Implant placement without native bone contact in fresh socket filled with bovine porous bone mineral: A case report

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Introduction

The increasing tendency to implant placement in fresh sockets after tooth extraction [1-7], induces problems associate with bone gap due to incongruity between walls of the alveolus and implant surface.

To preserve alveolar bone, avoiding invasive ridge augmentation procedures, bone allograft, bone autograft, xenograft, were used immediately following tooth extraction to ensure the formation of alveolar bone within the sites [8-10].

Due to excellent biocompatibility and bioactivity, cancellous bovine bone is a xenogenic material similar to human cancellous bone [11], is widely used in bone grafting and dental devices as bone substitute since this osteoconductive material stimulated new lamellar bone formation and bone apposition to simultaneously placed titanium implants [12-14].

It was also observed that 4 months after implant placement in defects filled with bovine bone mineral, the titanium hard tissue interface exhibited, from both a quantitative and qualitative aspect, a degree of "osseointegration" [15] similar to autologous bone.

Close matching of the resorption to the bone deposition rate represents an important concern between biomaterial grafts, because a rapidly resorbing scaffold might induce bone volume reduction, whereas one that resorbs too slowly, or not at all, would slow down bone deposition and limit tissue remodeling and maturation for implant placement [16-18].
The resorbing process represents a matter of controversy for bone substitutes, since little has been reported to date to give any insight as to whether such grafts can support functioning dental implants.

Only a few histological and clinical studies were reported on biological outcome of the contact between implant surface and grafted biomaterial particles [19-21] in fresh socket implant procedure.

The purpose of the present clinical case was to show the clinical outcome of an implant placed into the fresh socket immersed into the cancellous bovine bone, screwed to the temporary prosthesis, but not in contact with native bone.

**Case Description**

In June 2012 at the Department of Dentistry, San Raffaele Hospital, Milan, Italy, a woman of 55 years old presented a root fracture at maxillary right canine (fig. 1a). She was in good general health, no chronic systemic diseases, no smoking. It was decided for root extraction, filling the socket with biomaterial and immediate placement of implant fixed at the temporary bridge. The patient gave her written informed consent for immediate implant placement into biomaterial grafted socket.

**Surgical and Prosthetic Procedures**

One hour prior to surgery the patient received 1 g amoxicillin and 1 g twice a day for a week after surgical procedure. Surgery was performed under local anaesthesia (Optocaine, Molteni Dental, Scandicci (Fi), Italy).

The root extraction was performed without mucogengival flap elevation. All granulation tissue was carefully removed from the socket, and rinsed by physiologic solution (fig 1a).

Subsequently the root was inserted into the alveolus and impression was taken with a polyether material using an individual impression tray to obtain a copy on master model for temporary bridge manufacture. (fig 1b-d).

A xenogenic material bovine bone (Bio-Oss®, Geistlich Pharma AG, Wolhusen, Switzerland) was placed into the alveolus.

The implant was screwed to the temporary crown of the bridge that was fixed to the remaining implants, and immersed into the cancellous bovine placed into the socket, it was not in contact with native bone of the alveolus (fig. 2).

Screw-shaped implant with a rough surface TiUnite (Nobel Biocare, Zurich, Switzerland) with a progressive thread design and external hexagon was used Branemark MK IV 4x5 (Nobel Biocare, Zurich, Switzerland). Chlorhexidine mouthwash was prescribed twice daily for the next 15 days.
The temporary bridge was maintained in full contact in centric occlusion. The patient followed a soft diet (avoiding bread and meat) for 2 months.

Follow-up

A dental hygienist performed follow-up visits every 6 months after implant placement. The following clinical parameters were checked: plaque, bleeding index at 4 surfaces around the implant, pain, occlusion, and prosthesis mobility.[22-24] After five months implant stability was measured by resonance frequency analysis (RFA) that provided an implant stability quotient (ISQ) > 60. The absence of radiolucency around the implant, mucosal suppuration and pain were not reported.

Radiographic examination

Intraoral digital radiographic examinations (Schick CDR, Schick Technologies Long Island City, NY, U.S.A.) were made at baseline, 12 and 24 months after implant placement (fig. 3). The periapical radiographs were taken perpendicularly to the long axis of the implant with a long-cone parallel technique using an occlusal template to measure the marginal bone level. A radiologist measured the changes in marginal bone height over time. The marginal bone level was considered from the reference point represented by more coronal portion of the implant in contact with the bone, to the point, where the bone tissue met the implant surface at the mesial and distal sites. The difference of bone level was measured by included software (Schick Technologies Long Island City, NY, U.S.A.).

