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Reconstruction of maxillary ridge atrophy caused by dentoalveolar trauma, using autogenous block bone graft harvested from chin: a case report

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ABSTRACT

Background Dentoalveolar trauma, especially when involving front teeth, negatively affect the patient's life; in particular, tooth avulsion is a complex injury that affects multiple tissues, and no treatment option offers stable long-term outcomes. The aim of this study was to report a case of reconstruction of atrophic anterior alveolar ridge after tooth loss, performed with autograft harvested from the chin, and subsequent prosthetic rehabilitation with the use of an osseointegrated implant.
Case report A 23-years-old Caucasian girl, presented an atrophic alveolar bone in the area of tooth 11, as a result of tooth resorption 10 years after a tooth reimplantation procedure. Reconstruction was performed with autogenous bone harvested from the chin. After 6-months healing period to allow autograft incorporation, a dental implant was inserted. After further 6-months, a screw-retained implant supported metal-ceramic prosthesis was fabricated.
Results The prosthetic rehabilitation was successful, and after a follow-up period of 5 years, the achieved result was stable.
Conclusion It can be concluded that the autogenous bone graft harvested from the chin, is a safe and effective option for alveolar ridge defects reconstruction, allowing a subsequent placement of a dental implant supporting a prosthetic restoration.

KEYWORDS Autogenous bone graft; Dentoalveolar traumatism; Osseointegrated implants; Prosthetic rehabilitation; Tooth avulsion.

INTRODUCTION

Dentoalveolar traumas are very common, and mainly affect children and adolescents. The main causes are car accidents, sporting activities and aggressions. There are some predisposing factors for this condition, such as accentuated overjet, childhood obesity (1), upper lip incapable of covering the anterior teeth, and protrusion of the maxillary central incisor (2). The most common dento-alveolar traumas include fractures, luxations and tooth avulsion; the latter occurs when the tooth is completely forced out of its alveolar socket. The most conservative treatment for avulsion is tooth reimplantation; however, frequently this is not possible, leading to sequelae that include psychological effects on the patient, compromising oral function, esthetics and self-esteem (3), and biological damage to the hard and soft tissues of the affected region (4). Nevertheless, even when reimplantation is performed, the main and most likely complication is tooth resorption, which may trigger extensive bone resorption and severe atrophy of the maxilla (5). This condition makes implants insertion and prosthetic rehabilitations impossible or difficult. In these cases, bone regeneration procedures are mandatory to allow the implant placement in a correct tridimensional situation (6).
The goal of bone reconstructions by means of grafts is to re-establish adequate bone dimension, allowing correct rehabilitation with osseointegrated implants (7). Autogenic bone grafts are considered the gold standard among grafting materials in dentistry (8). This is due to their relative resistance to infection, incorporation by the host, without the occurrence of a foreign body reaction (9), in addition to osteogenic, osteoinductive and osteoconductive capacity (8). The

autogenous bone graft may be of trabecular, cortical or mixed (osseous coagulum and particulate bone) bone from an intra or extra-oral donor area (10). The main extra-oral donor sites are the iliac crest and calvarium, and the intra-oral sites are the chin, retromolar areas and maxillary tuberosity (11). The use of extra-oral areas involves extensive surgeries, greater morbidity and costs, requiring hospitalization of the patient (12), whereas grafts from intra-oral sources are obtained more easily due to the proximity between the donor and receptor sites, when possible under local anesthesia, and with less discomfort to the patient, in addition to a low resorption potential (8). On the other hand, the main disadvantage of using intra-oral donor areas is the limited quantity of bone tissue available (13).

One of the factors to be considered in the choice of donor area is the quantity of bone graft required. Among the intra-oral bone sites, the chin region is one of the most used, particularly in case of receptor areas that need a small quantity of bone volume and small augmentation of the alveolar ridge. The chin presents both cortical and medullary bone types, which ensure good incorporation, rapid revascularization and extremely little loss of grafted bone volume (8, 14). Moreover, it offers a thick block, larger bone volume, and moderate post-operative pain and edema, when compared with other intraoral donor areas (15). The limits of harvesting grafts from the mental symphysis are connected to the presence of the roots of teeth, mental foramen, inferior cortical and lingual cortical borders (16). One of the main limitations of this technique is the proximity to the mental nerve, that could be damaged and cause an alteration of sensitivity (8).

At present, there is great concern about the adequate placement of implants, allowing a more functional prosthetic rehabilitation from the biomechanical point of view, and enhanced esthetics, with benefits to the patient's self-esteem, and a high level of satisfaction. Therefore, the aim of this study was to report a case of reconstruction of atrophic anterior alveolar ridge, performed with autograft harvested from the chin, and rehabilitated with an implant-supported prosthesis.

