TITLE:

A Novel Approach For The Coronal Advancement Of The Buccal Flap.

RUNNING TITLE:

Buccal Flap Advancement

AUTHORS:

Marco Ronda, M.D., D.D.S., Private Practice, Genova, Italy; **Claudio Stacchi,** D.D.S., M.Sc., Department of Medical, Surgical and Health Sciences, University of Trieste, Trieste, Italy.

CORRESPONDING AUTHOR:

Marco Ronda, M.D., D.D.S.

piazza Brignole 3/8, 16122 Genova, Italy

Phone: +39 010 583435

Fax: +39 010 583435

Email: mronda@panet.it

Abstract

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, being often limited by anatomical factors. This paper 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.

Introduction

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, a proper management of the soft tissues is a crucial point for the success in any regenerative procedure: a complete and stable closure of the flaps during the healing is mandatory to prevent contamination and infection and allows for an undisturbed graft healing and incorporation. This prerequisite can be accomplished only if buccal and lingual flap are sufficiently released, in order to obtain a passive coverage of the augmented area, stabilizing it with tension-free sutures. Many studies suggested different clinical protocols for the management of the soft tissues, in order to reach satisfactory results in regenerative surgery[9-21]. Even if the longitudinal periosteal releasing incision (PRI) has a fundamental part for the flap passivation in most techniques, a precise description and analysis of this procedure has been very seldom conducted[22].

In this case series, we describe a novel surgical approach to release the buccal flap and to enhance its coronal displacement, in order to attain passive coverage of the wound and to maintain a predictable flap closure during the entire healing period.

Materials And Methods

64 consecutive patients needing dental implants associated to bone augmentation procedures in the posterior mandible were enrolled in this study and treated from February 2010 to June 2013. Of these patients, 49 (76,6%) were women and 15 (23,4%) were men, with an age range from 25 to 76 years (mean 52,7 ± 10,3 years). 11 patients were light smokers (17,2%), 53 were no smokers (82,8%). The inclusion criteria were a mandibular partial edentulism (Applegate-Kennedy class I or II), involving the premolar/molar area and associated with presence of 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 amino-bisphosphonates, 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 the presence of 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 on 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 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, Milano, Italy) and the subjects were asked to rinse with chlorhexidine mouthwash 0.2% (Corsodyl, Glaxo-SmithKline, Brentford, UK) for 60 seconds (Fig. 1). Under local anesthesia (4% articaine with epinephrine 1:100.000, Septanest, Septodont, Saint-Maur des Fosses, France), 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. In order to preserve the lingual nerve, when approaching the second molar area, the blade was inclined approximately 45° with the tip in 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 posteriorly 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 both 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 mesial direction for 1 cm, in the keratinized tissue. A full thickness lingual flap was elevated until reaching the mylohyoid line, and it was released by detaching the insertion of the mylohyoid muscle from the inner part of the flap as described by Ronda and Stacchi (2011)[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 with the following procedure: holding the flap in tension with an anatomical forceps, the periosteum was cut in a depth of 1 mm using a new blade (15 or 15C). This superficial incision was made moving the blade, without stopping, from distal to mesial direction (Fig. 3). The blade had to cut the tissue apically to the muco-gingival junction, to prevent from flap perforation, and coronally to the vestibular fornix. This conventional periosteal releasing incision (PRI) allowed for a coronal displacement of the flap which was measured with a periodontal probe in three different points of the periosteal incision line (mesial, central and distal part of the flap – Fig. 4).

The connective tissue exposed by the PRI in the inner part of the buccal flap, represents the working area where applying the "brushing" technique. Keeping the flap in tension, the blade was used, in the entire working area, with a "brushing" movement in order to interrupt the residual periosteal fibers and to dissect and separate the superficial from the deeper part of the flap (Fig. 5-6). This movement, for right-handed operators, should be performed from apical to coronal direction 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. 7).

The vertical augmentation procedure was then performed using a titanium-reinforced d-PTFE membrane (Cytoplast TI250XL, Osteogenics Biomedical Inc., Lubbock, TX, USA) and mineralized allograft (Puros, Zimmer Dental, Carlsbad, CA, USA). The implant site preparations were made using twist drills and finalized in the last portion over the mandibular canal with piezoelectric inserts (Piezosurgery 3, Mectron, Carasco, Italy). The fixtures were then placed (Tapered Screw-Vent and Trabecular Metal Dental Implant, Zimmer Dental, Carlsbad, CA, USA), and left protruding from the original bone level for the amount of vertical regeneration programmed (Fig. 8). 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, Fidenza, Italy) (Fig. 9). The mucoperiosteal flaps were tested for their passivity and for their capability to be displaced, completely covering the augmentation area without tensions. A double line of closure was performed: at first horizontal mattress sutures to favour a close contact between the inner connective portions of the flaps, then the closure was completed with multiple interrupted sutures (Cytoplast CS0518, Osteogenics Biomedical Inc., Lubbock, TX, USA). Amoxicillin/clavulanate potassium (875 + 125 mg) tablets (Augmentin, GlaxoSmithKline, Brentford, UK), one tablet twice a day, and ibuprofen (600 mg) (Brufen, Abbott Laboratories, Abbott Park, IL, USA), 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 12-15 days after surgery. Post-surgical visits were scheduled at 15 days intervals to check the course of healing and to verify the wound closure in the post-operative period.

Results

No dropouts presented during the entire period of observation. 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 classification[23]. In all the 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 releasing obtained with the “brushing” technique after PRI was 13.2 mm ± 4.8 mm.

In accordance with Fontana et al. (2011)[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 needs periosteal incisions to obtain an adequate passivation of the flap.

The healing period was uneventful in 73 sites (96.1%). One 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. 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 complications (1.3%) (formation of an abscess in the regeneration area without exposure of the membrane) were observed in two smoker patients after two months and three weeks, respectively. Membranes, graft and implants were removed, a local antibiotic wash was administered intra-operatively and patients were prescribed with systemic antibiotics.

In all the patients who had an uneventful healing period, the membranes were removed after 6–7 months (average 26.5 weeks ± 4.2), and the implants were connected with healing abutments (Fig. 10-11). 209 implants out of 215 resulted clinically osseointegrated (97.2%).

Discussion

Bone regeneration procedures have greatly evolved over the last fifteen 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-points conditioning the final outcome is the maintenance of the primary closure of the flaps for the entire healing period. Soft tissues management in the posterior mandible had been described in numerous studies[13,14,18,19,21], suggesting protocols and surgical techniques to perform regenerative procedures in a predictable way. PRI is widely used in these protocols to release flaps from tensions but, surprisingly, a precise description and analysis of this common surgical procedure was very seldom performed in literature[22]. After the elevation of a full-thickness flap, the periosteum should be cut with a longitudinal incision from distal to mesial, in a depth of 1-3 mm, allowing for a coronal displacement of the flap varying from 5 to 8 mm[20,21]. In case of insufficient closure, the conventional technique suggests to cut more deeply in the muscle layer, entering again in the first incision, or to perform a new periosteal release, with a parallel direction to the previous one and with the same modalities[22]. Further coronal displacement can be attained performing an additional muscle release by 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 nervous fibers of variable importance, increasing the incidence of intra-operative and post-operative complications (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, which is 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 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, in any moment, for a direct visual control of the surgical action, reducing the risk of endangering 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, obtaining an adequate flap release with a relative safety (Fig. 12).

