A Novel Approach for the Coronal Advancement of the Buccal Flap

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An adequate flap release is necessary to perform a tension-free suture over an augmented area. This is a fundamental requisite to attain and maintain a reliable biological seal, protecting the graft from bacterial contamination during the healing period. In the posterior mandible, in particular, the use of conventional periosteal incisions is not always sufficient for a proper buccal flap passivation, as they are often limited by anatomical factors. This article reports a series of 76 consecutive cases of vertical guided bone regeneration in the posterior mandible introducing a novel surgical technique to enhance the coronal advancement of the buccal flap in a safe and predictable way. (Int J Periodontics Restorative Dent 2015;35:795–801. doi: 10.11607/prd.2232)

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Vertical bone loss represents a major surgical challenge in the implant treatment of the posterior mandible, due to anatomical factors and technical difficulties. Various therapeutic approaches can be considered, including short implants,[1] block bone grafting,[2] interpositional grafts,[3] lateral nerve repositioning,[4] distraction osteogenesis,[5] and guided bone regeneration with membranes[6,7] or titanium meshes.[8] However, proper management of the soft tissues is a crucial point for success in any regenerative procedure: a complete and stable closure of the flaps during healing is necessary to prevent contamination and infection and allows for undisturbed graft healing and incorporation. This can be accomplished only if buccal and lingual flaps are sufficiently released to obtain a passive coverage of the augmented area and it is stabilized with tension-free sutures. Many studies suggested different clinical protocols for management of the soft tissues to reach satisfactory results in regenerative surgery.[9–21] Even though the longitudinal periosteal releasing incision (PRI) has a fundamental role in flap passivation in most techniques, precise description and analyses of this procedure have been rare.[22]

In this case series, we describe a novel surgical approach to release the buccal flap and enhance its

coronal displacement to attain passive coverage of the wound and maintain a predictable flap closure during the entire healing period.

Method and materials

Sixty-four consecutive patients needing dental implants and associated bone augmentation procedures in the posterior mandible were enrolled in this study and treated between February 2010 and June 2013. Of these patients, 49 (76.6%) were women and 15 (23.4%) were men, with an age range of 25 to 76 years (mean: 52.7 ± 10.3 years). Eleven patients (17.2%) were light smokers and 53 were nonsmokers (82.8%). The inclusion criteria were a mandibular partial edentulism (Applegate-Kennedy class I or II) involving the premolar/molar area and associated with a crestal bone height < 7 mm coronal to the mandibular canal. Exclusion criteria were general contraindications to implant surgery, immunosuppressed or immunocompromised, irradiated in the head and neck area, treated or under treatment with oral or intravenous aminobisphosphonates, uncontrolled diabetes (glycated haemoglobin > 7.5%), pregnant or nursing, substance abusers, psychiatric problems, or unrealistic expectations. Local exclusion criteria were poor oral hygiene and/or uncontrolled or untreated periodontal disease. All procedures were performed in accordance with the recommendations of the Declaration of Helsinki (2008) for investigations with human subjects. All patients received thorough explanations of the protocol and signed a written informed consent form prior to being enrolled in the trial.

At the initial visit, all subjects underwent a clinical examination with periapical and panoramic radiographs and study models. Then a prosthetic evaluation with diagnostic waxing was done, and a computed tomography (CT) scan using a template with radio-opaque markers was performed to plan implant surgery.

Surgical protocol

All the surgeries and the post-operative controls were conducted consecutively by a single operator.

Each patient was draped to guarantee maximum asepsis. The perioral skin was disinfected using iodopovidone 10% (Betadine, Meda Pharma) and the subjects were asked to rinse with chlorhexidine mouthwash 0.2% (Corsodyl, GlaxoSmithKline) for 60 seconds (Fig 1). Under local anesthesia (4% articaine with epinephrine 1:100,000, Septanest, Septodont), a full thickness crestal incision was performed in the keratinized tissue, from the retromolar pad to the distal surface of the more distal tooth. The incision continued in the mandibular ramus for 1 cm, finishing with a vertical releasing incision on its anterior surface. To preserve the lingual nerve, when approaching the second molar area the blade was inclined approximately 45 degrees with the tip in the buccal direction and the external oblique ridge was used as a marker for the incision going distally and buccally.

