Case Report - Implant

Reconstruction of alveolar bone defect with autogenous bone particles and osseointegrated implants: Histologic analysis and 10 years monitoring

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Paulo Sérgio Perri de Carvalho, Mariliza Comar Astolphi de Carvalho[1], Daniela Ponzoni[2]

Department of Stomatology Bauru School of Dentistry, University of São Paulo, [1]Professor of the Specialization Course on Implant Dentistry at NEC Odonto Araçatuba, [2]Department of Surgery and Integrated Clinic, Araçatuba School of Dentistry - UNESP, São Paulo, Brazil

Address for correspondence:
Profa. Dra. Daniela Ponzoni, Departamento de Cirurgia e Clínica Integrada, Faculdade de Odontologia de Araçatuba - UNESP, Rua José Bonifácio, 1193, CEP 16015-050, Araçatuba, São Paulo, Brazil.
E-mail: dponzoni@foa.unesp.br

ABSTRACT

Maintaining the volume of the alveolar process after extraction can be achieved by immediate implant placement and guided bone regeneration, with or without the use of biomaterials. The authors present a case report with a 10 years follow-up, rehabilitation using osseointegrated implants in the extraction area and maintenance of the volume of the alveolar process with autogenous cortical bone shavings.

Keywords: Dental implants, guided tissue regeneration, particulate bone graft

INTRODUCTION

The bone quantity and quality are two of the most important requirements for the placement of prosthetically positioned osseointegrated implants with sufficient initial stability. There are various causes of significant bone loss of the alveolar processes, including the presence of periodontal disease processes and/or periapical root fractures or even alveolectomies during dental extractions.[1]

Currently, during the planning of the extraction, atraumatic tooth extraction for the rehabilitation with dental implants should be considered. Furthermore, socket preservation procedure and immediate implants should be performed in order to minimizing the crestal bone loss.

When it is not possible to install implants immediately after tooth extraction, the alveolar process, depending on the thickness of the buccal bone plate at the end of the bone remodeling process, can undergo a depression on the labial surface that may require the need for autogenous bone grafts in block. In the anterior maxilla jaw, there is a 25% loss of bone volume in the 1st year and 40–60% of thickness until the 3rd year after extraction.[2-5] In the posterior region, there is 50% alveolar bone loss in the same period, however, it should be considered that the initial volume of the posterior maxilla is two times higher than the anterior maxilla.

When the bone defect has four walls (intact alveolar walls), the alveolar bone repair occurs naturally.[6] However, if the alveolar wall usually the entrance is <1.5 mm thick or is absent, the clinician should use intra-alveolar material (autogenous bone, mineralized bone or alloplastic material) associated with membranes that improve the predictability restoration of the original bone contour of the alveolar process. Authors[7,8] evaluated the demineralized bone in postextracted sockets and did not obtain neobone formation, most likely due to the change of pH and local metabolic conditions.

The guided bone regeneration technique is based on the assumption that a membrane acts as a barrier when supported on a bone defect, avoiding the presence of unwanted cells for the bone repair such as those derived from the epithelium and connective tissues. Among other applications, guided bone regeneration is suitable for the alveoli after tooth extractions in

order to maintain the socket's volume with or without the use of bone substitutes.[9]

Autogenous bone grafts presents the activities of osteogenesis, osteoinduction, osteoconduction, and osteopromotion. The activity of these osteogenetic cells lasts for 4 weeks (Phase I). Already its osteoinductive activity, by the release of bone morphogenetic proteins (BMP) remains between 2 weeks and 6 months with a peak at 6 months (Phase II), while the osteoconductive activity is maintained through its inorganic matrix (Phase III), and osteopromotive activity when the cortex, in cases of bone blocks act as a membrane (Phase IV).[10]

The autogenous bone may be used in the form of blocks (for increases in the horizontal and vertical edges) and the particle shape (for the filling of bone defects or cavities). The particles can be obtained by the particles of the bone blocks (through the bone particles), bone shavings (obtained by means of the bone scrapers), and macerate (obtained by collecting bone used in the aspiration tips).

What differentiates the particles are their size and quality of the mechanism of neobone formation and the best is the particulate through the particles, although both the shavings,[11] as well as the macerated bone[1] present biological qualities.

The purpose of this work was to present a clinical case with 10 years maintenance of the volume of the alveolar process after extraction and rehabilitation with an implant-supported prosthesis.

CASE REPORT

A 48-year-old male patient had a clinical examination of the tooth left maxillary first premolar with grade 3 mobility[12] [Figure 1]. In the radiographic examination, there was an advanced bone loss and tooth extraction was indicated [Figure 2].

