

Indications of Free Grafts in Mandibular Reconstruction, after Removing Benign Tumors: Treatment Algorithm

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Background: Mandibular reconstruction has been the subject of much debate and research in the fields of maxillofacial surgery and head and neck surgery.

Materials and Methods: A retrospective observational study was undertaken with 14 patients diagnosed with benign tumorous pathologies and who underwent immediate mandibular resection and reconstruction at the Hospital del Salvador Maxillofacial Surgery Unit and Dr. Rodrigo Fariña's private clinic between the years 2002 and 2012. We propose a treatment algorithm, which is previous teeth extractions in area that will be removed.

Results: Fourteen patients underwent surgery, and a total of 40 dental implants were installed in 6 men and 8 women, the mean age of 33.5 (age range, 14–58 y). Reconstruction with iliac crest bone graft, and rehabilitation following this protocol (average of reconstruction was 8.7 cm), was successful with no complications at all in 12 patients. One patient had a minor complication, and the graft was partially reabsorbed because of communication of the graft with the oral cavity. This complication did not impede rehabilitation with dental implants. Another patient suffered the total loss of the graft due to infection because of dehiscence of oral mucosa and great communication with the mouth. Another iliac crest free graft reconstruction was undertaken 6 months later.

Conclusions: The scientific evidence suggests that mandibular reconstruction using free grafts following the removal of benign tumors is a biologically sustainable alternative. The critical factor to improve the prognosis of free grafts reconstruction in benign tumors is to have good quality soft tissue and avoid communication with the oral cavity. For this, it is vital to do dental extractions before removing the tumor. (*Plast Reconstr Surg Glob Open* 2016;4:e845; doi: 10.1097/GOX.0000000000000832; Published online 15 August 2016.)

Mandibular reconstruction has been the subject of much debate and research in the field of maxillofacial surgery and head and neck surgery. The removal of large tumorous lesions often leads to significant bone- and soft-tissue damage, with consequential esthetic and functional side effects.¹⁻³

The evolution of surgical techniques based on microvascular-free flaps has become the gold standard for extensive reconstruction. However, in specific cases, the technical difficulty of microsurgical reconstruction, the morbidity of the donor region, and mainly the lack of adequate bone height in the alveolar area for the subsequent rehabilitation with dental implants and prosthesis place this technique at a disadvantage when compared with free grafts.

MATERIALS AND METHODS

A retrospective observational study was undertaken on 14 patients diagnosed with benign tumorous pathologies and who underwent mandibular resection and immediate reconstruction (average, 8.7 cm) at the Hospital del Salvador Maxillofacial Surgery Unit and Dr. Rodrigo Fariña's private clinic between the years 2002 and 2012. The main author performed the surgeries in all patients.

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The patients underwent mandibular resection, the extent of which was first planned according to computed tomographic scan and the histological type. All patients underwent surgery following the protocol proposed below:

Protocol (algorithm is shown in Fig. 1):

Deciding safety margins according to the histopathology of the lesion and the subsequent extraction of the teeth in the area that will be removed.

Hermetic seal of the postexodontia alveolar defect and of the tumorous region, with mobilization of the periosteum and oral mucosa.

Reconstructive dental treatment and periodontal therapy if necessary, to minimize oral pathogenic bacterium.

The previously planned mandibular resection is undertaken with a cervicotomy after a period of 6 to 8 weeks, when the oral mucosa has healed, preventing communication with the oral cavity to reduce the risk of contamination and eventual infection of the free graft.