When there was a tooth still present posterior to the augmentation area, the crestal cut continued 5 mm distally from it, before performing the releasing incision.

On the mesial part, the flap design continued intrasulcularly on the vestibular and lingual sides. Buccally, it involved two teeth before finishing with a vertical hockey-stick releasing incision.[13] Lingually, it involved one tooth until the gingival zenith and then continued horizontally in the mesial direction for 1 cm, in the keratinized tissue. A full thickness lingual flap was elevated to the mylohyoid line and was released by detaching the insertion of the mylohyoid muscle from the inner part of the flap as described by Ronda and Stacchi.[19]

On the buccal side, a full-thickness mucoperiosteal flap was elevated to expose the entire defect. In the mental foramen area, the mental nerve was identified and carefully isolated from the tissues surrounding it (Fig 2).

The buccal flap was then released using the following procedure: holding the flap in tension with an anatomical forceps, the periosteum was cut to a depth of 1 mm by moving a new blade (15 or 15c), without stopping, distal to mesial (Fig 3). The blade had to cut the tissue apically to the mucogingival junction to prevent flap perforation, and coronally to the vestibular fornix. This conventional PRI allowed for a coronal displacement of the flap, which was measured with a periodontal probe at three different points on the periosteal incision line (mesial, central, and distal) (Fig 4).

Fig 1 *Preoperative situation with a severe atrophy of the posterior mandible.*

Fig 2 *Elevation of a full-thickness flap to expose the entire defect. The mental nerve is identified and carefully isolated.*

Fig 3 *The longitudinal periosteal releasing incision is made moving the blade perpendicular to the periosteum, without stopping, from distal to mesial.*
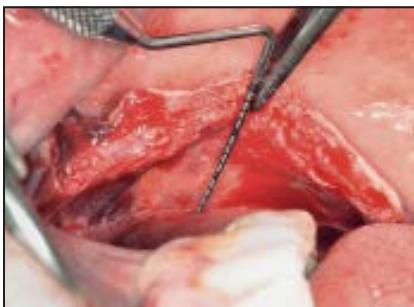
Fig 4 *The coronal displacement after PRI is measured with a periodontal probe in the mesial, central, and distal parts of the flap.*
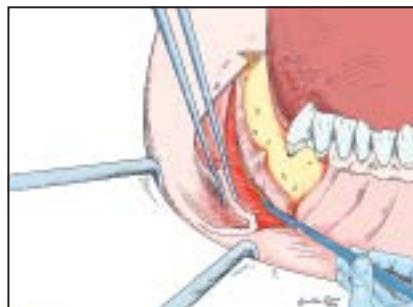

Fig 5 *Keeping the flap in tension, a brushing movement is performed with a new blade, dissecting and separating the superficial from the deeper part of the flap.*


Fig 6 *The coronal displacement after the brushing is measured with a periodontal probe in the mesial, central, and distal parts of the flap.*

The connective tissue exposed by the PRI in the inner part of the buccal flap represents the work area where the brushing technique was applied. Keeping the flap in tension, the blade was used with a brushing movement over the entire area to interrupt the residual periosteal fibers and to dissect and separate the superficial from the deeper part of the flap (Fig 5). Right-handed operators should perform this movement from apical to coronal in right buccal flaps and from coronal to apical in left flaps. The coronal advancement reached after the brushing procedure was measured with a periodontal probe with the previously described modalities (Fig 6).

The vertical augmentation procedure was then performed using a titanium-reinforced d-PTFE membrane (Cytoplast Ti-250 XL, Osteogenics Biomedical) and mineralized allograft (Puros, Zimmer Dental). The implant site preparations were made using twist drills and finalized in the last portion over the mandibular canal with piezoelectric inserts
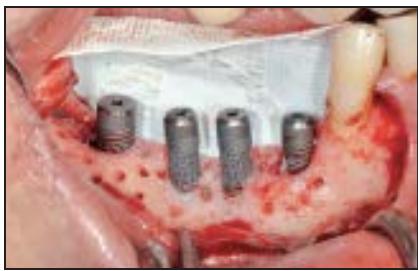
Fig 7 (left) *Implants protrude from the bone level for the amount of vertical regeneration programmed.*