Two options for the patient were given predicting rehabilitation with implants after the left maxillary first premolar extraction: Wait for the period of alveolar repair and maturation of the formed tissue or the attempted maintenance of the alveolar bone volume. The patient agreed to attempt to preserve the alveolar bone.

The patient underwent extraction of the tooth left maxillary first premolar under local anesthesia. The mucoperiosteal flap was made with an L-shape incision in the region of teeth left maxillary first and second premolars. After flap elevation, it was possible to observe the extent of bone loss induced by the periodontal disease, which included all the vestibular wall of the socket [Figure 3]. Curettage and vigorous irrigation of the socket with the saline solution were performed [Figure 4]. Due to the impossibility of immediate implementation, was chosen for the reconstruction of the defect through its filling with scraped autogenous bone and using a resorbable membrane.

After infiltrative terminal anesthesia of the region of the oblique line on the left side, a linear incision was made, mucoperiosteal detachment and exposure of the donor area. With the aid of a bone scraper (Autogenous®, Serson, São Paulo, Brazil.) zest of mandibular cortical bone was obtained in sufficient quantity to fill the defect [Figures 5 and 6].

The autogenous bone graft was positioned, filling the defect in the alveolar region of the tooth left maxillary first premolar, with a normal blood clot in the defect [Figure 7]. The reconstructed region was covered by the bovine cortical bone membrane (Gemderm, Baumer®, Mogi Mirim, São Paulo, Brazil) [Figure 8]. Periosteal incisions were made in order to increase the elasticity of the flap and to obtain the closing of the wound by first intention without tensional forces that could cause ischemia and wound dehiscence. The flap was sutured with simple interrupted stitches with 4.0 silk thread (Etchicon®, Johnson e Johnson do Brasil Indústria e Comércio LTDA).

After 6 months of undistributed healing, the area was exposed to implant installation [Figure 9]. The installation of the implant was performed under local anesthesia supraperiosteal infiltrative terminal. An L-shape incision was made. During drilling, a biopsy of the grafted area was taken with a 2 mm round trephine drill. The sample was decalcified in a solution of 4.3% EDTA, pH 7.2, and if renewing it every week until it is found that the total demineralization. The same was subjected to histological processing. The drilling followed with the use of pilot cutters (2/3 mm), 3 mm, and countersink. A 3.75 mm diameter and 13 mm height cylindrical implant were installed (SIN®, São Paulo, Brazil) and a cover screw was screwed [Figure 10].

Histological analysis

Observed vital neo-formed bone tissue with scraped bone particles remaining inside. There is a suggestion of partial resorption of autogenous bone particles [Figure 11].

After 4 months of submerged healing, the implant was exposed, and the healing abutment was connected. Furthermore, a metal-ceramic crown was fabricated and screwed onto the implant [Figures 12 and 13].

Ten years follow-up

Observed maintenance of bone structures and gingival peri-implants with the element in function. The patient was followed in semiannual visits in the first 2 years where clinical examination and periapical radiographs were performed. Initial bone loss crest to the level of the first thread was observed in the 1st year after installation of the prosthetic crown, which is expected to control implants with the hexagonal platform. In the following years, the patient was followed up annually, and bone loss in crest level remained stable, as well as the peri-implant soft tissues [Figures 14 and 15].

DISCUSSION

In the case described, there were two options after the left maxillary first premolar extraction: Wait for the period of alveolar repair and maturation of the formed tissue or the attempted maintenance of the alveolar bone volume. If the first option is chosen, the patient probably has to be submitted for alveolar reconstruction using an autogenous bone graft block for