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 if compared to other procedures described in 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 the large majority of the cases considered in this study (97.4%). Two membrane exposures were observed: an early exposure with infection which led to a failure of the regenerative procedure and a late exposure which was managed successfully with antimicrobic agents until the membrane removal. An additional failure occurred with an early graft infection without membrane exposure, likely due to an intra-operative 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 the regenerative procedures.

An unavoidable side effect of this surgical technique, in common with all the other procedures of flap advancement, is the reduction of the vestibule depth. If necessary, this situation can be corrected during the second stage surgery with a vestibuloplasty associated to a connective tissue graft or 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 if compared to PRI and double-flap incision. Moreover, the operator has always a direct visual control during the dissection: this factor reduces the risks of accidental damages to nervous and vascular structures.

References

1. Grant BT, Pancko FX, Kraut RA. Outcomes of placing short dental implants in the posterior mandible: a retrospective study of 124 cases. J Oral Maxillofac Surg 2009;67:713–717.
2. Cordaro L, Amadé DS, Cordaro M. Clinical results of alveolar ridge augmentation with mandibular block bone grafts in partially edentulous patients prior to implant placement. Clin Oral Implants Res 2002;13:103–111.
3. Jensen OT. Alveolar segmental “sandwich” osteotomies for posterior edentulous mandibular sites for dental implants. J Oral Maxillofac Surg 2006;64:471–475.
4. Peleg M, Mazor Z, Chaushu G, Garg AK. Lateralization of the inferior alveolar nerve with simultaneous implant placement: a modified technique. Int J Oral Maxillofac Implants 2002;17:101–106.

5. Garcia-Garcia A, Somoza-Martin M, Gandara-Vila P, Saulacic N, Gandara-Rey JM. Alveolar distraction before insertion of dental implants in the posterior mandible. Br J Oral Maxillofac Surg 2003;41:376–379.
6. Simion M, Jovanovic SA, Tinti C, Parma Benfenati S. Long-term evaluation of osseo-integrated implants inserted at the time or after vertical ridge augmentation. A retrospective study on 123 implants with 1-5 year follow-up. Clin Oral Implants Res 2001;12:35–45.
7. Ronda M, Rebaudi A, Torelli L, Stacchi C. Expanded vs. dense polytetrafluoroethylene membranes in vertical ridge augmentation around dental implants: a prospective randomized controlled clinical trial. Clin Oral Implants Res 2014;25:859-866.
8. Louis PJ, Gutta R, Said-Al-Naief N, Bartolucci AA. Reconstruction of the maxilla and mandible with particulate bone graft and titanium mesh for implant placement. J Oral Maxillofac Surg 2008;66:235–245.
9. Moy PK, Wainlander M, Kenney EB. Soft tissue modifications of surgical techniques for placement and uncovering of osseointegrated implants. Dent Clin North Am 1989;33:665-681.
10. Tinti C, Parma-Benfenati S. Coronally positioned palatal sliding flap. Int J Periodontics Restorative Dent 1995;15:298-310.
11. Rosenquist B. A comparison of various methods of soft tissue management following the immediate placements of implants into extraction sockets. Int J Oral Maxillofac Implants 1997;12:43-51.
12. Novaes AB Jr., Novaes AB. Soft tissue management for primary closure in guided bone regeneration: Surgical technique and case report. Int J Oral Maxillofac Implants 1997;12:84-87.
13. Tinti C, Parma-Benfenati S. Vertical ridge augmentation: surgical protocol and retrospective evaluation of 48 consecutively inserted implants. Int J Periodontics Restorative Dent 1998; 18:434-443.

14. Fugazzotto PA. Maintenance of soft tissue closure following guided bone regeneration: Technical considerations and report of 723 cases. J Periodontol 1999;70:1085-1097.

15. Fugazzotto PA. Maintaining primary closure after guided bone regeneration procedures: introduction of a new flap design and preliminary results. J Periodontol 2006;77:1452-1457.

16. Goldstein M, Boyan BD, Schwartz Z. The palatal advanced flap: A pedicle flap for primary coverage of immediately placed implants. Clin Oral Implants Res 2002;13:644-650.

17. Greenstein G, Greenstein B, Cavallaro J, Elian N, Tarnow D. Flap advancement: practical techniques to attain tension-free primary closure. J Periodontol 2009;80:4-15.

18. Hur Y, Tsukiyama T, Yoon TH, Griffin T. Double flap incision design for guided bone regeneration: a novel technique and clinical considerations. J Periodontol 2010;81:945-952.

19. Ronda M, Stacchi C. Management of a coronally advanced lingual flap in regenerative osseous surgery: a case series introducing a novel technique. Int J Periodontics Restorative Dent 2011;31:505-513.

20. Park JC, Kim CS, Choi SH, Cho KS, Chai JK, Jung UW. Flap extension attained by vertical and periosteal releasing incisions: a prospective cohort study. Clin Oral Implants Res 2012;23:993-998.

21. Ogata Y, Griffin TJ, Ko AC, Hur Y. Comparison of double-flap incision to periosteal releasing incision for flap advancement: a prospective clinical trial. Int J Oral Maxillofac Implants 2013;28:597-604.

22. Romanos GE. Periosteal releasing incision for successful coverage of augmented sites. A technical note. J Oral Implantol 2010;36:25-30.

23. Tinti C, Parma Benfenati S. Clinical classification of bone defects concerning the placement of dental implants. Int J Periodontics Restorative Dent 2003;23:147-55.

24. Fontana F, Maschera E, Rocchietta I, Simion M. Clinical classification of complications in guided bone regeneration procedures by means of a nonresorbable membrane. Int J Periodontics Restorative Dent 2011;31:265-273.

25. Ovalle W, Nahirney P. Histology of the oral cavity: cheek and gingiva. In: Netter's Essential Histology, ed 2. Philadelphia: W.B. Saunders, 2013:267.

26. Alantar A, Roche Y, Maman L, Carpentier P. The lower labial branches of the mental nerve: anatomic variations and surgical relevance. J Oral Maxillofac Surg 2000;58:415-418.

27. Quirynen M, De Soete M, van Steenberghe D. Infectious risks for oral implants: a review of the literature. Clin Oral Implants Res 2002; 13:1-19.

