally Advanced Lingual Flap in Regenerative Osseous Surgery: A Case Series Introducing a Novel Technique



*Marco Ronda, MD, DDS**
*Claudio Stacchi, DDS, MSc***

One of the crucial factors in the success of guided bone regeneration procedures is the correct management of the soft tissues. This allows for stable primary wound closure without tension, which can result in premature exposure of the augmentation area, jeopardizing the final outcome. The use of vertical and periosteal incisions to passivate buccal and lingual flaps in the posterior mandible is often limited by anatomical factors. This paper reports on a series of 69 consecutive cases introducing a novel surgical technique to release and advance the lingual flap coronally in a safe and predictable manner. (Int J Periodontics Restorative Dent 2011;31:505–513.)

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The effectiveness of guided bone regeneration (GBR) procedures to promote horizontal and vertical bone regeneration has been well documented.[1–9] Moreover, the stability of regenerated bone and its favorable response under functional loading have been demonstrated.[10–13] The ideal goal of this therapy has shifted from regenerating sufficient bone to place implants to reconstructing hard and soft tissues similar to the prepathologic condition. Vertical GBR is a technique with great potential, but it is very demanding for surgical skills. The careful management of the soft tissues is key to the success: Obtaining and maintaining primary closure of the flap during healing is necessary to prevent contamination and infection of the membrane, an event that always compromises the augmentation procedure.[14,15] Maintaining closure of the flap over nonresorbable membranes is even more challenging when compared to other augmentation procedures (eg, bone grafting, split crest techniques) because expanded polytetrafluoroethylene separates the flap

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from the underlying periosteal vascularization, depriving it of an important blood supply. Numerous studies have suggested a variety of clinical protocols for the management of soft tissues.[16–21] In this paper, a novel technique for the coronal displacement of the lingual flap is described and its clinical efficacy to obtain and maintain primary closure on the augmentation area for the entire healing period evaluated.

Method and materials

Fifty-two patients requiring dental implants in the posterior mandible were enrolled in this study. Of these, 38 (73.1%) were women and 14 (26.9%) were men, with an age range from 25 to 79 years (mean, 50.9 ± 12.1 years). Twenty patients were light smokers (38.5%) and 32 were not smokers (61.5%). The inclusion criteria were mandibular partial edentulism (Applegate-Kennedy Class I or II) involving the premolar/molar area and an associated presence of crestal bone height < 7 mm coronal to the mandibular canal. General exclusion criteria were acute myocardial infarction within the past 6 months, uncontrolled coagulation disorders or metabolic diseases, radiotherapy to the head or neck region within the past 24 months, treatment with intravenous bisphosphonates, psychologic or psychiatric problems, heavy smoking (> 10 cigarettes/day), and alcohol or drug abuse. The local exclusion criterion was the presence of uncontrolled periodontal disease. All patients signed a written informed consent form.

At the initial visit, all subjects underwent clinical examination with periapical and panoramic radiographs. A prosthetic evaluation with a diagnostic wax-up was accomplished, and a computed tomography (CT) scan with a template was created to plan implant surgery. A total of 69 sites in the posterior mandible were treated by insertion of dental implants associated with vertical bone augmentation procedures.

Surgical protocol

All surgeries and postoperative visits were conducted by a single operator. Under local anesthesia (4% articaine with epinephrine 1:100,000; Septanest, Ogna), a full-thickness crestal incision was performed in the keratinized tissue from the distal surface of the more distal tooth to the retromolar pad, continuing the incision in the mandibular ramus for 1 cm, and finishing with a releasing incision on its lateral surface. To preserve the lingual nerve when approaching the second molar area, the blade was inclined approximately 45 degrees with the tip in a vestibular direction, and the external oblique ridge was used as a marker for the incision going distally and buccally, bearing in mind that the ramus of the mandible flares up laterally and posteriorly. When there was a tooth still present posterior to the augmentation area, the incision continued 5 mm distal from it before performing the releasing incision.