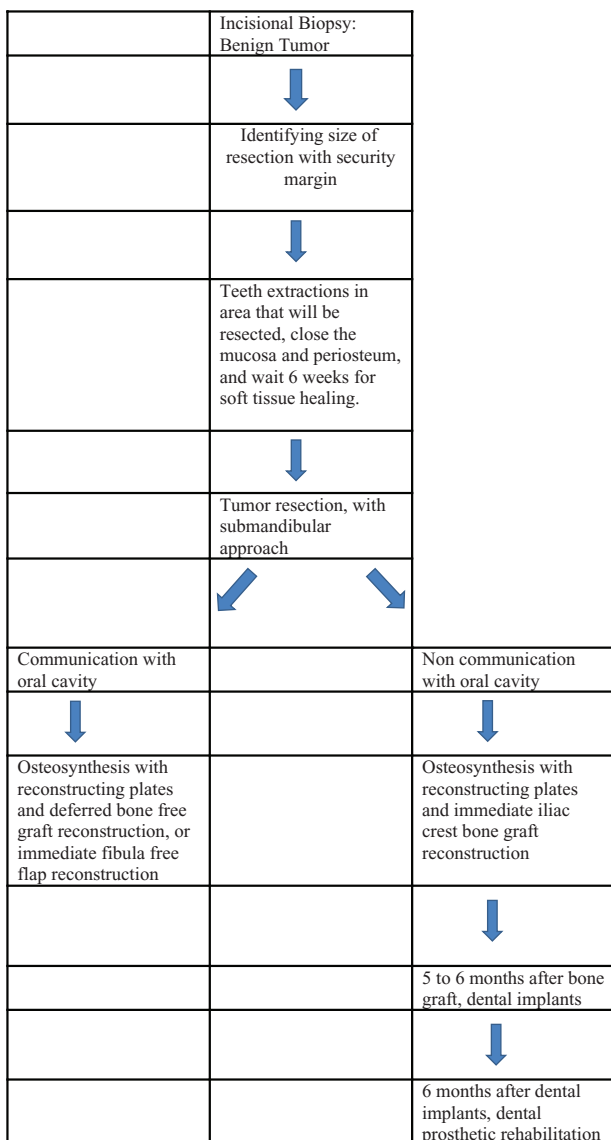


Fig. 1. Algorithm of resection and mandibular reconstruction in benign tumors.

The osteosynthesis elements are previously molded with stereolithographic models and transferred to the patient with a splint designed by Fariña et al⁴ (Figs. 2–4, patient 10). The resection and reconstruction are undertaken in the same surgical time with tricortical blocks of iliac crest and stabilizing the graft with 2.4 locking plates (Walter Lorenz).

Patients received intraoperative antibiotic of cefazolin and remained in postoperative antibiotherapy for 10 days with amoxicillin. Chlorhexidine mouthwashes were prescribed for a week. Panoramic x-ray or cone-beam imaging controls were undertaken 1 and 6 months after surgery.

Osseointegrated implants were installed 5 to 6 months post grafting operation, and dental prosthetic rehabilitation was undertaken 6 months after implants insertion. Postrehabilitation controls were held successively.



Fig. 2. Patient 10: stereolithographic model, reconstructing plate and the Fariña's splint.

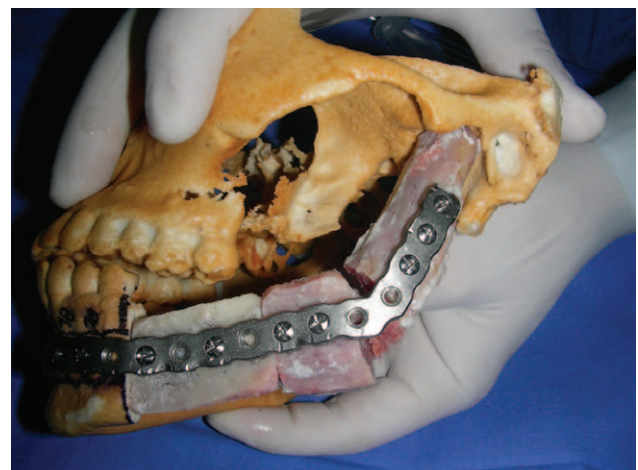


Fig. 3. Patient 10: iliac bone graft adapted to pre-molded reconstructing plate.