28. De Bruyn H, Collaert B. The effect of smoking on early implant failure. Clin Oral Implants Res 1994; 5:260-264.

29. Levin L, Herzberg R, Dolev E, Schwarz-Arad D. Smoking and complications of onlay bone grafts and sinus lift operations. Int J Oral Maxillofac Implants 2004;19:369–373.

30. Levin L, Schwartz-Arad D. The effect of cigarette smoking on dental implants and related surgery. Impl Dent 2005; 14:357-363.

31. Strietzel FP, Reichart PA, Kale A, Kulkarni M, Wegner B, Küchler I. Smoking interferes with the prognosis of dental implant treatment: a systematic review and meta-analysis. J Clin Periodontol 2007; 34:523-544.

32. Thoma DS, Benić GI, Zwahlen M, Hämmerle CH, Jung RE. A systematic review assessing soft tissue augmentation techniques. Clin Oral Implants Res 2009;20:146-165.

33. Hashemi HM, Parhiz A, Ghafari S. Vestibuloplasty: allograft versus mucosal graft. Int J Oral Maxillofac Surg 2012;41:527-530.

34. McGuire MK, Scheyer ET. A randomized, controlled clinical trial to evaluate a xenogeneic collagen matrix as an alternative to free gingival grafting for oral soft tissue augmentation. J Periodontol 2014 Mar 5. [Epub ahead of print]

Figure Legends.

Fig.1 Pre-operative 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, in a direction from distal to mesial.

Fig.4 The coronal displacement after PRI is measured with a periodontal probe in the mesial, central and distal part of the flap.

Fig.5-6 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.7 The coronal displacement after the “brushing” is measured with a periodontal probe in the mesial, central and distal part of the flap.

Fig.8 Implants protrude from the bone level for the amount of vertical regeneration programmed.

Fig.9 An allograft and a d-PTFE membrane are positioned around implants to reconstruct the defect.

Fig.10 The membrane is removed after 6 months and the implants appear covered by the newly-formed hard tissue.

Fig.11 Radiographic images of the pre-operative (A) and post-operative (B) situations, at membrane removal.

Fig.12 If necessary, the direct visual control permits to perform the “brushing” release also in close proximity to the mental nerve.