The flap design was continued intrasulcularly on both vestibular and lingual sides of the mesial portion of the flap. Buccally, it involved two teeth before finishing with a vertical hockey stick releasing incision.[22] Lingually, it involved one tooth to the gingival zenith and then continued horizontally in a mesial direction for 1 cm in the keratinized tissue. A full-thickness vestibular flap was elevated and, after isolating the mental nerve, released with a longitudinal periosteal incision avoiding the mental foramen area. This slight horizontal cut, performed using a new blade, was extended from the distal to the mesial releasing incisions covering the entire length of the flap. On the lingual side, a full-thickness mucoperiosteal flap was elevated until reaching the mylohyoid line. Then, using a blunt instrument (eg, a Pritchard elevator), it was localized a connective tissue band continuing with the epimysium of the mylohyoid muscle (Fig 1). This band, usually located in the first molar area, is 1 to 2 cm wide in a mesiodistal direction and is inserted into the inner part of the lingual flap approximately 5 mm from the crest in an apical direction. The blunt instrument was inserted below the connective band, and, with gentle traction in the coronal direction, this muscular insertion was detached from the lingual flap (Figs 2 and 3). The vertical augmentation procedure was then performed

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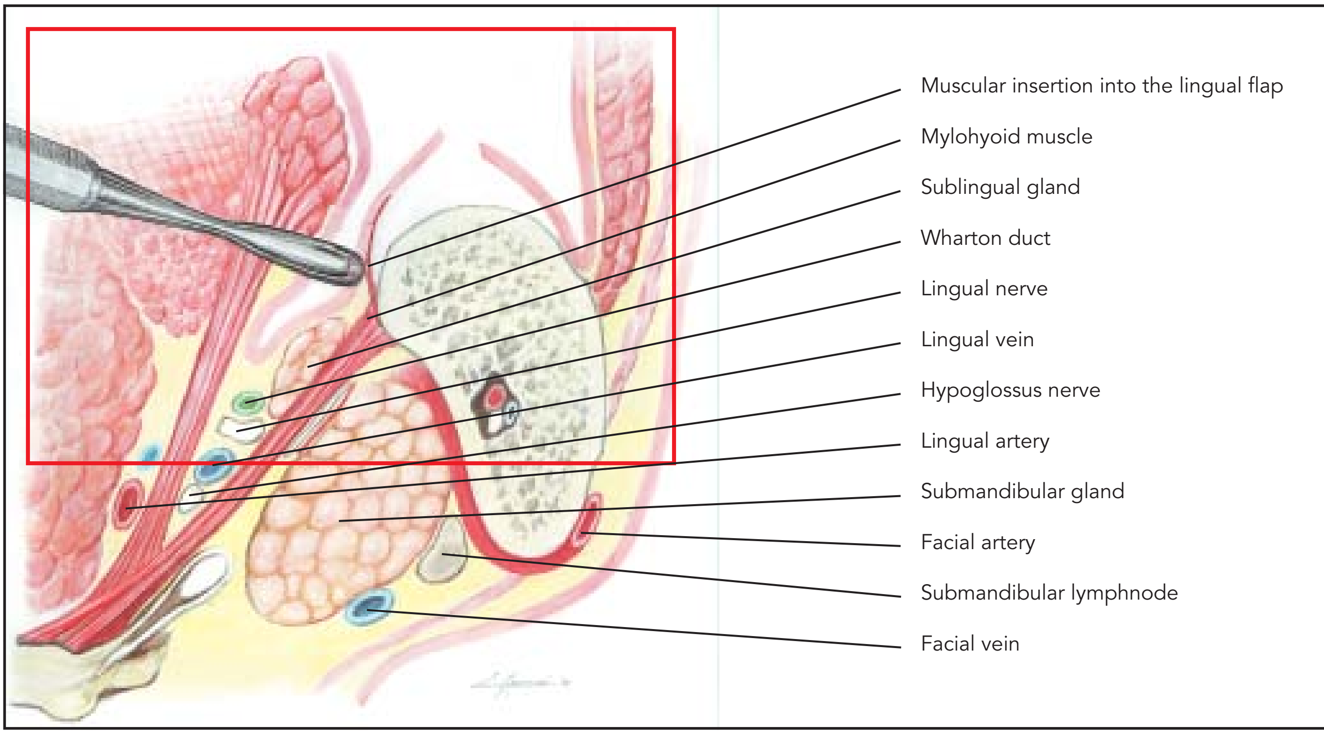

Fig 1 *Cross-sectional anatomical drawing of the first molar region showing the insertion of the mylohyoid muscle into the lingual flap and its relations with other anatomical structures of the area.*

