Original article

Management of soft tissues in bone regeneration/reconstruction using the modified double-flap incision technique. Periostium preservation technique

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ABSTRACT

Introduction: Implant techniques require the presence of bone structures that are adequate in quality and quantity in order to place osteointegrated fixations in a predictable manner. On occasions, the bone substrate is insufficient and bone reconstruction/regeneration techniques that require complete primary closure are needed in order to ensure success in the formation of new bone tissue. The purpose of this study is to describe a series of eight clinical cases in which the Modified Double-Flap Incision Technique was used to reconstruct areas of bone defect in the posterior mandibular region that limited placement of osteointegrated fixations.

Methods: This is a prospective study of eight clinical cases, from our private practice, with bone deficit in the posterior mandibular region, who required rehabilitation treatment with fixed implant-supported prosthetics. The Modified Double Flap Incision Technique (DFITm) was used in all cases.

Results: We achieved a complete primary closure at 15 days and proper placement of the implants in the regenerated area was possible in all cases.

Conclusion: The modified double flap incision technique allows to carry out adequate primary closure without tension in cases that require bone reconstruction or regeneration, avoiding the appearance of dehiscence that would lead to treatment failure.

KEYWORDS

Bone transplantation; Alveolar ridge augmentation; Surgical flaps; Dental implants.

INTRODUCTION

Implant techniques require the presence of bone structures that are adequate in quality and quantity in order to place osteointegrated fixations in a predictable manner. When the bone substrate is insufficient because of an esthetic problem, an anatomical circumstance (pneumatized maxillary sinus), a physiological circumstance (loss of bone volume secondary to tooth extraction) or because of sequelae from iatrogenic incidents (removal of infected dental implants), we need to use bone regeneration or reconstruction techniques.[1-7]

There are currently a large variety of predictable techniques[1-7]: bloc grafts, bone layers or split block bone technique (SBBT), osteoperiostial flaps, particulated grafts or guided tissue regeneration (GTR) techniques, among others. Professionals select a certain technique taking into account the type of defect, the esthetic requirements of the case and the patient's characteristics. In addition, other factors may also play a role like the surgeon's preferences, the type of practice (dental center, hospital center) or the patient's opinion.[1-5]

Regardless of all of these circumstances, bone regeneration will occur if the constructed matrix intended for transformation into bone tissue is perfectly isolated from the oral environment. This means that a complete primary closure is needed in order to ensure that the phenomena that would lead to new bone tissue take place.

For this purpose, several authors have proposed different incision and flap designs.[7-12;15-25] The double flap incision technique (DFIT)[9.10] has been shown to be particularly useful for regeneration in the posterior mandibular area with results comparable to other approaches. In addition, due to its characteristics, it appears to be especially useful in the dental clinic.

The present study describes a series of eight clinical cases in which the modified double flap incision technique was used to reconstruct areas of bone defect in the posterior mandibular region that limited placement of osteointegrated fixations.

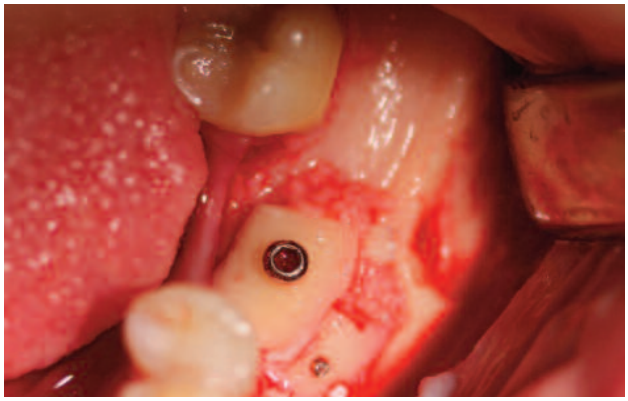

Figure 1. Bone reconstruction using the SBBT technique (clinical case 3).

Figure 2. Primary closure of the periostial layer of the double flap (clinical case 3).

Figure 3. Non-laminated autologous bone graft with microscrew for exclusively horizontal bone gain (clinical case 4).

MATERIALS AND METHODS

This is a prospective study of eight clinical cases, from our private practice, with bone deficit in the posterior mandibular region who require rehabilitation treatment with fixed implant-supported prosthetics.