Fig 8 (right) *An allograft and a d-PTFE membrane are positioned around implants to reconstruct the defect.*

(Piezosurgery 3, Mectron). The fixtures (Tapered Screw-Vent and Trabecular Metal Dental Implant, Zimmer Dental) were then placed and left protruding from the original bone level for the amount of vertical regeneration programmed (Fig 7). After multiple perforations of the cortical bone, the allograft was positioned and the membrane was adapted and fixed with lingual and buccal fixation tacks (Maxil Micropins, Omnia) (Fig 8). The mucoperiosteal flaps were tested for passivity and for capability to be displaced, completely covering the augmentation area without tension. A double line of closure was performed: at first, horizontal mattress sutures were used to favor a close contact between the inner connective portions of the flaps, then the closure was completed with multiple interrupted sutures (Cytoplast CS-0518, Osteogenics Biomedical). Amoxicillin/clavulanate potassium (875 + 125 mg) tablets (Augmentin, GlaxoSmithKline), one tablet twice a day, and ibuprofen (600 mg) (Brufen, Abbott Laboratories), twice a day, were prescribed 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 the sutures were present. Sutures were removed 12 to 15 days after surgery. Postsurgical visits were scheduled at 15-day intervals to check the course of healing and to verify wound closure in the postoperative period.

Results

No dropouts presented at any point in the observation period. In 64 consecutive patients, 76 mandibular sites were treated with the insertion of 215 dental implants associated with contextual vertical guided bone regeneration procedures. All the sites presented class II vertical ridge deficiencies (> 3 mm), according to Tinti and Parma-Benfenati's classification.[23] In all sites, the buccal flap was released using the brushing technique, while the lingual flap was passivated by detaching the insertion of the mylohyoid muscle from its inner part using a blunt instrument.[19]

The coronal displacement of the buccal flap, measured after the PRI, varied from 4 to 11 mm (mean: 8.4 ± 1.8 mm). After the additional release performed with the brushing technique, the buccal flap advancement varied from 10 to 38 mm (mean: 21.7 ± 6.3 mm).

Mean additional enhancement in flap release obtained with the brushing technique after PRI was 13.2 mm ± 4.8 mm.

In accordance with Fontana et al,[24] surgical and healing complications were evaluated. No class A complications (flap damage) were recorded. Minor temporary neurological complications (class B) occurred in three cases: transient paresthesia caused by stretching of mental nerve fibers during flap management or edema compression on the mandibular nerve. The timing for a complete recovery from the neurological symptoms varied between 1 and 4 weeks. Minor vascular complications (class C) also occurred, leading to various grades of local edema or hematoma; these complications were expected by the surgeon, as this technique requires periosteal incisions to obtain an adequate passivation of the flap.

The healing period was uneventful in 73 sites (96.1%). One

Fig 9 *The membrane is removed after 6 months and the implants appear covered by the newly formed hard tissue.*

Fig 10 *Radiographic images of the preoperative (a) and postoperative (b) situations at membrane removal.*
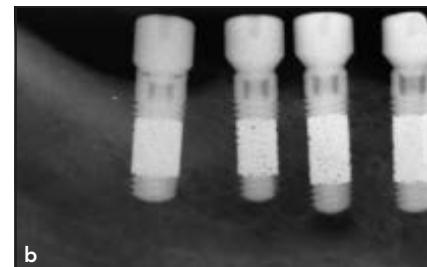
class I complication (1.3%), a small membrane exposure without purulent exudate, occurred in a smoker patient after 18 weeks and was treated with topical application of 0.2% chlorhexidine gel twice a day. The membrane was removed after 22 weeks with a satisfactory regenerative result.

One class III (1.3%) (membrane exposure with purulent exudate) and one class IV complication (1.3%) (formation of an abscess in the regeneration area without exposure of the membrane) were observed in two smoker patients after 2 months and 3 weeks, respectively. Membranes, graft, and implants were removed, a local antibiotic wash was administered intra-operatively, and patients were prescribed systemic antibiotics.

In all patients who had an uneventful healing period the membranes were removed after 6 to 7 months (mean: 26.5 weeks ± 4.2), and the implants were connected with healing abutments (Figs 9 and 10). Out of 215 implants, 209 (97.2%) resulted in clinical osseointegration.