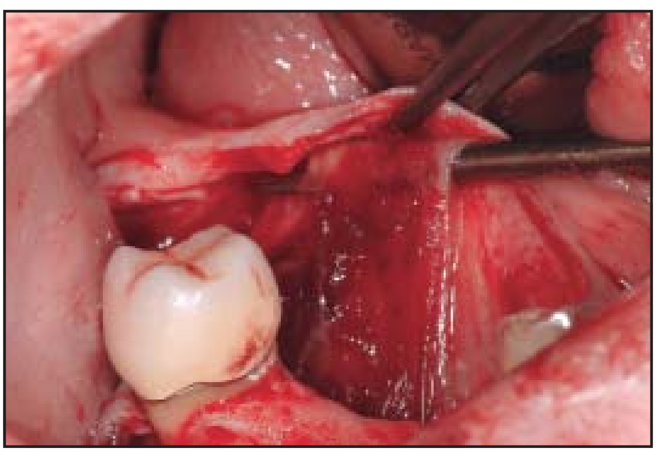

Fig 2 *Detachment of the mylohyoid muscle insertion from the lingual flap was accomplished by applying gentle traction with a blunt instrument in a coronal direction.*

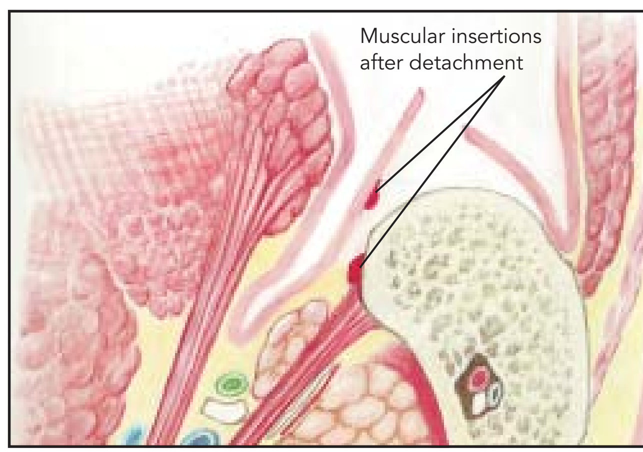

Fig 3 *Cross-sectional anatomical drawing of the first molar region representing the situation after detachment of the muscular insertion from the lingual flap.*

using a titanium-reinforced expanded polytetrafluoroethylene Gore-Tex membrane (W.L. Gore) with a composite bone graft. The grafting material consisted of a 1:1 mixture of mineralized bone allograft (Puros, Zimmer) and autogenous bone harvested from the external oblique ridge with bone scrapers (Safescraper, Meta).

The implant site preparations were made using twist drills and finalized in the last portion over the mandibular canal with an OT4 piezoelectric insert (Piezosur-

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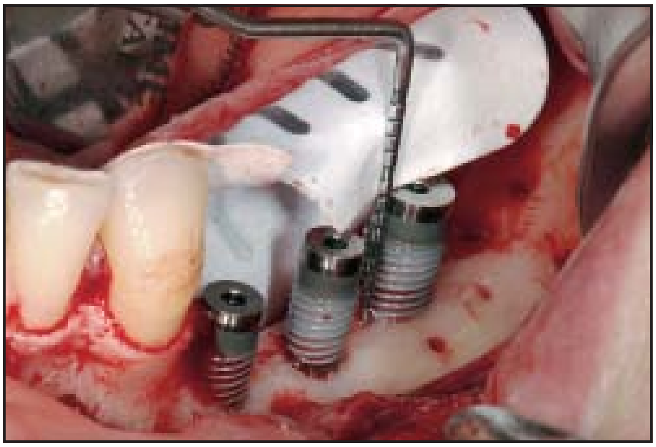

Fig 4 *Implants inserted in place and left to protrude 8 mm from the original bone level. The membrane is already fixed on the lingual side and some cortical perforations are visible.*