Regarding sample selection criteria, none of the patients had pathology or treatments that could compromise the bone regeneration outcome (osteoporosis under bisphosphonate treatment, decompensated diabetes, patients undergoing oncology treatment, smokers of more than 10 cigarettes per day). The age of patients participating in the study ranged between 20 and 60 years.

In all cases, regeneration techniques were performed using bone obtained from the same incision, either from the external oblique line or from the retromolar zone.

In four defects with a vertical and horizontal component, a laminated bone graft (SBBT) was used with a 3D reconstruction similar to the Khoury technique[4] (Figures 1 and 2).

In three defects with a horizontal component, autologous blocks obtained without lamination were used, and they were fixed with micro-screws for exclusively horizontal bone gain (Figures 3 and 4).

In one defect with a vertical and horizontal component, an autologous bone block was used in the central zone, without laminating, and the areas lateral to the graft were filled with a mixture of autologous bone mixed with 50% bovine biomaterial (Figures 5, 6 and 7).

The Modified Double Flap Incision Technique (DFITm) was used in all cases. Compared to other techniques, it provides greater mobilization of the epithelial and connective tissues, favoring primary closure without tension. In addition, preservation of the periostium promotes vascularization of the bone graft and the flap created.[11]

Knowledge of oral mucosal histology is important for understanding this double flap. The most superficial part is the epithelial layer, which is bound to a deeper layer called the lamina propia (connective tissue) thanks to the basal membrane. The border between the lamina propia and the periostium is marked by the submucosal layer, which is not always well defined. Therefore, when practicing this surgical technique, we make two layers in which the most superficial one is made up of the epithelial tissue, basal membrane, lamina propia and submucosa, while the deepest plane consists exclusively of periostium.[12.13]

When performing a DFIT, first a partial thickness supraperiostial incision with mesial unloading is made and a mucosal flap is fashioned. After this step, another periostial flap is made by making a second incision, now deepened to the mandibular bone (Figure 8).

We prefer to modify the DFIT by first making a full-thickness mucoperiostial incision that can be accompanied by an accessory mesial unloading. We raise the flap to full thickness and identify the structures that we are interested in, thus being able to access and observe the mandibular branch and the external oblique line, there by facilitating the location of mental nerve foramen.

We then make an incision 2 mm away from the border of the flap, along its edge. This should only be periostial, and we free the periostial flap with a Buser or Back Action blunt separator. We prefer to make this modification (DFITm) because it is a faster and simpler procedure than fashioning the flap to partial thickness, especially because it minimizes the possibility of fenestration or tearing of the mucosal flap which, logically, has a very small thickness (Figure 9).

It is recommended that this double flap be made at the beginning of the operation, in order to achieve proper hemostatic management and, so the final suture maneuver and closure of the two planes are greatly simplified.

As we have already mentioned, this flap design achieves a wide surgical field with access to the external oblique line and/or retromolar zone from which the autologous graft can be easily obtained (Figures 10, 11 and 12).

After this step, we carry out the selected bone regeneration technique, we fix the grafts and place the absorbable membranes. There are arguments for and against their use.[26-31] We prefer to use them in order to help maintain the volume of regenerated bone tissue,

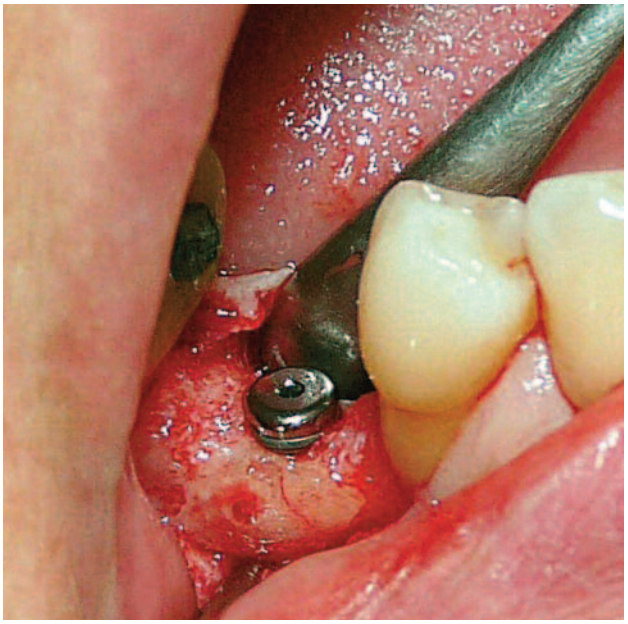

Figure 4. Reentry and placement of the implant in the most favorable prosthodontic position (clinical case 4).