Figure 1: Initial clinical aspect

Figure 2: Radiographic exam

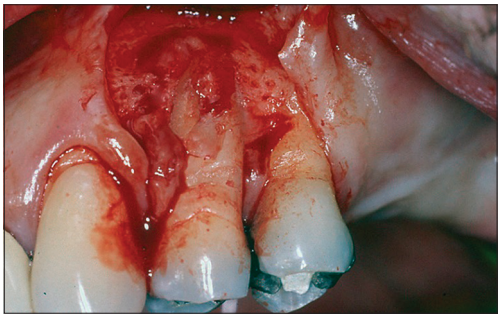

Figure 3: Extension of periodontal bone loss

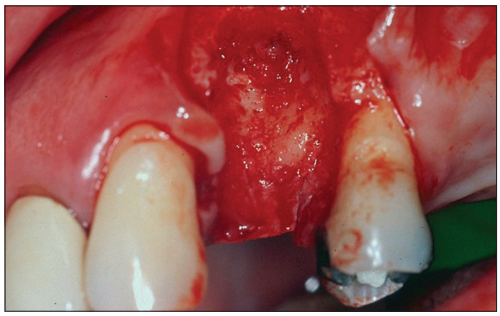

Figure 4: Remaining alveolar bone after curettage

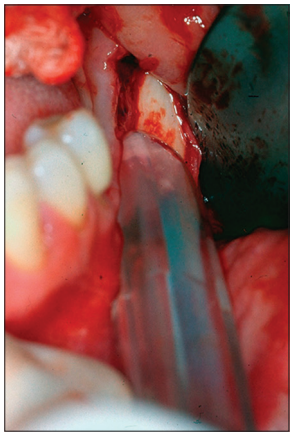

Figure 5: Obtaining bone shavings of the oblique line

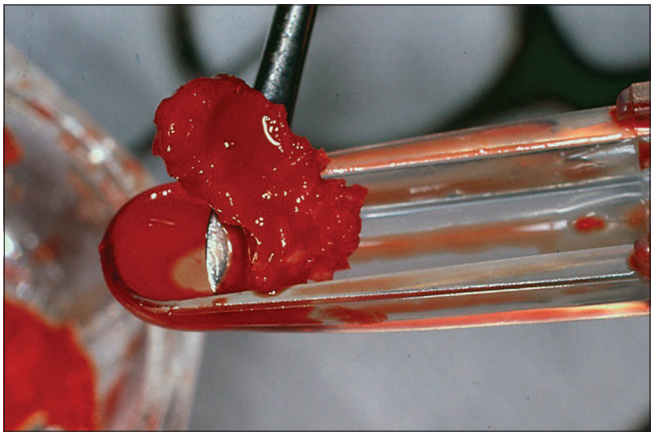

Figure 6: Amount of obtained bone shavings

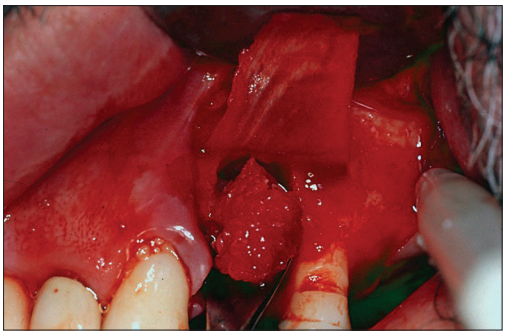

Figure 7: Filling of the defect with grafting

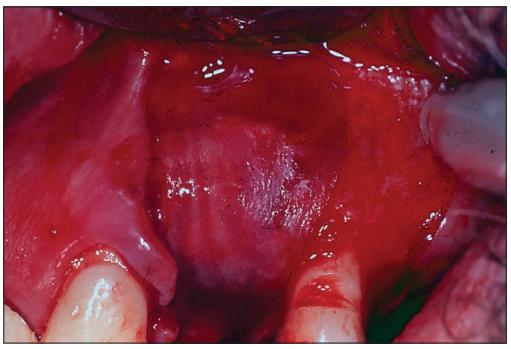

Figure 8: Covering with absorbable membrane

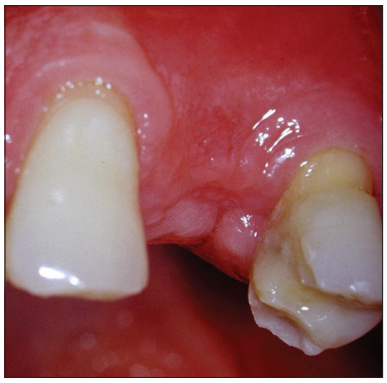

Figure 9: Six months postoperative

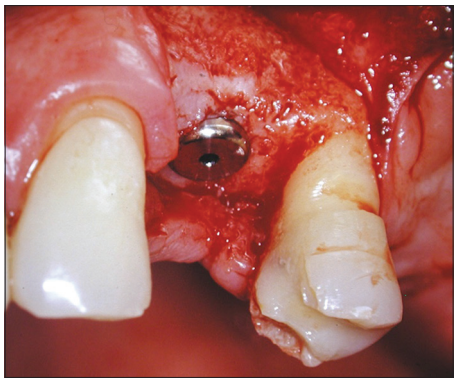

Figure 10: Installed implant

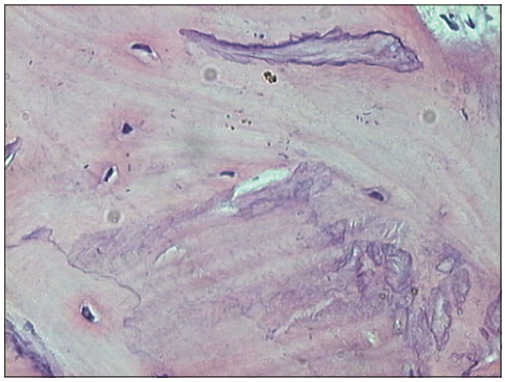

Figure 11: Histological examination: Observe vital tissue, neo-formed bone with the presence of particles of remaining bone shavings inside (H and E, ×40)