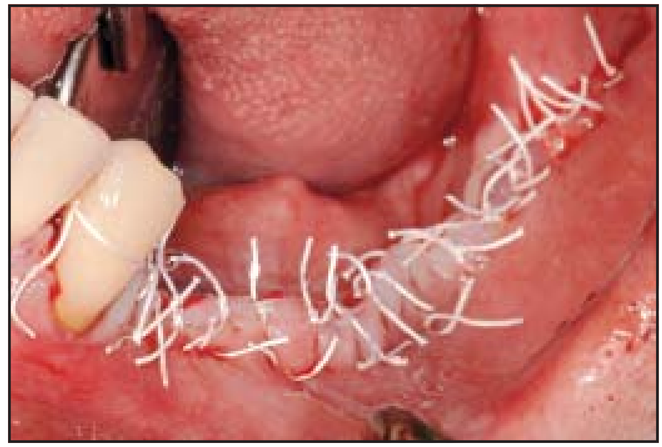

Fig 5 *Primary closure of the flaps over the augmentation area with two lines of sutures.*

gery, Mectron). Implants were then placed (Spline Twist and Tapered Screw-Vent, Zimmer) and left to protrude from the original bone level for the amount of planned vertical regeneration (Fig 4). After multiple perforations of the cortical bone, performed using an OP5 piezoelectric insert, the composite graft was positioned and the membrane was adapted and fixed with lingual and buccal fixation tacks (Micropin, Omnia). The mucoperiosteal flaps were tested for their passivity and their capability to be displaced to cover the augmentation area completely. A double line of suturing was performed: Horizontal mattress sutures were used for close contact between the inner connective portions of the flaps, then multiple interrupted sutures (Gore-Tex CV5, W.L. Gore) followed (Fig 5).

Amoxicillin/clavulanate potassium (875 + 125 mg) and ibuprofen (600 mg) were prescribed twice a day for 1 week. Patients were also instructed to rinse twice a day with a 0.2% chlorhexidine solution and to avoid mechanical plaque removal in the surgical area until sutures were removed. Sutures were removed 10 to 12 days after surgery. Postsurgical visits were scheduled at 15-day intervals to check the course of healing and to verify primary wound closure in the postoperative period. Successful primary closure was defined as complete coverage of the membrane for at least 6 months after the augmentation procedure. Any membrane exposure was considered a loss of primary closure and a failure for the aims of this study.

Statistical analysis

The chi-square test was performed to analyze nonparametric data obtained in this study (SPSS 16.0, IBM).

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Table 1	Distribution of surgical sites by amount of vertical augmentation required
Vertical regeneration	**No. of sites**
< 3 mm	0
3–6 mm	42
6.1–9 mm	24
> 9 mm	3
Total	69

Results

A total of 69 consecutive vertical GBR procedures were performed in this study, with the contextual insertion of 187 implants. The amount of required vertical regeneration around implants ranged from 1.1 to 12 mm (mean, 5.2 ± 1.8 mm). The distribution of the surgical sites by maximum amount of vertical regeneration required per site is summarized in Table 1. There were no dropouts during the entire observation period. Coronal displacement of the flaps was sufficient to obtain a complete and passive coverage in all 69 augmented sites. During the postoperative period, there were no recorded hemorrhagic problems or neurosensory changes. No evidence of adverse local or systemic side effects was observed in 65 sites throughout the study; in 4 sites, although primary closure of the flaps was perfectly maintained, there were signs of infection in the augmented zone (swelling and purulent exudate) during the first 2 weeks after surgery. In these cases, membranes and implants were immediately removed (overall failure rate, 5.8%). Three of the 4 unsuccessful sites were in smokers (11.1% failure in the smokers group, 2.4% in the nonsmokers group). The higher failure rate in the smokers group resulted in a statistically significant difference ($P < .001$).

No membrane exposure was observed in any patient during the entire healing period (Fig 6). Six months after surgery, the membranes were removed, and implants were connected with healing abutments (Figs 7 and 8).

Discussion

GBR procedures have evolved greatly over the last 15 years, allowing for predictable implant placement in horizontally and vertically augmented ridges.[7–13] The success of this technique is dependent on strict observation of the surgical protocols. A crucial factor is to achieve and maintain primary closure of the flaps for the entire healing period. Flap management has to fulfill two main requirements: It must allow for complete and passive coverage of the augmented zone without any residual tension, and it must be safe for the adjacent anatomical structures.