decrease its resorption, help stabilize it in its immobilized position and avoid penetration of soft tissues.[26-31]

Finally, we proceed to close the periostial plane with absorbable 4-0 suture, trying to cover as much bone graft as possible. We suture the mucosal plane with 5-0 silk or 5-0 monofilament, which slides easily over the area to be regenerated, thereby allowing for a comfortable closure without tension on the area. We keep this suture for at least 15 days in order to ensure complete primary closure of the wound and to avoid dehiscence, which would lead to exposure of the graft

Table 1. Bone reconstruction/regeneration phase.

CASE	AGE	SURGICAL TECHNIQUE	TYPE OF DEFECT	NEUROLOGICAL/ INFECTIOUS COMPLICATIONS	PRIMARY CLOSURE (15 DAYS)
1	45	Non-laminated block	Horizontal	NO	YES
2	60	Non-laminated block and particulated graft (autologous+bovine)	Horizontal and vertical	NO	YES
3	42	SBBT	Horizontal and vertical	NO	YES
4	40	SBBT	Horizontal and vertical	NO	YES
5	50	Non-laminated block	Horizontal	NO	YES
6	47	SBBT	Horizontal and vertical	NO	YES
7	60	SBBT	Horizontal and vertical	NO	YES
8	47	Non-laminated block	Horizontal	NO	YES

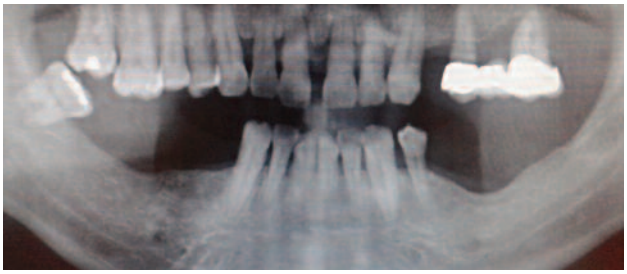

Figure 5. Initial situation of the vertical and horizontal bone defect in zone 34- 36 (clinical case 2).

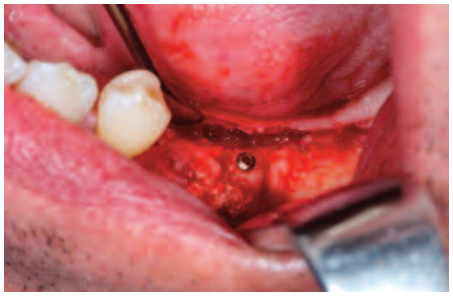

Figure 6. Situation at reentry of the area regenerated with a block of autologous bone, obtained from the external oblique line, placed in the center of the defect with a lateral filling of particulated autologous bone mixed with bovine biomaterial (clinical case 2).

Figure 7. Follow-up orthopantomography for monitoring of regeneration and implants at two years with no clear reabsorption (clinical case 2).

Figure 8. Double flap incision technique design. Image redrawn from the article by Ogata et al.9

Figure 9. Intraoperative image which shows the double flap obtained, revealing a mucous layer and another deep periostial layer.

Figure 10. With a single incision, we obtain an operative field that allows us to obtain the material from the autologous graft, as well as its fixation to resolve the bone defect present (clinical case 5).

Figure 11. Fixation of the autologous bone graft material (clinical case 5).

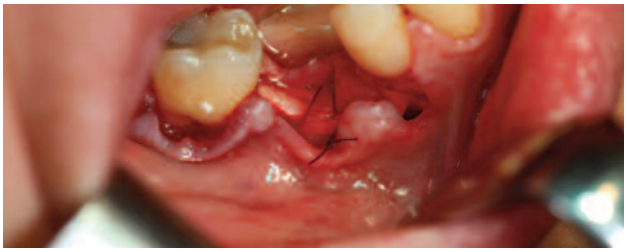

Figure 12. Suture of the periostial layer of the clinical case shown in figure 11 (clinical case 5).

material. The duration of surgery was less than one hour for all procedures (Figures 2 and 12).