Fig.1

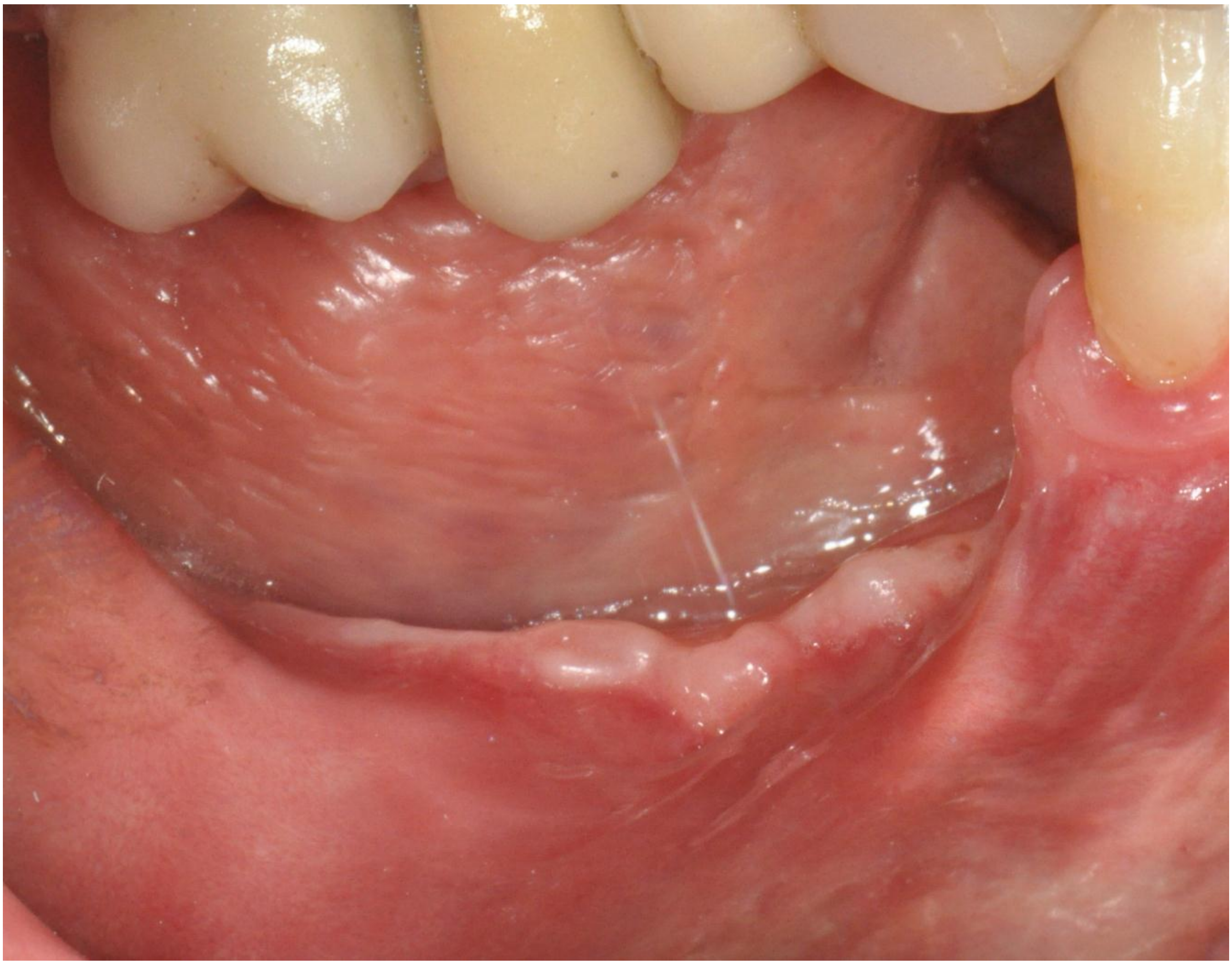

Fig.2

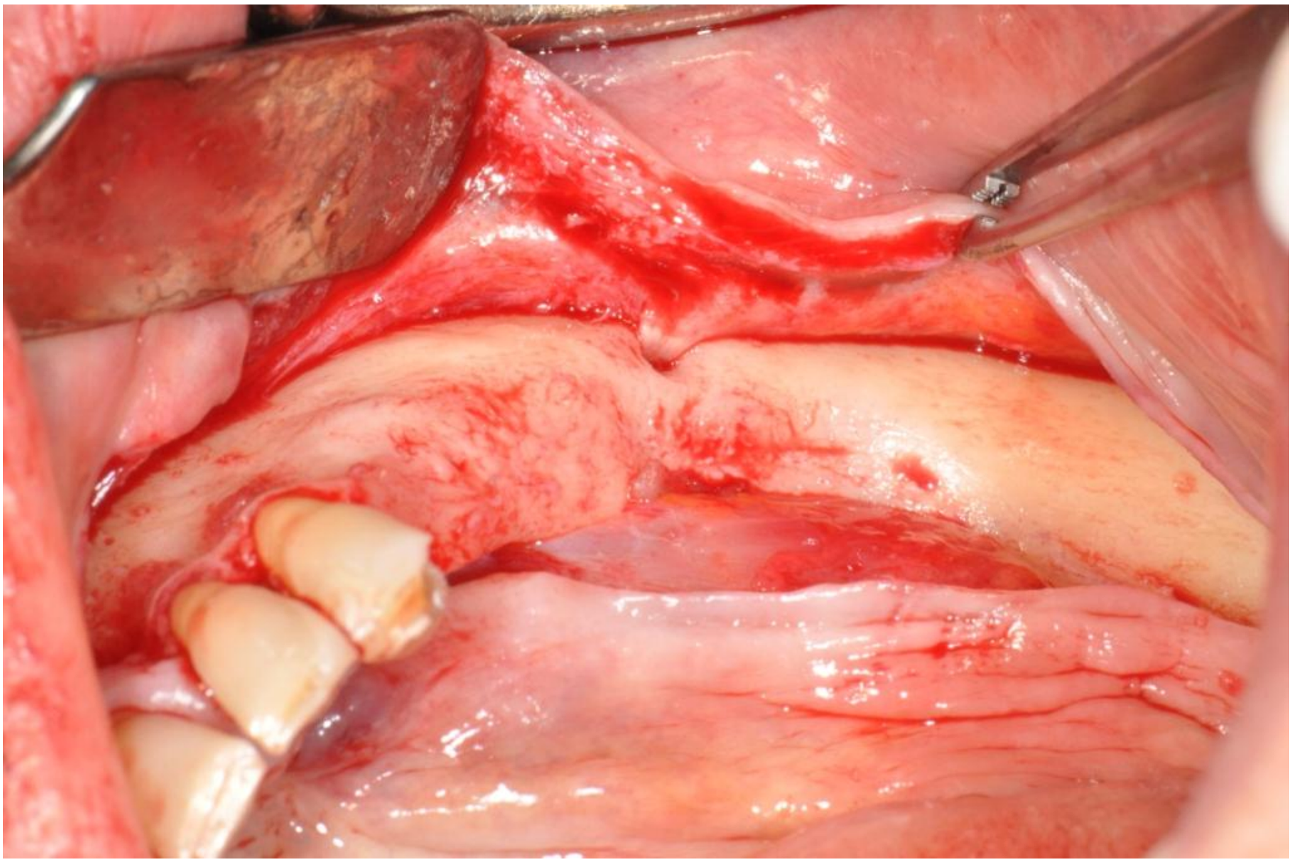

Fig.3