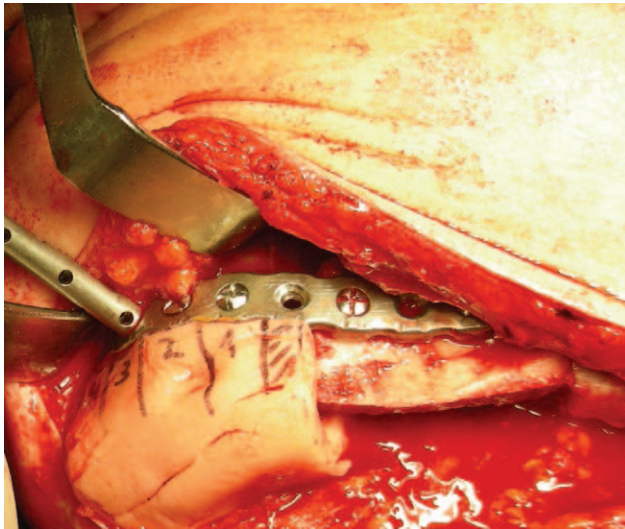


Fig. 4. Patient 10: fixing the plate and screws with the Fariña's splint.

This study was approved by the Hospital del Salvador ethics board.

RESULTS

Fourteen patients underwent surgery: 6 men and 8 women with an average age of 33.5 years, of whom 12 were successfully reconstructed and rehabilitated following this protocol with no complications at all. One patient had a minor complication, and the graft was partially reabsorbed (patient 10) because of communication of the graft with the oral cavity. This complication did not impede rehabilitation with dental implants. Another patient suffered a total loss of the graft due to infection because of dehiscence of oral mucosa and great communication with the mouth (patient 2). Another iliac crest free graft reconstruction was undertaken 6 months later.

A total of 40 dental implants were installed; 2 patients (patient 8 and patient 10) lost 1 implant each, a month after its installation. The average follow-up after dental rehabilitation was 60 months (24–120 mo). The quality of bone tissue found in the 14 reconstructions was of bone types II and III on the Lekholm and Zarb classification system⁵ (Table 1 and Figs. 5–17).

DISCUSSION

There are multiple fundamental factors to be considered when it comes to proposing a reconstruction, among which are the size and position of the defect, the quality of the remaining tissue (hard and soft), the quality of vascularization, the need for postoperative radiotherapy, and the patient's general condition. The final result is more affected by the reconstruction of soft tissue than by the bone reconstruction.^{6–8}

With regard to the free graft, several authors agree that it should be no longer than 6 cm. In our experience, the average of the grafts was 8.7 cm, and we performed 3 hemimandibular reconstructions with iliac crest bone free grafts (12, 13, and 14 cm, respectively), obtaining acceptable success rates in 2 of them. The loss of the graft in patient 2 was due to exposure to the oral cavity during surgery. The use of nonvascular grafts would be indicated for patients who do not require radiotherapy and have suitable quantity and quality of soft-tissue cover.^{8,9} Vu and Schmidt¹⁰ reported 17% failure rates in iliac crest grafts measuring more than 6 cm in length. Our failure rate was 1 patient (7.1%).

Regarding the morbidity of the donor area when we compare the removal of the nonvascular and vascular iliac crest graft, there are not many differences between the 2 techniques in terms of postoperative morbidity, except for the fact that the surgical access is larger than with vascular grafts.^{11–14}

With regard to the treatment of aggressive benign tumors, Simon et al¹⁵ affirmed that there is no lack of soft tis-

Table 1. Patient Distribution According to Sex, Age, Diagnosis, Affected Mandibular Area, Complications, Number of Dental Implants, Implants Lost, and Total Follow-up