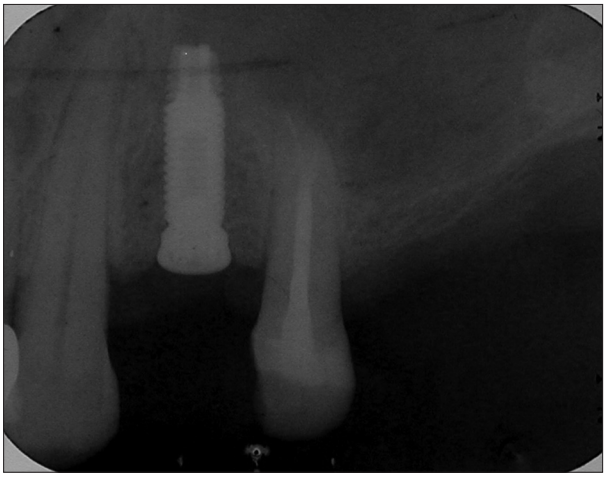

Figure 12: Periapical radiograph immediately after implant installation

Figure 13: Finalized metal-ceramic prosthesis

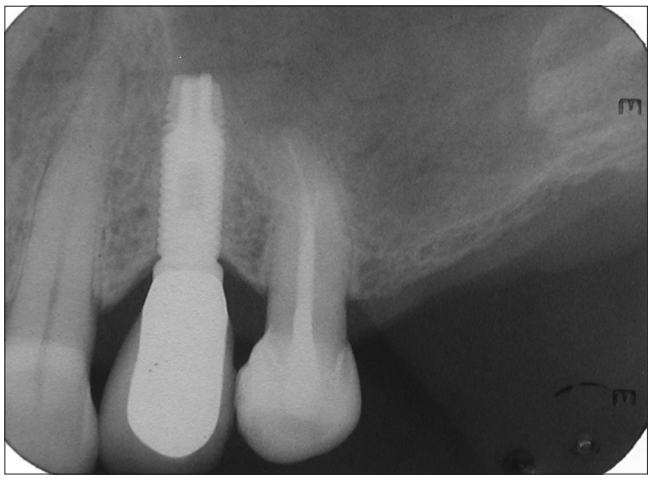

Figure 14: Ten years control - Periapical radiograph

Figure 15: Ten years control - Clinical aspect

increased thickness and subsequent implantation, which retard the treatment by at least 6 months.

The attempt to maintain the volume of the alveolar bone through the implant installation immediately after the extraction was contraindicated. According to the authors,[9] the immediate implant placement, among other criteria, must be limited to those cases with minimal bone loss by periodontal disease, where there

is enough bone for the initial implant stability. All options were discussed with the patient.

Thus, the option of choice for the maintenance of bone volume was guided bone regeneration. However, in order to obtain success with the regeneration technique, it is imperative, that there be beneath the membrane, a biological space that will be maintained by some kind of artificial metal (screw) or membrane supported by the remaining bone or biomaterial.

In the present case, the choice was to use the shavings of the autogenous cortical bone, and on this, the absorbable membrane of the bovine cortical bone.

In all the reported studies, the superiority of the autogenous bone in relation to other bone substitutes remains evident, with the disadvantage of the need for another surgical access. In the case of small amounts of bone, the intra-buccal region offers conditions for obtaining it. In cases of bone defects in two or more walls, the autogenous bone scraping is of great applicability, because it is an obtained biomaterial by means of an instrument that may or may not be connected to the unit of blood aspiration, and does not often require another surgical access.[13-15]

The results obtained in this case with autogenous bone shavings were satisfactory in maintaining the initial volume, the bone quality obtained and the maintenance of a long-term implant. The initial bone quality may be observed clinically (during milling and the initial stability of the implant) and histologically (by way of a biopsy).

The histological analysis observed neo-formed bone tissue with particles of the remnant bone shavings inlaid in its interior. The histological aspect also relates partial resorption of the biomaterial, while the natural or synthetic hydroxyapatite remains fully within the bone cavity.[13-15]

There are advantages in the use of bone shavings, because when it is introduced into the bone defect, it promotes, by mechanical action, hemostasis, and helps in neobone formation as a result of an osteoinductive and osteogenic action, since the cortical bone presents the greatest amount of BMP.[2,16-20]

In the case presented, the bone volume was maintained, allowing an adequate initial locking of the implant and a good result of the labial outline after long-term prosthetic rehabilitation, confirming the predictability of the technique used.

New researches are necessary in relation to the presence of autogenous bone shavings inside the dental alveolus, considering that the alveolus is a special cavity and that every intra-alveolar implanted material provokes delay in the chronology of the repair due to the presence of the remnant periodontal ligament.[15]

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