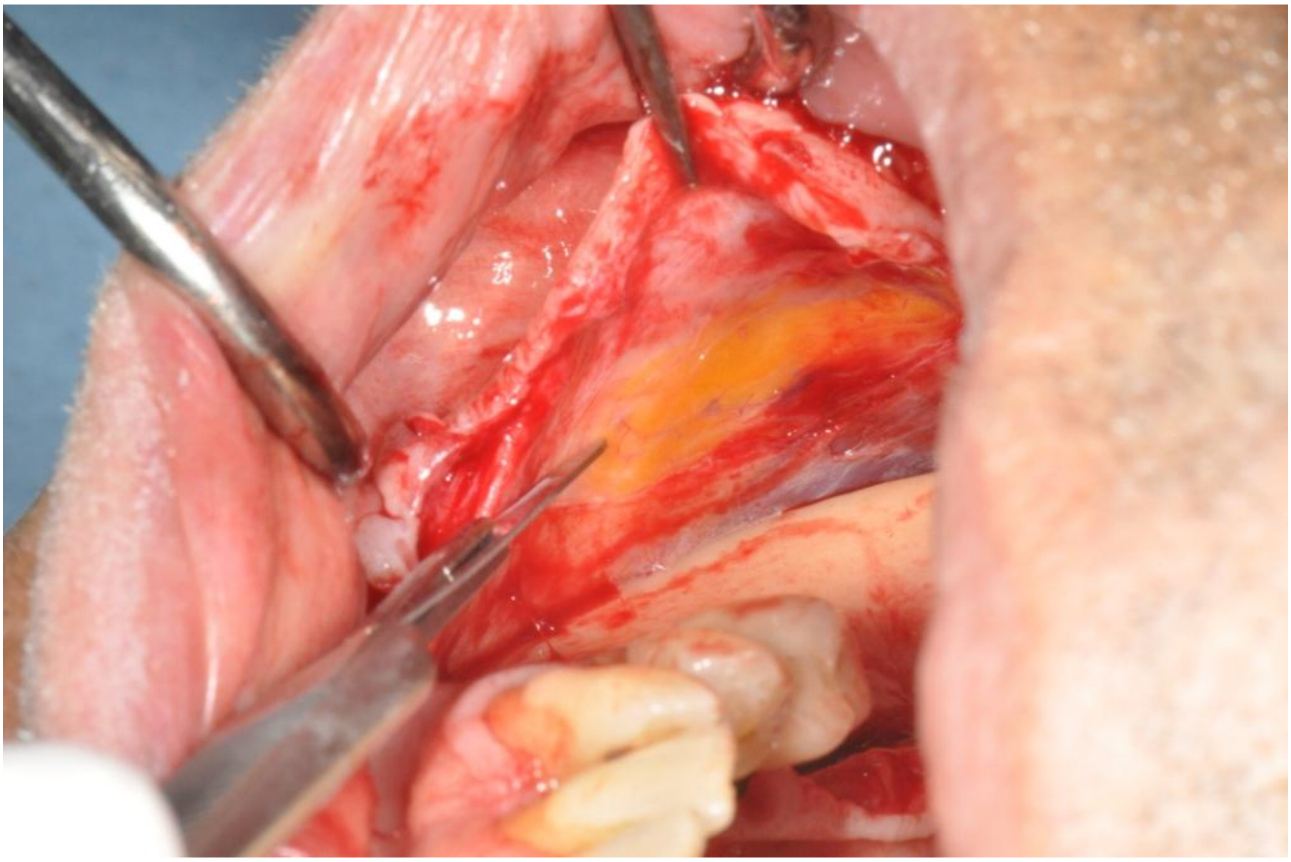

Fig.4

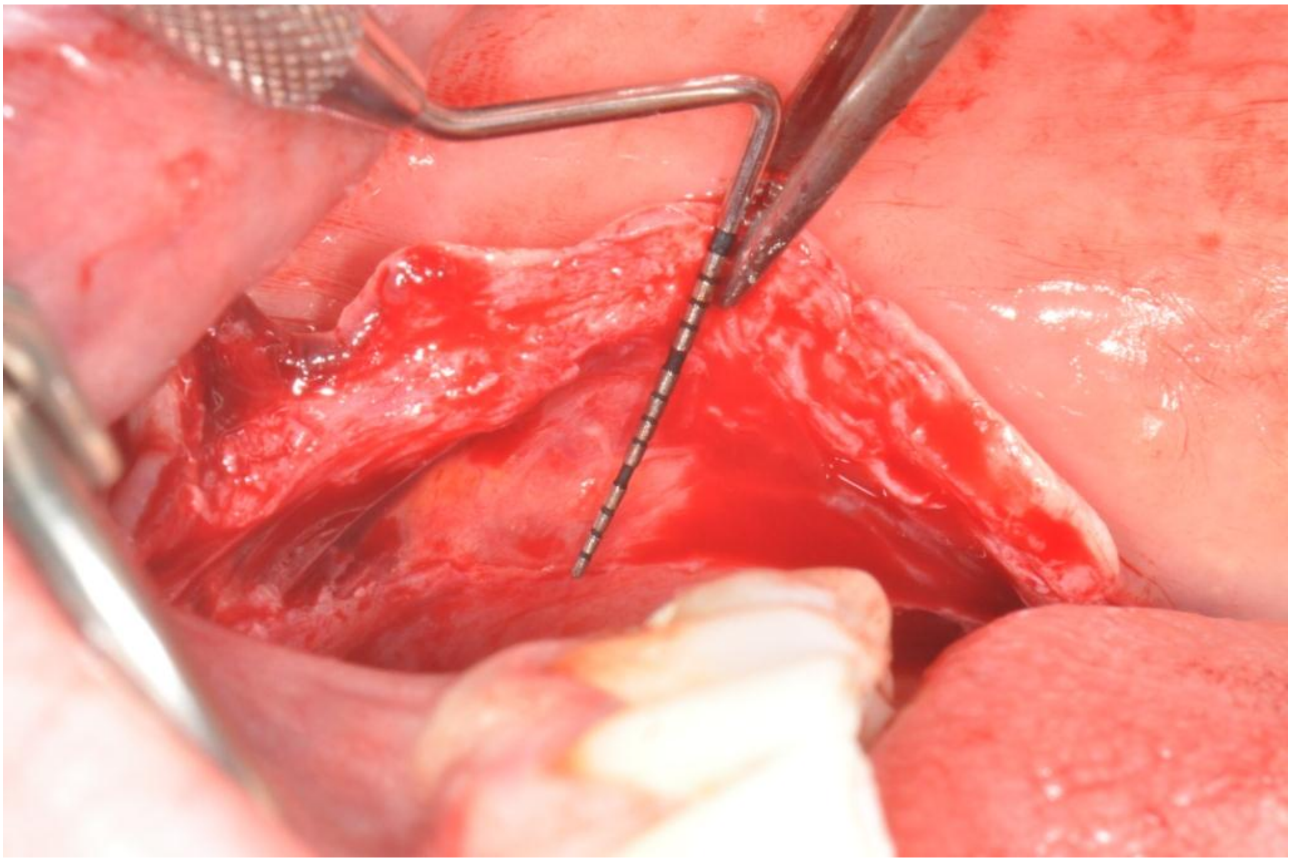

Fig.5