Patient	Sex	Age	Diagnosis	Affected Mandibular Area/cm	Complication	Dental Implants	Lost Implant	Follow-up (mo) after Prosthetic Treatment
1	M	22	Ameloblastoma	Left body and angle/5	No	4	No	60
2	F	29	Ameloblastoma	Left hemimandibular with condyle/13	Lost the free graft, another graft was done 6 mo later	2	No	48
3	F	30	Ameloblastoma	Left body and angle/8	No	2	No	36
4	M	18	Ameloblastoma	Left body/6	No	2	No	40
5	M	55	Ossifying fibroma	Right body and angle/8	No	2	No	48
6	M	20	Aggressive ossifying fibroma	Right hemimandibular with condyle/12	No	3	No	72
7	F	34	Odontogenic myxoma	Left body and angle/9	No	4	No	108
8	F	42	Odontogenic myxoma	Left body and angle/8	No	4	1	78
9	M	52	Odontogenic myxoma	Symphysis/8	No	5	No	120
10	F	27	Chronic diffuse sclerosing osteomyelitis	Left hemimandibular with condyle/14	Partial reabsorption	3	1	84
11	F	58	Central giant-cell granuloma	Left body and angle/9	No	3	No	24
12	M	35	Central giant-cell granuloma	Right body/5	No	2	No	36
13	F	14	Aneurysmal bone cyst	Symphysis/9	No	4	No	96
14	F	21	Central giant-cell granuloma	Symphysis/8	No	4	No	26



Fig. 5. Patient 10: frontal view, 7-y follow-up.

sue because they act as tissue expanders. Mooren et al¹⁵⁻¹⁷ recommend the use of 2.3-mm reconstruction plates to keep the graft in place. In addition, they both argue that the defects should be no larger than 5cm to attain the highest success rate.

In the case of tumorous pathology reconstruction in minors, Troulis et al¹⁸ proposed a 4-phase framework in which resection and stabilization are carried out in the first step, reconstruction with an autogenic free graft in the second, insertion of dental implants in the third, and oral reha-

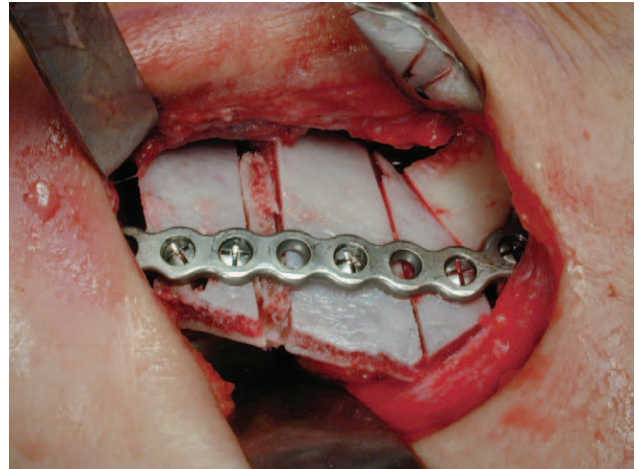


Fig. 7. Patient 7: iliac bone graft, after removal of odontogenic myxoma.

bilitation in the fourth. Their protocol expresses itself in favor of deferring bone reconstruction, because children have a far greater reparative potential, thus reducing the size of the initial deficit. In addition, the number of potential donor areas is smaller. In this way, along with the resection surgery, the segments are only stabilized with plates and screws. They undertake the reconstruction using nonvascularized iliac crest grafts in defects measuring less than 9 mm, consistent with the method used by Pogrel et al.⁹

August et al¹⁹ argue that there are several parameters to be analyzed regarding the long-term success of mandibular reconstruction. In their sample of 70 cases, of which 68 received nonvascular grafts and 2 vascularized ones, they proposed that the treatment's success was determined by a closed operation lesion, the absence of infection, continuity, bone stability, and maintenance of bone volume. Schliephake et al²⁰ report a fuller bone and facial contour with nonvascular iliac crest grafts and report that the long-term stability is similar, except for patients who have been