Primary closure was evaluated at 15 days and considered complete when there was absence of dehiscence, signs of infection, inflammation or abnormal coloration. The

Figure 13. Reentry in which the proper state of the autologous bone block grafts is seen (clinical case 1).

occurrence of neurological complications of the inferior dental and mentonian nerves was assessed (anesthesia, hypoesthesia, paresthesia, disesthesia), as well as the presence of immediate infectious complications.

At 5 months after surgery, reentry was carried out in order to place the implants, and the volume and appearance of the regenerated bone (optimal/acceptable/inadequate) was evaluated. We also checked whether placing the implants in the regenerated area was possible, using prosthetic-guided criteria, graded as correct or incorrect, according to the need to regraft or use techniques with angled implants (Figures 13 and 14).

RESULTS

We achieved complete primary closure in all cases at 15 days, without any neurological or infectious complication (Table 1).

In seven cases, the volume of the regenerated bone tissue was considered optimal and in one case it was acceptable, as there was mild resorption of the graft caused by a small exposure of the head of the fixation screw in a block of laminate (SBBT) in the fourth month after surgery. This did not preclude precise placement of the bindings from a prosthodontic point of view (Figures 15 A and B).

Placement of the implants in the regenerated area, with prosthetically-guided criteria was possible in all cases, so it was not necessary to regraft or place the implants in an angled fashion in any of the operated cases (Figures 16, 17 A and B, 18 A, B and C) (Table 2).

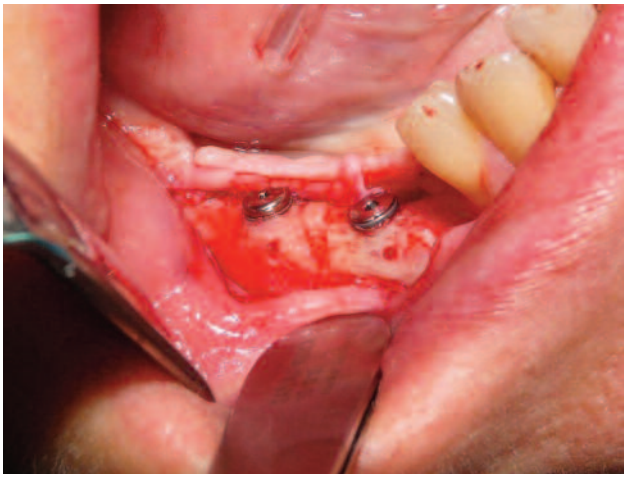

Figure 14. Placement of the implants in their ideal positions, following prosthodontic criteria, by having direct monitoring of the three-dimensional situation of the autologous bone grafts in the reconstructive phase (clinical case 1).

DISCUSSION

The incisions should always preserve the vascularization of the flap, paying special attention to the mandible due to its poorer irrigation. Given that it is a bone with a greater cortical component, special care is needed to avoid exposure of the grafted material. This is of greater importance in patients who are smokers and diabetics due to their known vascular deficiency and diminished healing ability.[33]

From this premise, it is possible to design any type of flap in the maxilla and mandible with the objective of allowing access to the area to be regenerated with a primarly closure of optimal quality. Several authors have made all types of proposals in search of this objective: Langer 1990[15] proposes a palate approach technique; Buser 1993[16] and 1995[17], Tinti and Parma-Befenati 1995[18], Fugazzotto 1999[19] propose a 3-4 mm horizontal incision in the oral vestibule, apical to the vertical unloading and away from it; Khoury 1999[34] proposes the two-incision consistent tunnel approach, one mesial and the other distal, through which two laminated blocks are introduced for reconstruction of bone defects, being especially indicated in the posterior mandibular sector; Cranin 2002[20] avoids making incisions in the periostium, so they make a partial-thickness incision below the mucogingival line that facilitates coronal advancement of the flap; Sclar 2003[21] proposes a biselated (45º-60º)