CASE REPORT

Case history

A 23-year-old Caucasian girl, showed attendance at the clinic of Oral and Maxillofacial Surgery of the Araçatuba of Dental School – UNESP, in order to replace a partial fixed adhesive denture on teeth 12, 11, and 21 with an osseointegrated implant. There was absence of tooth 11, lost as a consequence of tooth resorption: the patient had suffered a tooth avulsion at the age of 10 years. On the day of the avulsion the tooth was reimplanted by a dental surgeon specialized in Pediatric Dentistry, in the city where the patient

FIG. 1A Adhesive partial denture.

FIG. 1B Bone thickness defect.

FIG. 2 Initial panoramic radiograph.

was born. She reported that, at that time, the protocol for late reimplantation was performed, with surface treatment of the tooth, endodontic treatment and definitive restoration at the site of the coronal opening. Nine years after, tooth 11 was lost as related by the patient, because it had become mobile, with presence of a purulent exudate. The surgical procedure for extraction was performed by the same clinician and an adhesive fixed partial denture was fabricated on tooth 11, with adhesive abutments on teeth 12 and 21 (Fig. 1a).

The patient reported to have used the denture up to the moment of referral, but she complained about the difficulty of cleaning it, and exacerbation of the nasal filter sinking due to the alveolar bone resorption in correspondence of tooth 11.

During the clinical intra-oral examination, bone resorption of the vestibular wall was observed, in correspondence of the missing tooth (Fig. 1b). A panoramic radiograph was requested (Fig. 2), in which

FIG. 3A Mucoperiosteal Incision.

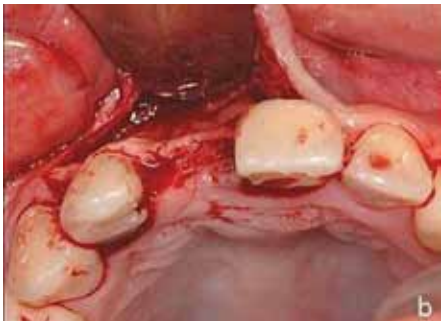

FIG. 3B Vestibular wall thickness.

it was possible to observe bone tissue without signs of bone rarefaction, with preserved bone height between the alveolar crest and floor of the nasal fossa.
Complementary exams were requested in order to evaluate the patient's general state of health, which included hemogram, complete coagulogram, fasting glycemia, urea, creatinine and electrolyte dosages (Sodium, Potassium and Calcium); thus, the patient was graded into surgical risk ASA I, in accordance with the American Society of Anesthesiologists (1963). Reconstruction of the alveolar ridge corresponding to tooth 11 was planned, by means of an autogenous bone graft harvested from the chin, with an implant supported prosthetic rehabilitation to be performed at a later date.
After the pre-operative review, on the day of surgery, the patient received preventive antibiotic therapy of 2g of Amoxicillin (Amoxicilina, Eurofarma, São Paulo, Brazil) and 5 mg of Diazepam (Valium, Products Roche Chemistry and Pharmaceutics, Rio de Janeiro, Brazil) to control anxiety, in addition to verbal tranquilization throughout the surgical procedure.