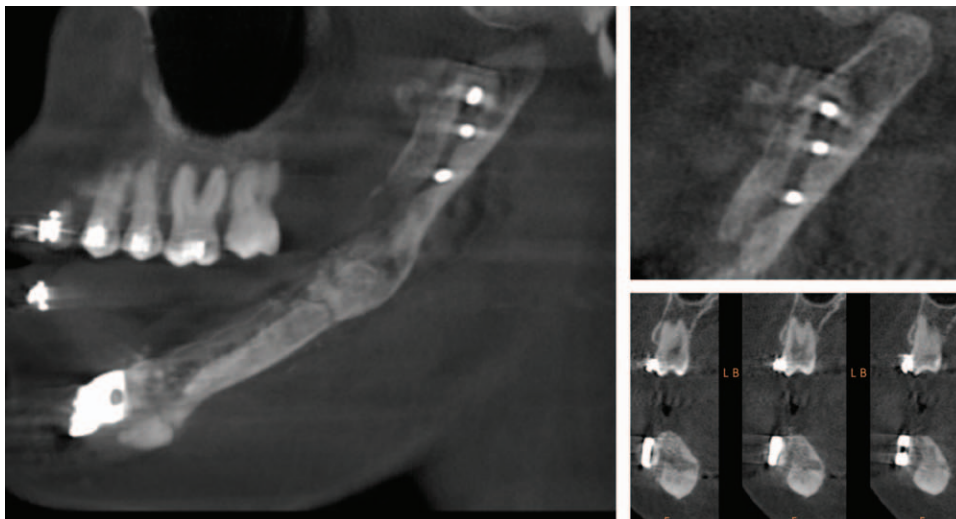


Fig. 6. Patient 10: cone-beam image of condyle reconstructed with iliac crest bone graft.



Fig. 8. Patient 7: x-ray of bone grafts (the image shows the cross section of bone).

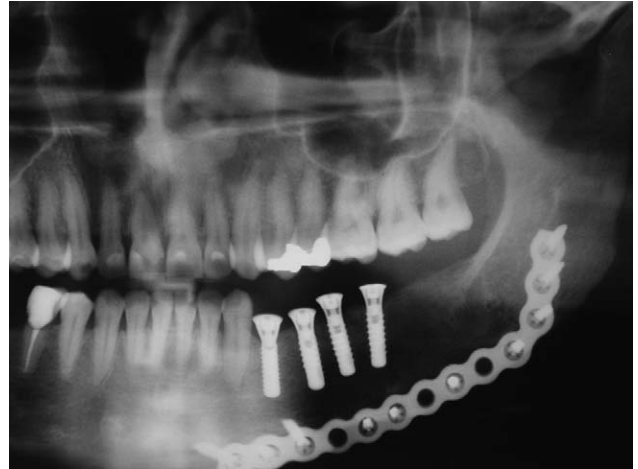


Fig. 11. Patient 7: x-ray of bone graft and 4 dental implants (the image does not show difference between the graft and the rest of the jaw).

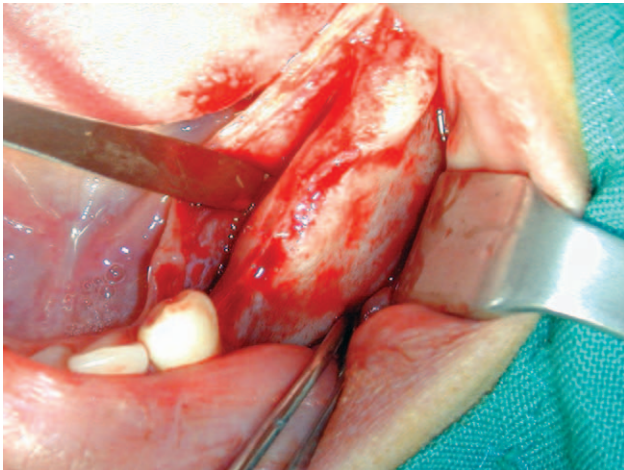


Fig. 9. Patient 7: 7 mo after grafting, implant surgery.