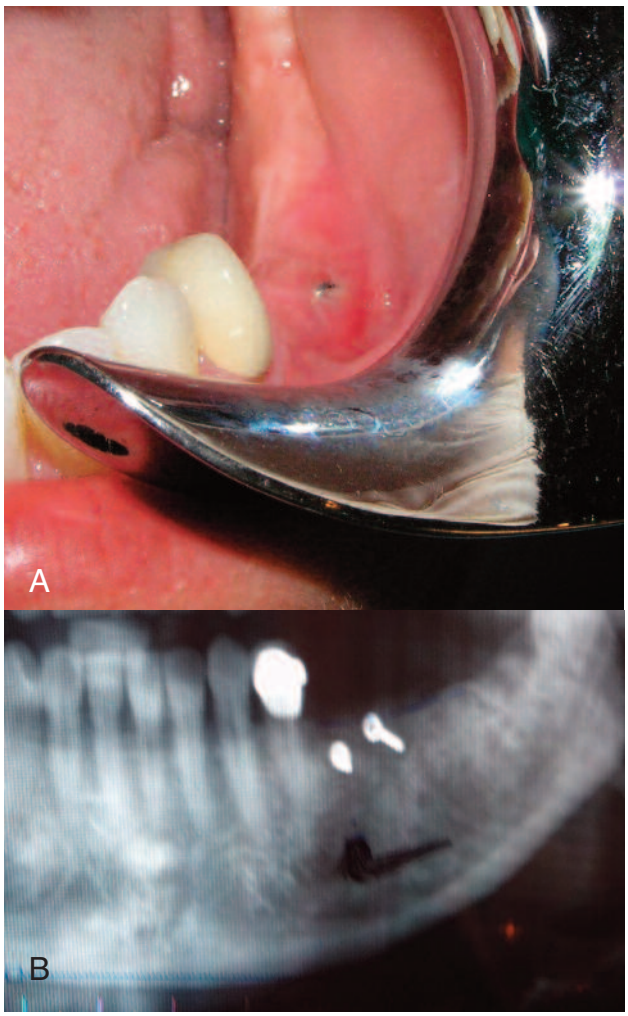

Figure 15. Clinical case 7. A, image in which minimal exposure of the head of the fixation screw is seen at the fourth postoperative month. B, radiographic follow-up image at the fourth postoperative month.

horizontal incision at the base of the vertical unloadings towards the center of the flap; Herford 2011[22] designs a flap of vascularized connective tissue by making incisions that separate the soft tissue, thereby increasing its quantity, promoting primary closure of the operative field; Ronda and Stacchi 2011[23] design a lingual advancement flap; Steigmann 2012[24] designs the "periosteal pocket flap" technique; Park 2012[25] uses the PRI technique with one or two vertical unloaded in order to achieve greater coronal advancement; Restoy 2015[7] proposes the use of an access and closure with two planes using the inverted technique (inverted double flap), similar to that proposed by Kan 2016[35] in

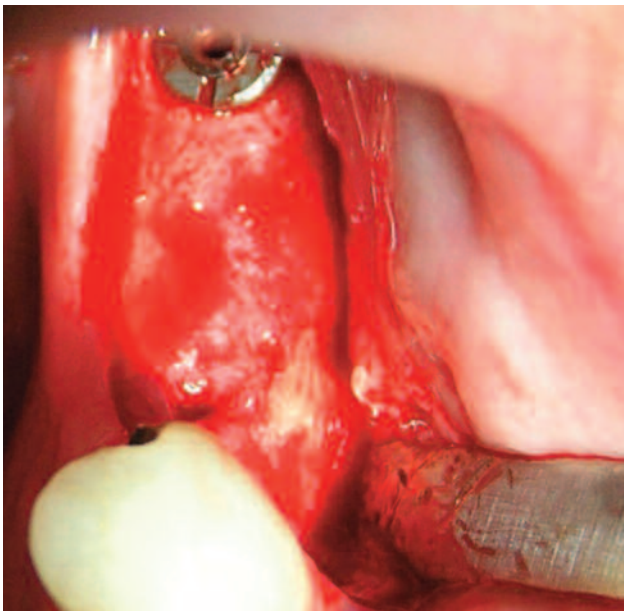

Figure 16. Reentry that allows for placement of the implants in the positions predetermined with prosthetic criteria (clinical case 7).