The handling of the soft tissues has been analyzed in numerous studies,[17–24] but most of them are focused on the management of the

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Fig 6 (left) *At 6 months, primary closure was perfectly maintained, and soft tissues appeared healthy.*

Fig 7 *At removal, the membrane was stable and perfectly adherent to the crest. The regenerated tissue covered the implants, filling the space delimited by the membrane completely.*

Fig 8 *Occlusal view of the implants with healing abutments; the height and thickness of the crest were restored satisfactorily.*

palatal flap. Coronal displacement of the lingual flap, essential to GBR in the posterior mandible, has been well described[7–9,22]: After full-thickness elevation beyond the mylohyoid line, a slight mesiodistal incision of the periostium was performed to advance the flap coronally. This technique is very effective but, in unexperienced hands, could be potentially harmful for the delicate anatomical structures of the floor of the mouth. The surgical technique of the coronally advanced lingual flap presented in this study is fundamentally based on the separation of the lingual flap and the underlying muscular structures in the molar area. From anatomy, it is known that the most posterior portion of the mylohyoid muscle arises from the lingual tuberosity, just below the retromolar pad. Further, in the molar region, it is located very close to the attachment of the mucous membrane to the mandible; in the premolar region, the attachment drops suddenly to a lower level, giving a distinct step in the line of origin.[25] These anatomical factors suggest that the close contact between the mylohyoid muscle and the lingual flap in the molar area is an important limitation in obtaining coronal displacement. For this reason, the detachment of the mylohyoid insertion in the molar zone allows the lingual flap additional extended movement in the coronal direction, enhancing its mobility greatly (Fig 9). The separation between the muscle and flap was obtained using a blunt instrument by applying gentle traction force in a coronal direction to the connective tissue, continuing with the epimysium of the mylohyoid muscle without endangering local anatomical

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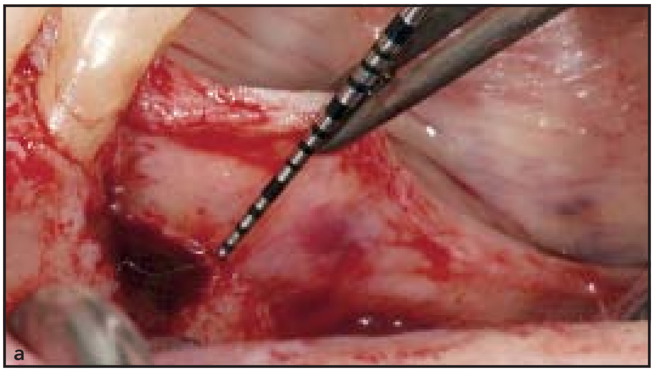