Fig. 12. Patient 7: frontal view, 9 y after surgery.



Fig. 10. Patient 7: 5 mo after dental implant surgery.

subjected to intense radiotherapy.²¹ August et al¹⁹ found that the success rate after a year was close to 70%, which is consistent with other authors.^{19,20}

The main failings are associated with 4 factors indicated as the being most important: the size of the reconstruction, abundant blood loss during the procedure, lack of postoperative antibiotic coverage, and complications in the receiving area. This is the case in our series, where the partial loss was due to the coverage failure where the graft



Fig. 13. Patient 7: occlusal view, 9 y after surgery.



Fig. 16. Patient 8: frontal view, 6 y after surgery.



Fig. 14. Patient 8: iliac bone grafting 2 mo after removal of tumor.



Fig. 17. Patient 8: occlusal view, 6 y after surgery.

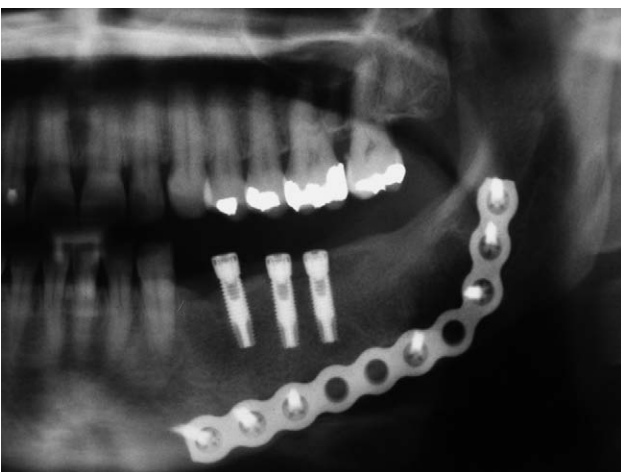


Fig. 15. Patient 8: 10 mo after grafting, inserted dental implants.

was exposed to the oral cavity and subsequently became infected.^{19,20}

Oral rehabilitation with dental implants in the reconstructed area has been analyzed by several authors, who have had different success rates after following cases over the long term.^{14,20,21} Schliephake et al²⁰ had a 100% success rate after 5 years and 60% after 10 years.

The loss of grafts was associated with nonvascular grafts in operative bases that received radiation before resection. Cheung and Leung^{22,23} report over 90% success on follow-up 50 months later. However, they associate the failures with grafts inserted in large reconstructions

and poor positioning. They both agree on the insertion of implants 6 months postresection and a minimum of 5 months for the subsequent implant connection. Our experience shows a 95% success rate with dental implants in the grafts (2 dental implants were lost) with an average follow-up of 60 months, after dental rehabilitation.

Rates of complications of fibula free grafts were described by Erdmann et al,²⁴ with 5% lost and 62% healed uneventfully. In our cases with iliac free grafts we had 7% lost; however, 85.7% healed uneventfully.

CONCLUSIONS

The scientific evidence suggests that mandibular reconstruction following the removal of benign tumors using free grafts is a biologically sustainable alternative.

The size is not a factor of success or failure.

A vital requirement to successfully keeping the free graft (nonvascularized) in mandibular reconstruction is to prevent its communication with the oral cavity, for which we propose teeth extractions in the area that will be removed, at least 6 weeks before tumor resection. The critical factor for improving the prognosis of free grafts reconstruction is to have good quality soft tissue and avoid communication with the oral cavity.

This type of treatment allows esthetic and functional rehabilitation and the subsequent insertion of dental implants.

The free graft is not indicated in patients with nonsuitable soft-tissue cover (quantity and quality) or in malignant tumors that were irradiated or will need radiotherapy.

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PATIENT CONSENT

Patients provided written consent for the use of their images.

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