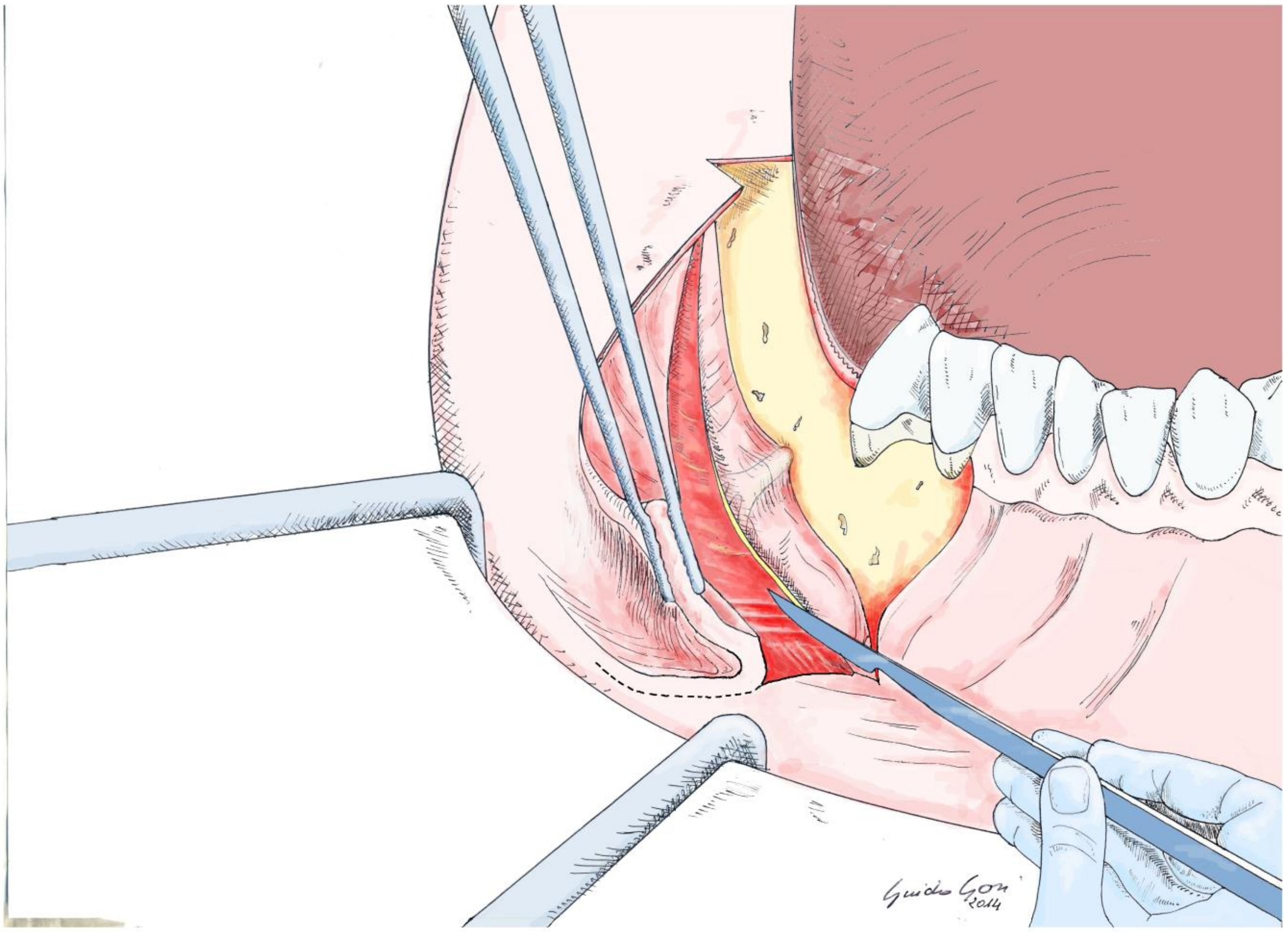

Fig.6

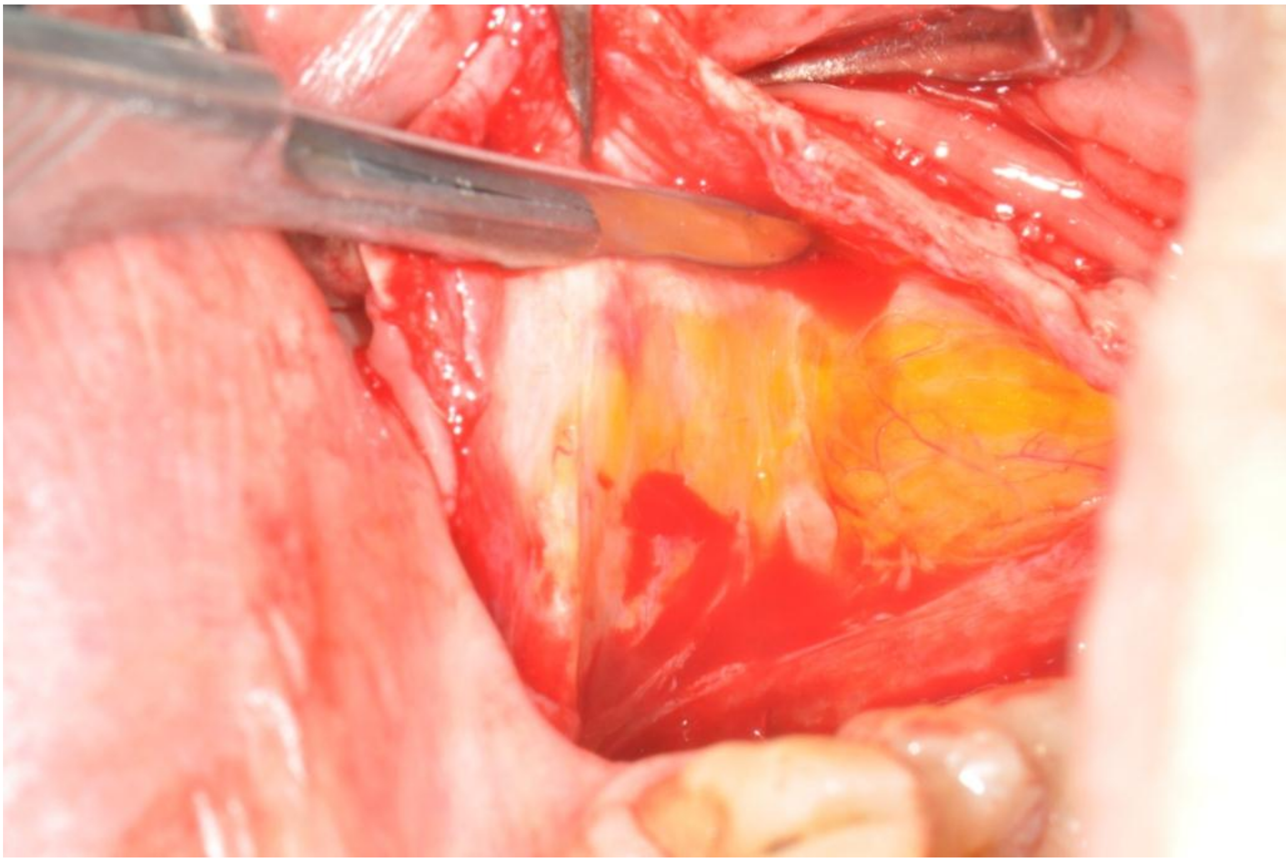

Fig.7

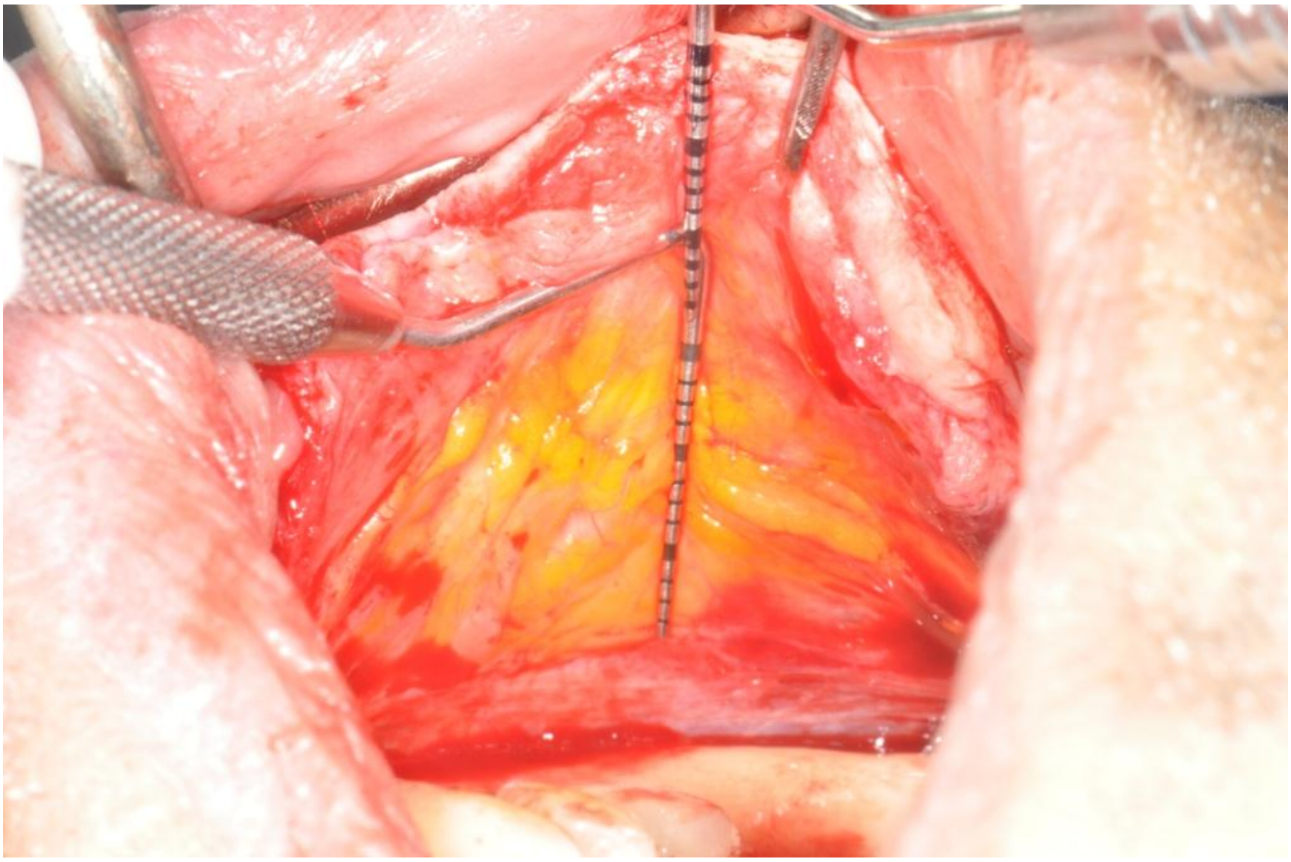