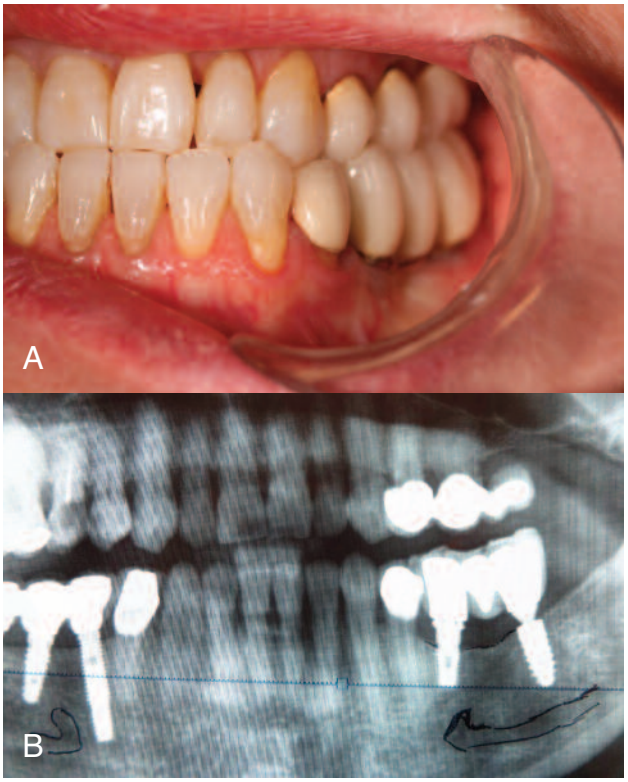

Figure 17. Clinical case 7. A, clinical follow-up at 4 years postop (3i Osseotite and Ankylos implants). B, radiological follow-up image at 4 years postop.

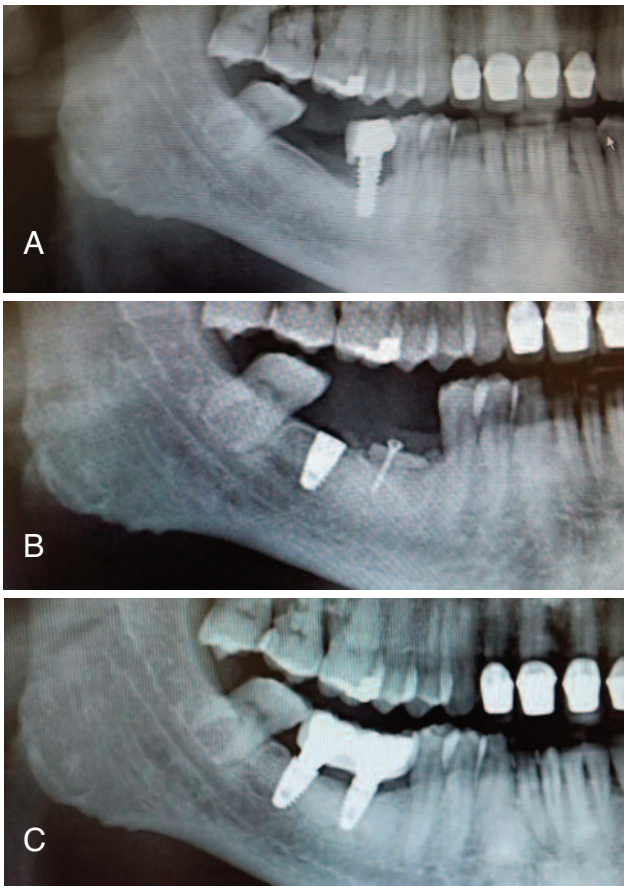

Figure 18. Clinical case 6 A, preoperative radiographic image in which it was decided to remove the implant in zone 46 in order to do a subsequent reconstruction with an autologous graft that would allow for the residual bone defect to be overcome. B, radiological image in which the autologous bone graft is seen. C, postoperative radiological image at one year of follow-up.

order to carry out extensive reconstructions in the maxilla with cranial bone.

The DFITm has shown better results compared to the displacement or a coronal reposition flap. The primary advantage of this surgical technique is the preservation of the periosteal vascularization, thereby avoiding deep incisions in the submucosa. For this reason, it achieves greater coronal advancement with less postoperative morbidity, thereby decreasing the incidence of dehiscence, necrosis and exposure of bone regeneration/reconstruction material.[8-10]

Regarding the lower postoperative morbidity for the patient, special mention should be made of the lower level of postoperative inflammation and edema shown by patients due to preservation of the periosteal vascularization.[8-10]

TABLE 2. IMPLANTATION PHASE

Case	Assessment (Integrated)	Reentry Assessment	Nº Implants Prosthodontics
1	OPTIMAL	46-47	CORRECT
2	OPTIMAL	34-35-36	CORRECT
3	OPTIMAL	36	CORRECT
4	OPTIMAL	46	CORRECT
5	OPTIMAL	45-46	CORRECT
6	OPTIMAL	46-47	CORRECT
7	ACCEPTABLE (MILD BONE REABSORPTION)	36-37	CORRECT
8	OPTIMAL	45	CORRECT

Regarding the tunneling technique[34], our technique appears to provide promising results that should ideally be confirmed in larger blinded trials. We believe it is particularly useful in cases of regeneration with a reduced vertical or exclusively horizontal component.