Discussion

Bone regeneration procedures have greatly evolved over the last 15 years, allowing for implant placement in vertically augmented ridges using guided bone regeneration or bone block grafting.[1–8] Nevertheless, the success of these techniques is strongly correlated to a strict respect of the surgical protocols. One of the key factors in the final outcome is maintenance of the primary closure of the flaps for the entire healing period. Soft tissue management in the posterior mandible has been described in numerous studies[13,14,18,19,21] that suggest protocols and surgical techniques to perform regenerative procedures in a predictable way. PRI is widely used in these protocols to release flaps from tension, but surprisingly, a precise description and analysis of this common surgical procedure is rare in the literature.[22] After the elevation of a full-thickness flap, the periosteum should be cut with a longitudinal incision from distal to mesial, at a depth of 1 to 3 mm, allowing for a coronal displacement of the flap varying from 5 to 8 mm.[20,21] In the case of insufficient closure, the

conventional technique suggests cutting more deeply in the muscle layer, entering again in the first incision, or performing a new periosteal release parallel to the first and with the same modalities.[22] Further coronal displacement can be attained by performing an additional muscle release using dissection scissors.[22] These approaches are effective but have some limitations: deep linear cuts in the muscle layers are performed without a direct visual control and can interrupt blood vessels and nerve fibers of variable importance, increasing the incidence of intraoperative and postoperative complications (eg, immediate or delayed bleeding, edema, hematoma, neurological injuries).

In the posterior mandible, oral mucosa consists of two layers: the surface stratified squamous epithelium and the deeper lamina propria. The lamina propria, a fibrous connective tissue layer, attaches at underlying skeletal muscle fibers of the buccinator without the interposition of a submucosa.[25] The surgical technique for the coronal advancement of the buccal flap that we introduce in this study is

Fig 11 *If necessary, direct visual control permits performance of the brushing release in close proximity to the mental nerve.*

essentially based on the separation between the superficial and the deep layers of the flap, after conventional PRI. A careful dissection is performed within the width of the lamina propria, using the blade as a brush in the area delimited by the periosteal margins of the longitudinal incision. This progressive movement allows for direct visual control of the surgical action, reducing the risk of damaging local anatomical structures (vessels and nerves). Moreover, the mental nerve, after its emergence from the foramen, continues in the deeper part of the lamina propria and enters into the muscular layers.[25,26] The dissection performed with the brushing technique involves the superficial layers of the lamina propria. For this reason, this surgical approach can be carefully applied even in the most severe cases, where the mental nerve has an extremely coronal position, attaining an adequate flap release with relative safety (Fig 11).

Mean coronal advancement of the buccal flap obtained in the 76 cases of this study was 21.7 ± 6.3 mm. This result seems to indicate a greater potential of the brushing technique in attaining coronal displacement of the buccal flap compared to other procedures described in the literature, such as PRI or double flap incision.[20,21]

The primary closure of the flaps over the membrane was maintained for the entire healing period in a large majority of the cases considered in this study (97.4%). Two membrane exposures were observed: an early exposure with infection that led to failure of the regenerative procedure, and a late exposure that was successfully managed with antimicrobic agents until membrane removal. An additional failure occurred with an early graft infection without membrane exposure, likely due to an intraoperative contamination of the biomaterial with bacteria present in saliva.[27] All the complications occurred in smoker patients. This finding seems to confirm, in accordance with the literature,[28–31] that smoking could be a significant risk factor affecting the clinical outcomes of regenerative procedures.

An unavoidable side effect of this surgical technique, in common with all the other flap advancement procedures, is reduction of the vestibule depth. If necessary, this situation can be corrected during the second-stage surgery with a vestibuloplasty with a connective tissue graft or graft to xenogeneic or allogeneic materials.[32–34]

Conclusions

In this case series, the authors introduce a novel technique to increase the coronal advancement of the buccal flap in regenerative surgery. The proposed surgical modifications to the conventional PRI resulted in a 97% maintenance of primary closure over d-PTFE membranes during the healing period. The brushing technique allows for a significant enhancement in the coronal displacement of the buccal flap compared to PRI and double-flap incision. Moreover, the operator always has direct visual control during the dissection, which reduces the risk of accidental damage to nervous and vascular structures.

Acknowledgments

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