Fig.8

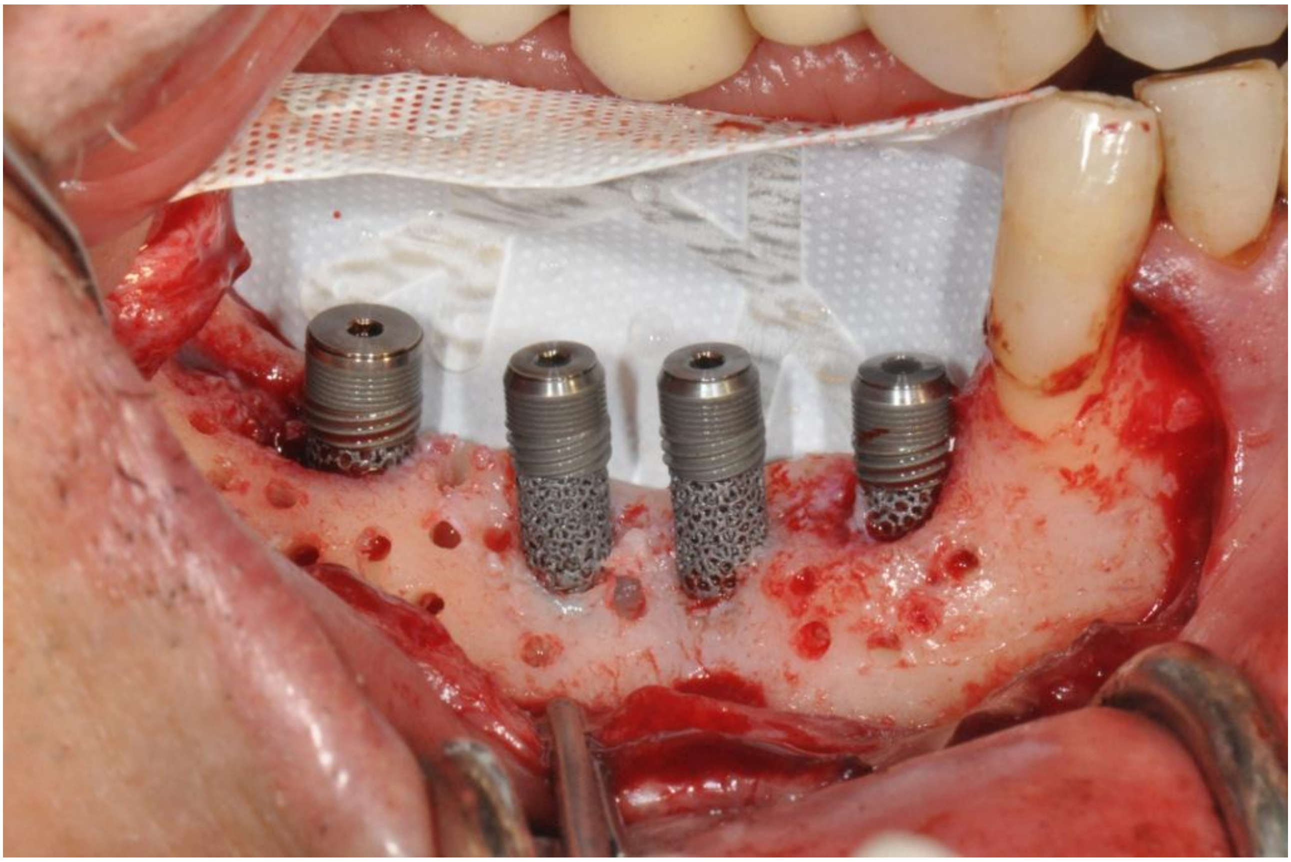

Fig.9

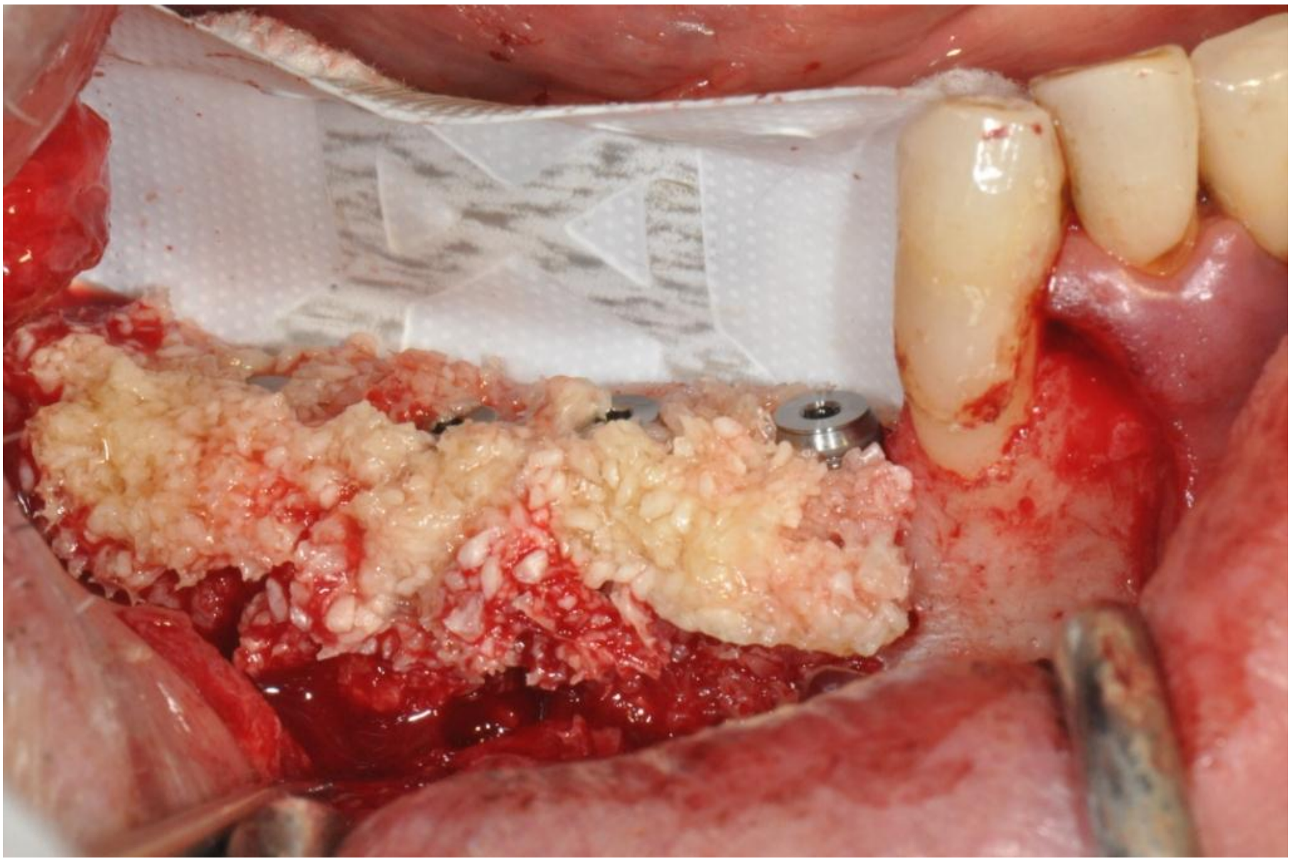