Among the advantages[8-10] it provides greater intraoperative safety due to direct vision and control of the foramen of the mentonian nerve; greater control of the position of the graft and the anatomy to be regenerated, which is very important for the subsequent placement of the implants under prosthodontic criteria, since it is not a blind technique. In addition, this is a less invasive surgical technique since the donor zone comes from the same surgical field, accessed by the same incision. It is also a technique that, though requiring delicate and expert handling of the soft tissue, is generally faster. All our cases were operated on in less than an hour. This is very useful for patients being operated exclusively under local anesthesia.

Finally, it should be noted that in those clinical cases in which the soft tissue is of reduced thickness, we are currently introducing modifications like the use of dermal membranes or thin layers of palate connective tissue that we place at the supraperiosteal level.

CONCLUSION

The modified double flap incision technique allows to carry out adequate primary closure without tension in cases that require bone reconstruction or regeneration, avoiding the appearance of dehiscence that would lead to treatment failure. In addition, this surgical technique is faster and safer compared to other techniques, since it allows for good visualization of the operative field, precise location of the mentonian foramen and adequate three-dimensional placement of the grafts, with proper positioning of the implants using prosthodontic criteria.

BIBLIOGRAPHY

1. Espósito M, Grusovin MG, Felice P, Karat- zopoulos G, Worthington HV, Coulthard P. Interventions for replacing missing teeth: horizontal and vertical bone augmentation techniques for dental implant treatment. Cochrane Database of Systematic Reviews. 2009, Issue 4. Art. No.: CD003607. DOI: 10.1002/14651858.CD003607.pub4
2. Rochietta I, Fontana F, Simion M. Clinical outcomes of vertical bone augmentation to enable dental implant placement: A systematic review. J Clin Periodontol 2008; 35: 203-215.
3. Aghaloo TL, Moy PK. Wich hard tissue augmentation techniques are the most succesful in furnishing bony support for implant placement? Int J Oral Maxillofac Implants 2007; 22(suppl): 49-70.
4. Khoury F, Hanser T. Mandibular bone block harvesting from the retromolar region: A 10-year prospective clinical study. Int J Oral Maxillofac Implants 2015; 30: 688-697.
5. Jensen O. The osteoperiosteal flap. A simplified approach to alveolar bone reconstruction. Chicago: Quintessence Publishing Co Inc; 2010.