Surgical technique

The surgical procedure began with intra-oral antisepsis with 0.12% chlorhexidine digluconate (Periogard, P&G, São Paulo, Brazil), and extra-orally with topical application of 10% PVPI (Riodeine, Rioquímica, São José do Rio Preto), and apposition of sterile fields. Anesthesia was performed with bilateral regional block of the anterior middle superior alveolar nerve, and of the nasopalatine nerve in the maxilla.
Similarly, bilateral pterygo-mandibular anesthesia was performed by means of the Smith technique of 3 positions (17), in the mandible. In addition, subperiosteal infiltrative terminal anesthesia was also performed in the vestibule of the anterior regions of the maxilla and mandible with the intention of curbing possible hemorrhages.
Surgical access began in the receptor area with a Newman mucoperiosteal incision using a scalpel blade (15s, Feather, Feather Safety, Japan) mounted in a scalpel handle (Hu-Friedy, Berlin, Germany), for detachment and exposure of the receptor site (Fig 3a). Extensive bone resorption was observed in the vestibular-palatine direction, proved by the thinness of the receptor site (Fig. 3b). Decortication of the vestibular bone plate was performed by means of a Maxicut spherical bur (Edenta, Zahn-Labor, Labordental, São Paulo, Brazil) and perforations with Bur 702 (Maillefer Instruments, Ballaigues, Switzerland), mounted in a straight multiplicator handpiece (Kavo do Brasil, Joinvile, Brazil) with electric motor (Kavo do Brasil, Joinvile, Brazil), under constant irrigation with 0.9% physiological solution (Darrow, Rio de Janeiro, Brazil).
An incision was made in the mucosa at the depth of the anterior vestibular fornix, then a perpendicular muco-periosteal incision to detach and expose the chin donor area was performed (Fig. 4a). The size of the graft necessary for the reconstruction was delimited in the donor area (Fig 4b), followed by monocortical osteotomy (Fig. 4c), performed with Bur 702. The monocortical block bone graft was removed with the aid of Wagner chisels and hammer (Quinelato, São Carlos, Brazil), as shown in Figure 4d. The recipient site was shaped for passive graft accommodation insertion (Fig. 5a) and fixation by means of 2 bicortical screws measuring 1.3x11.0 mm (SIN, Sistema de Implante Nacional, São Paulo, Brazil) (Fig. 5b). The desired thickness achieved after performing the graft can be noted (Fig. 5c). Then, the sharp angles were rounded off in order to avoid possible exposure and/or fenestrations and the area was sutured with simple "U"-shaped stiches, using 5.0 nylon thread (Mononylon, Ethicon, Johnson, São José dos Campos, Brazil). Moreover, the acute edges of the donor area were rounded off; the muscle plane was sutured with Polyglactin thread 910 (Vicryl 5.0, Ethicon, Johnson, São José dos Campos, Brazil) and the mucosal plane with 5.0 nylon thread (Fig. 5d).
After suturing, a compressive micropore dressing was placed (Johnson & Johnson, São José dos Campos, Brazil) on the chin and upper lip, and kept in place for 24 hours. A maintenance therapy prescription was prescribed, with 500 mg Amoxicillin (Amoxicilina, Eurofarma, São Paulo, Brazil) every 8h for 7 days, 100mg Nimesulide (Nimessulida, Medley, Campinas, Brazil) every 12h for 3 days, in addition to pain control with 500 mg Sodium Dipyrone (Dipirona Sódica, Eurofarma, São Paulo, Brazil) every 6h in case of pain. Furthermore, the patient was instructed to perform a careful oral hygiene with moderate topical

FIG. 4A Access to donor site.

FIG. 4B Delimitation of bone graft.

FIG. 4C Osteotomy of bone graft.

FIG. 4D Removal of bone graft by means of chisels.

FIG. 5A Passive accommodation of bone graft in receptor area.

FIG. 5B Fixation of bone graft in receptor area.

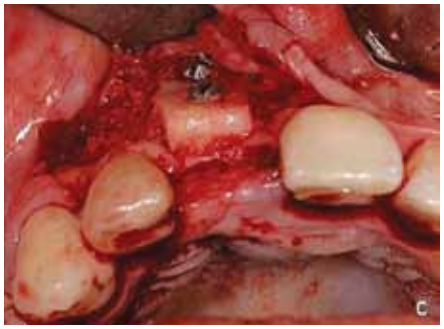

FIG. 5C Desired thickness achieved.

FIG. 5D Suturing of receptor and donor areas.

mouth washes with 0.12% Chlorhexidine Digluconate (Periogard, P&G, São Paulo, Brazil) starting on the day after surgery. On the same day, the adhesive prosthesis was bonded with resin cement.

After 14 days, the sutures were removed and the wound was inspected to detect any infections and dehiscences. The patient was visited at least once per month until implant surgery.

Implant placement

After 6 months the patient was submitted to the same pre-operative and surgical procedures, as previously described. After exposure of the reconstructed area, the 2 bicortical stabilization screws of the graft were removed and remodeling of the bone graft in the reconstructed area was observed (Fig. 6). The bone graft was fixed to the residual bone with absence of mobility, indicating that incorporation had occurred. Therefore, in this area, a cylindrical dental implant with a hexagon connection (SIN, Sistema de Implante Nacional, São Paulo, Brazil) measuring 4.0x13.0 mm was placed (Fig. 7). Thus, the patient's adhesive denture was bonded with resin cement, in order to avoid any interference in the peri-implant mucosa.

FIG. 6 Remodeling of bone graft after 6 months.

FIG. 7 Implant placement.

FIG. 8 Provisional resin composite denture on implant.

Suture removal was performed 7 days after implant placement.