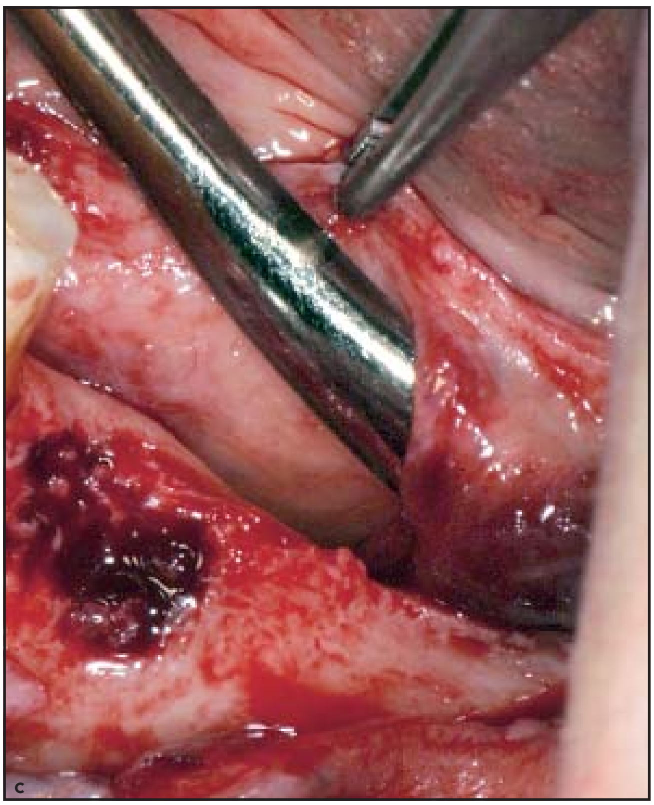

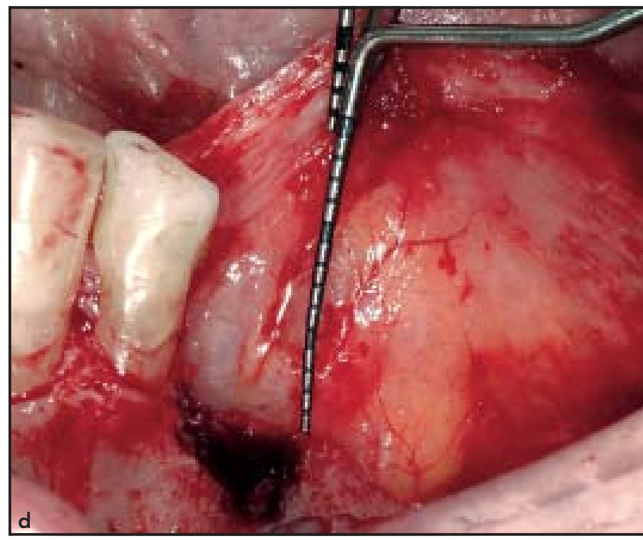

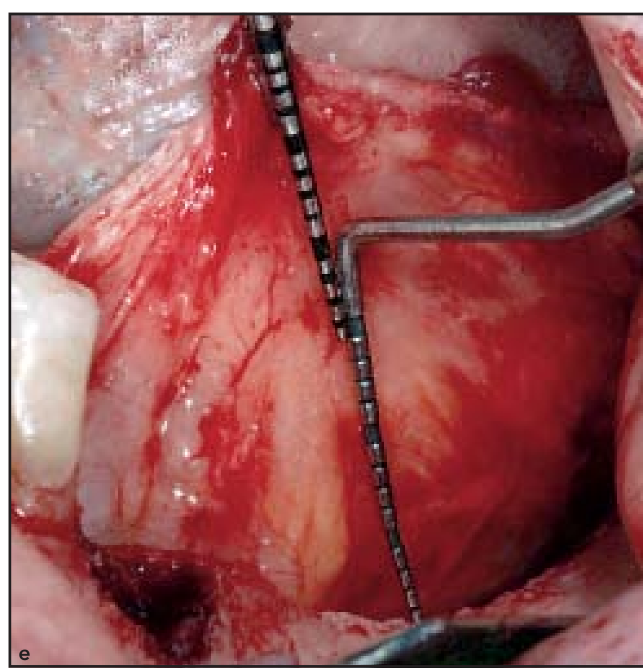

Fig 9a *Coronal displacement of a lingual flap measured in the mesial portion after full-thickness elevation until the mylohyoid line (10 mm).*

Fig 9b *Coronal displacement of the same flap measured in the distal portion after full-thickness elevation until the mylohyoid line (15 mm)*

Fig 9c *Detachment of the muscular insertion from the flap obtained with gentle traction in the coronal direction using a blunt instrument.*

Fig 9d *Enhancement in coronal displacement of the flap measured in the mesial portion (19 mm) after detachment of the muscular insertion. Compare to Fig 9a (baseline).*

Fig 9e *Measurement of coronal advancement obtained in the distal portion of the flap (29 mm) after detachment of the muscular insertion. Compare to Fig 9b (baseline).*

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structures (eg, lingual nerve, lingual artery, sublingual gland). Furthermore, with this technique, the lingual flap is elevated only until the mylohyoid line and not beyond, as proposed previously,[22] providing additional protection to the underlying anatomical structures.

Primary closure of the flap was maintained in all cases considered in this study. The four early infections were likely a result of intraoperative contamination of the composite bone graft with bacteria present in saliva.[26] Moreover, the data seem to confirm, in accordance with the literature,[27–29] that smoking could be a significant risk factor that can jeopardize the outcome of regenerative procedures.

Conclusions

In this case series, the authors introduce a novel technique to coronally advance the lingual flap in regenerative surgery. In the cases considered, the proposed surgical management of the lingual flap resulted in a 100% success rate in the maintenance of soft tissue primary closure for a period of 6 months postoperatively. Moreover, this surgical approach allows for safe displacement of the lingual flap. The use of blunt instruments and the elevation limited to the mylohyoid line minimize the possibility of potential damages to the delicate anatomical structures of the floor of the mouth.

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