Placement of the definitive prosthesis

Five months after the implant placement, the temporary prosthesis was removed and impression was taken with a polyether material (Impregum®; ESPE, Seefeld, Germany) for definitive metal-ceramic restoration.

After 24 months from implant placement, peri-implant tissues were in good health and no prosthetic complications were reported. A marginal bone loss of 0.82 mm was recorded.

Discussion

The clinical assessments performed prior to take impression for final prosthetic bridge disclosed that implant was stable and that the surrounding mucosa was clinically no inflamed.

May the bovine bone grafted into fresh socket biologically integrate with titanium surface and biomechanically support the implant, after five months?

Sennerby et al [25] showed that the stability of titanium implants depended on the amount of compact bone in the
interface, and that a small amount of compact bone may be sufficient to achieve and maintain osseointegration during functional loading.

In the present case report the implant was placed in contact only with the biomaterial, and no residual native bone.

However the result of the present case report may be explained by study of Berglundh & Lindhe [15]. They compared the healing around implants placed in normal bone and in defects filled with bovine bone mineral in beagle dogs.

The histological examination showed the volume of the hard tissue that was occupied by Bio-Oss® particles was reduced between the 3- and 7-month intervals. This indicates that with time, Bio-Oss® becomes integrated and subsequently replaced by newly formed bone. It was also observed that 4 months after implant installation, the titanium hard tissue interface at test and control sites exhibited, from both a quantitative and qualitative aspect, a similar degree of "osseointegration".

The ground sections showed Bio-Oss® particles were consistently separated from the implant surface by mineralized bone.

The histological examination of this specimen confirms the positive osteoconductive properties of Bio-Oss®, as documented in human case report [17] where deproteinized cancellous bovine bone (Bio-Oss®) was placed as a grafting material for sinus floor elevation and after 6 months of healing, 3 cylindrical titanium-plasma coated implants were inserted.

Six months later one implant was removed along with a small portion of the surrounding peri-implant tissues. The area density of bone amounted to 27% in the non-grafted as compared to 28% in the grafted area.

The slow resorption of Bio-Oss® will not jeopardize the osseointegration of such implant since, as shown in the histomorphometry, no contact between the graft particles and the implant surface were observed in any of the sections. Therefore, BioOss® resorption does not seem absolutely necessary to provide predictable osseointegration [20].

Little is known about the healing pattern and the osseointegration process at the interface of implants placed into different grafting materials in man. In 2 different studies, two implants retrieved, due to fracture four [26] and five [27] years after insertion in sinus-augmentation procedure using 100% anorganic bovine bone, were removed and histologic section examined. In both samples at low magnification, in the peri-implant bone in the grafted area, many particles of anorganic bovine bone were still present. Bone was always
interposed between the grafted particles and the metal surface, and in no case the graft particles were in contact with the implant. No acute or chronic inflammatory cell infiltrate or foreign body reactions were present around the particles or at the bone-implant interface. A high percentage of direct contact between bone and implant, without the interposition of graft material particles, was present 72±4% after 4 years and 50% after 5 years.

In a clinical study Jensen et al [19] after a sinus graft procedure with two types of graft material: radiated mineralized cancellous allograft in one side, and iliac cancellous autograft in the other side, placed implants, an additional microimplant was placed into the graft through the lateral wall of the sinus. At abutment connection, the microimplants were retrieved and histologic sections demonstrated significantly more bone was found at the autografted than at the allografted implants. The use of autogenous bone for augmentation of the maxillary sinus floor resulted in a greater amount of viable bone surrounding the implant; however, simultaneous placement of implants apparently resulted in a low proportion of bone-implant contact after 6 to 14 months irrespective of graft type.

Conclusion

These results may explain the result obtained in this clinical report that the slow resorption of the graft particles did not compromise the osseointegration of the implants and above all the clinical outcome of the implant placement.

Conflict of Interest

No potential conflict of interest relevant to this article was reported

Authors Contributions

Roberto Villa: Clinical procedure, Roberto Crespi: Clinical procedure, drafting the paper, Paolo Capparè: drafting the paper and critical revision, Giorgio Gastaldi: drafting the paper and critical revision, Enrico Gherlone: critical revision and final approval

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