Prosthetic rehabilitation

After further 6 months, a new panoramic radiograph was taken to evaluate the implant osseointegration, and the absence of bone resorption. Re-opening of the implant site was performed, and transfer molding with square transfer coping (SIN, Sistema de Implante Nacional, São Paulo, Brasil) was placed. A provisional screw-retained resin denture (Fig. 8) was screwed with a torque of 10 N/cm. Then, a definitive metal ceramic screw-retained denture was delivered.

Surgical reconstruction

There was incorporation of the block bone graft harvested from chin in the receptor site (maxilla), as the clinical and radiographical results showed:

- Absence of persistent pain, dysesthesia or infection with suppuration in the donor site or reconstructed area.
- Absence of bone graft mobility during implant placement.
- Absence of bone resorption of the graft.

Implant osseointegration

There was successful implant osseointegration into the area reconstructed with the autogenous block bone graft harvested from chin, as the clinical and radiographical results satisfied the criteria for evaluation of implant survival suggested by Chiapasco et al. (18):

- Absence of persistent pain or dysesthesia;
- Absence of peri-implant infection with suppuration;
- Absence of vertical or horizontal implant mobility after masticatory force;
- Absence of continuous peri-implant radiolucency.

Prosthetic results

After a follow-up period of 5 years, stability of the result achieved was assessed by means of clinical (Fig. 9) and radiographical (Fig. 10) evaluation.

DISCUSSION

The most conservative treatment for tooth avulsion is tooth reimplantation (5), with success rate ranging from 4% to 50% (19). When failure occurs, it is almost always associated with tooth and bone resorption (4); these bone defects are not only due to dento-alveolar traumas, but also could be a consequence of diseases, surgeries, tooth extractions or physiological resorption that may affect bone quantity, height and volume (7). The most common surgical procedure for reconstruction

FIG. 9 Screw-retained definitive crown after five years follow-up.

FIG. 10 Five years follow-up panoramic radiograph.

of such areas is bone grafting, for which materials of autogenous, allogeneic, xenogenic and synthetic origin are used. In this case report, autologous bone was chosen due to its osteogenicity. In the literature, autogenous bone grafting has been established as the best material for reconstructions, because it has live immunocompatible bone cells that are essential in the early stages of osteogenesis (20) and allows a better incorporation into the receptor site (8).

Among the donor areas for autografts, intraoral sites are preferred to extraoral ones due to their convenient access, proximity between the donor and receptor sites, lower degree of morbidity after graft harvesting and minimum discomfort to the patient (21). However, in some cases it is not possible to use intraoral donor areas, particularly when a large quantity of bone is required. In case of single tooth area replacement, partial anterior reconstructions, or sinus membrane elevation in a single maxillary sinus (14, 22), the intraoral donor site provides a sufficient quantity of bone to reconstruct the alveolar defect.

Some authors (23, 24) reported that bone harvested from the mandible offers benefits inherent to its embryological origin, such as small loss of grafted bone volume and good incorporation into the host. Moreover, others authors (25, 26) showed that a low level of grafted bone resorption occurs due to the microarchitecture of the mandibular cortical and trabecular bone plates. In the present case report, there was a considerable bone graft remodeling due the receptor site condition, where a high level of bone resorption occurred as a result of dento-alveolar trauma. A previous study (27) reported that bone resorption level after alveolar ridge (maxillary sites) augmentation with mandibular block bone graft represents 20% of initial volume for lateral augmentation and up to 41.5% in case of vertical augmentation.

The chin region as a donor site in bone grafting procedures offers a low degree of morbidity (28), relatively good bone quantity and quality due to the presence of cortical and medullary bone (21), in addition to a small loss of bone volume when grafted. In this case report, the chin was used as donor site due to the cortical-medullary anatomic characteristics of the graft, thus providing a reconstruction with greater bone volume in the reconstructed area, where there was extensive bone resorption.

For a good integration of the grafted bone tissue into the receptor bed and its good vascularization (29), the surgical site should be immobilized, avoiding obstacles during its healing phase. The placement of a temporary prosthetic (adhesive fixed denture), both during graft incorporation and implant osseointegration, allowed healing of the treated site without interferences or loading.

Implant placement soon after incorporation of the graft has a stimulating effect on bone, maintaining its volume and preventing subsequent bone loss (12, 30). For this reason, in the case here reported, the implant was placed six months after the bone graft, which corresponded to the final stage of autogenous bone grafts incorporation (8). In relation to the success of bone grafting procedures, many studies report that surgical techniques performed, donor site, recovery time, and time of implant placement are also crucial.

CONCLUSION

It can be concluded that the autogenous bone graft harvested from the chin is a safe and effective option for alveolar ridge defects reconstruction, allowing a further placement of dental implant supporting a prosthetic restoration.

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