Fig.10

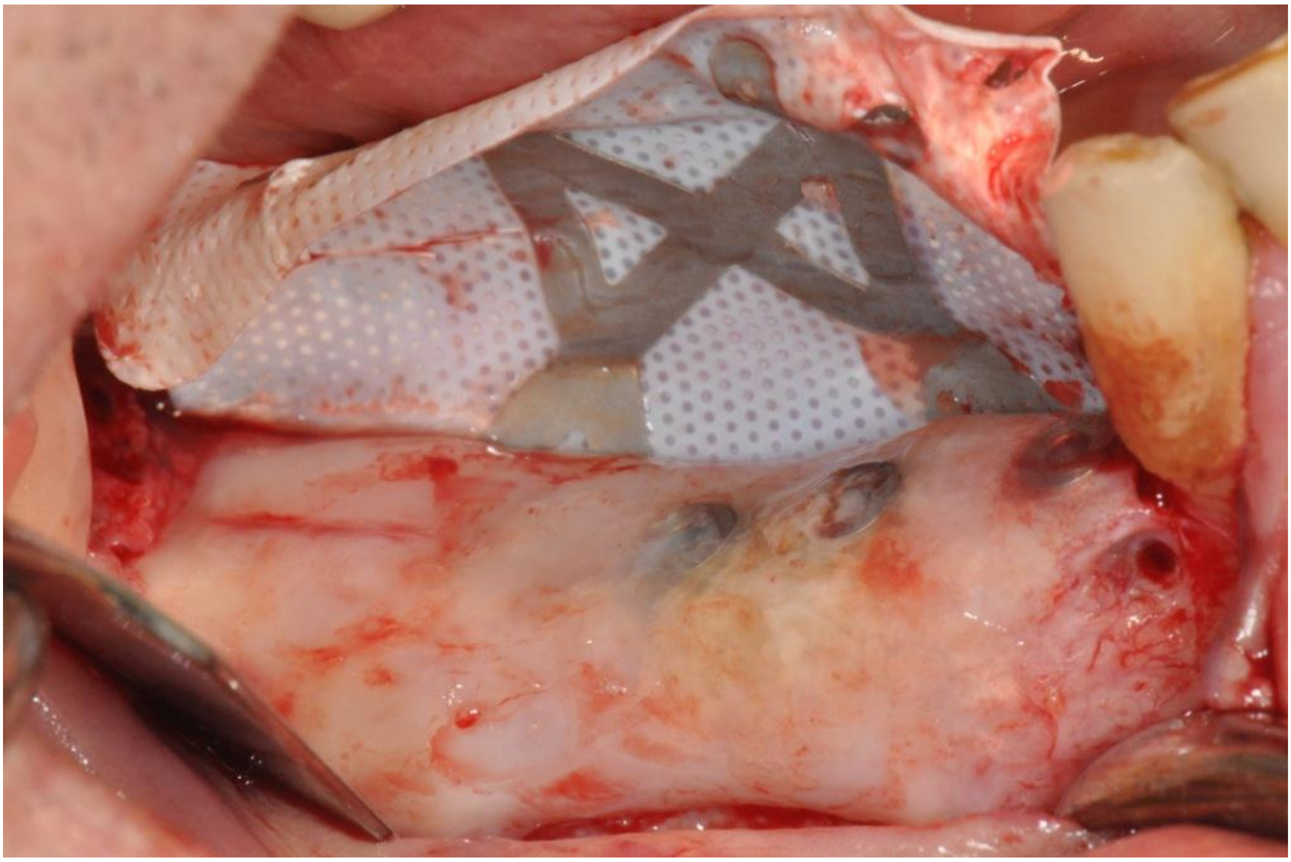

Fig.11

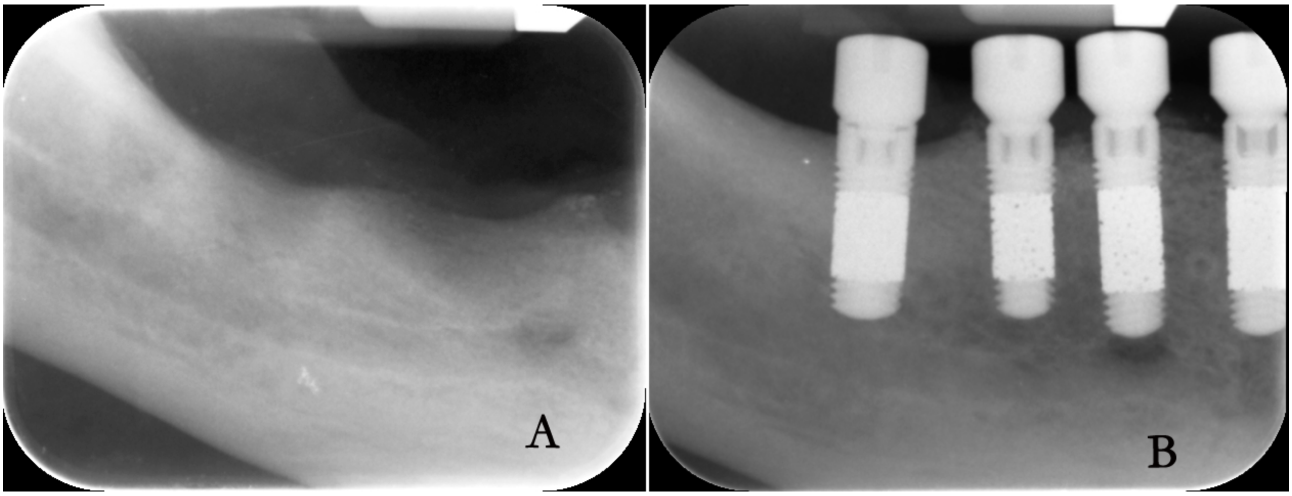

Fig.12