6. Restoy Lozano A, Dominguez-Mompell J.L, Infante Cossio P, Lara Chao J, Espin Galvez F, López Pizarro V.M. Reconstruction of mandibular vertical defects for dental implants with autogenous bone block grafts using a tunnel approach: clinical study of 50 cases. Int J Oral Maxillofac Surg 2015; 44: 1416-1422.
7. Restoy Lozano A, Domínguez-Mompell J.L, Infante Cossio P, Lara Chao J, López Pizarro V.M. Calvarial Bone Grafting for Three-Dimensional Reconstruction of Severe Maxillary Defects: A Case Series. Int J Oral Maxillofac Implants 2015; 30: 880-890.
8. Romanos GE. Periosteal Releasing inci- sion for successful coverage of augmented sites. A technical note. J Oral Implantol 2010; 36(1): 25-30.
9. Ogata Y, Griffin TJ, Ko AC, Hur Y. Comparison of double-flap incisión to periosteal releasing incisión for flan advancement: A prospective clinical trial. Int J Oral Maxillofac Implants 2013; 28: 597-604.
10. Hur Y, Tsukiyama T, Yoon T, Griffin TJ. Double flap incision design for guided bone regeneration: A novel Technique and clinical considerations. J Periodontol 2010; 81:945-952.
11. 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.
12. Kleinheinz J, Büchter A, Kruse-lösler B, Weingart D, Joos U. Incision design in implant dentistry based on vascularization of the mucosa. Clin Oral Implants Res 2005;16: 518-523.
13. Garzón Bello IJ, Campos Muñoz A, Alamitos Mingorance M, Sánchez Quevedo MC. Estudio de los marcadores de diferenciación epitelial en mucosa oral construida por ingeniería tisular. Tesis Doctoral. Universidad de Granada, 2009.
14. Marzal Gamarra C, Bagán Sebastián JV, Vera Sempere FJ. Estudio de la mucosa oral en pacientes que emplean colutorios. Tesis Doctoral. Universidad de Valencia. 2012.
15. Langer B, Langer L. Overlapped flap: A surgical modification for implant fixture installation. Int J Periodontics Restorative Dent 1990; 10: 208-215.
16. Buser D, Dula K, Belser UC, Hirt HP, Berthold H. Localized ridge augmentation using guided bone regeneration. I. Surgical procedure in the maxilla. Int J Periodontics Restorative Dent 1993; 13: 29-45.
17. Buser D, Dula K, Belser UC, Hirt HP, Berthold H. Localized ridge augmentation using guided bone regeneration. II. Surgical procedure in the mandible. Int J Periodontics Restorative Dent 1995; 15: 10-19.
18. Tinti C, Parma-Benfenati S. Coronally positioned palatal sliding flap. Int J Periodontics Restorative Dent 1995; 15: 298-310.
19. Fugazzotto PA. Maintenance of soft tissue closure following guided bone regeneration: Technical considerations and report of 723 cases. J Periodontol 1999; 70:1085-1097.
20. Cranin AN. Implant surgery: The management of soft tissues. J Oral Implantol 2002;28: 230-237.
21. Sclar AG. Surgical techniques for management of peri implant soft tissues. In: Soft Tissue Esthetic Considerations in Implant Therapy. Chicago: Quintessence Books;2003: 47-51.
22. Herford AS, Cooper TC, Maiorana C, Cicciu M. Vascularized connective tissue flap for bone graft coverage. J Oral Implantol 2011; 37: 279-285.
23. 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.
24. Steigmann M, Salama M, Wang HL. Periosteal pocket flap for horizontal bone regeneration: A case series. Int J Periodontics Restorative Dent 2012; 32: 311-320.
25. Park JC, Kim CS, Choi SH, et al. Flap ex- tensión attained by vertical and periosteal releasing incisions: A prospective cohort study. Clin Oral Implants Res 2012; 23:993-998.
26. De Stavola L, Tunkel J. A new approach to maintenance of regenerated autogenous bone volume: Delayed relining with xenograft and resorbable membrane. Int J Oral Maxillofac Implants 2013; 28: 1062-1067.
27. Jensen SS, Terheyden H. Bone augmentation procedures in localized defects in the alveolar ridge: Clinical results with different bone grafts and bone-substitute materials. Int J Oral Maxillofac Implants 2009; 24(suppl): 218–236.
28. Donos N, Kostopoulos L, Karring T. Alveolar ridge augmentation using a resorbable copolymer membrane and autogenous bone grafts. An experimental study in the rat. Clin Oral Implants Res 2002; 13: 203–213.
29. Chiapasco M, Abati S, Romeo E, Vogel G. Clinical outcome of autogenous bone blocks or guided bone regeneration with e PTFE membranes for the reconstruction of narrow edentulous ridges. Clin Oral Implants Res 1999; 10: 278–288.
30. Antoun H, Sitbon JM, Martinez H, Missika P. A prospective randomized study comparing two techniques of bone augmentation: Onlay graft alone or associated with a membrane. Clin Oral Implants Res 2001;12: 632–639.
31. Proussaefs P, Lozada J. The use of resorbable collagen membrane in conjunction with autogenous bone graft and inorganic bovine mineral for buccal/labial alveolar ridge augmentation: A pilot study. J Prosthet Dent 2003; 90: 530–538.
32. Burchardt H. The biology of bone graft repair. Clin Orthop Relat Res 1983; 174: 28–42.
33. Khoury F, Hanser T, Khoury C, Neugebauer J, Terpelle T, Tunkel J, Zöller J. Bone augmentation in oral implantology. Chicago: Quintessence; 2010.
34. Khoury F. Augmentation osseuse et chirurgie implantaire. Implant 1999; 5: 221-37.
35. Kan B. A Flap Design for Alveolar Bone Augmentation: Inverted Double Flap. Implant Dent 2016; 25(4): 556-9.