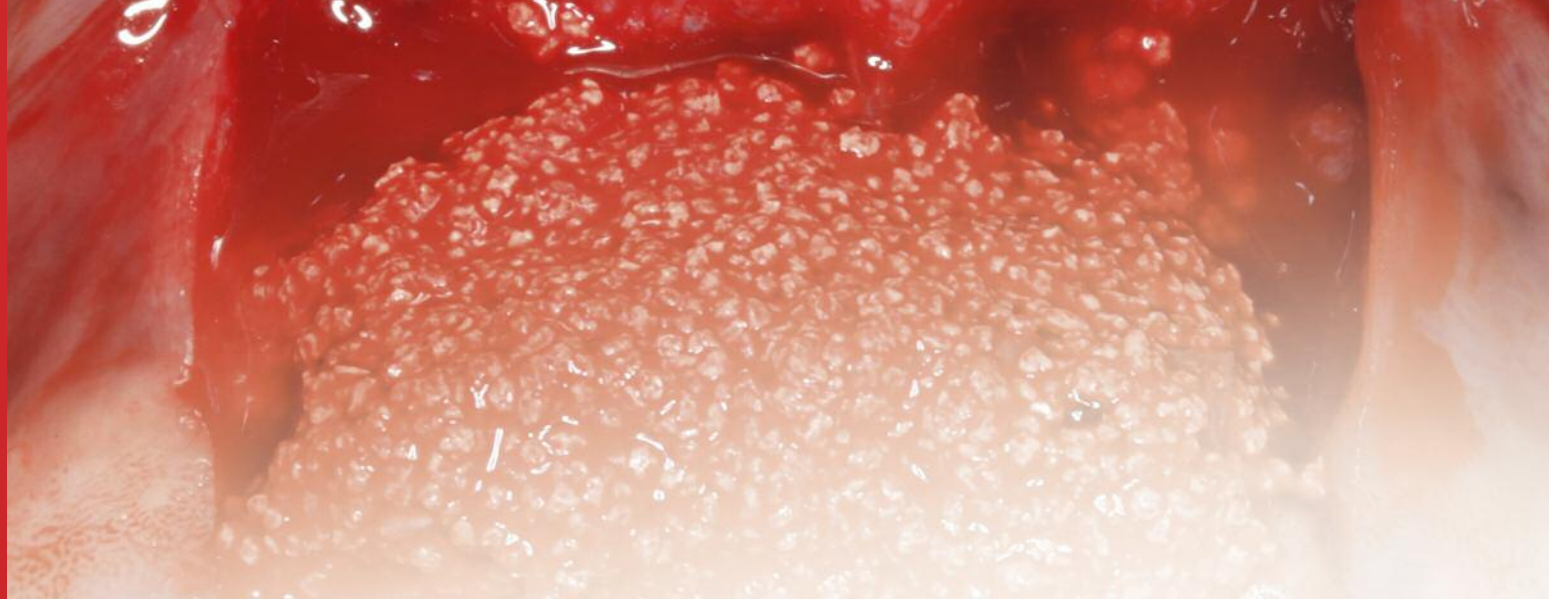

ß-tricalcium phosphate used with onlay graft for horizontal bone augmentation yielded preferable result: a case report

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Introduction

Rehabilitation of teeth lost due to disease, trauma, surgery or congenital problems with implant-supported prosthesis has become a common practice worldwide. (1) However, various bone defects often exist in implant area. In some severe atrophic cases, alveolar bone must be restored before or in combination with implant placement. Bone augmentation using onlay bone grafts which are harvested from either intraoral or extraoral sites is currently one of the most reliable techniques with potential success rate. (2,3) However, the use of autografts only as onlay grafts has some drawbacks such as the high morbidity at the donor site, limited bone graft supply and the need for multiple surgical sites. (4,5) Therefore, synthetic bone graft materials have become a popular choice for bone augmentation during last decade and the application of different bone substitutes has been described in different oral surgeries. (6.7.8.9) Recently, the synthetic bone graft based on ß-tricalcium phosphate which can be completely absorbed in 6 to 9 months has been reported to be used in different oral surgeries such as alveolar preservation and periodontal defects with satisfactory clinical and histologic results. (10.11.12) Tricalcium phosphate grafts has structural characteristics which is similar to bone tissue, moreover, during reabsorption it can provide ion calcium and magnesium for surrounding tissue, thus creating a correct ionic environment, which could activate more alkaline phosphatase for further bone synthesis. (13)
The purpose of this case report is to present clinical and radiographic results for a patient treated with ß-TCP bone substitute with autogenous bone block harvested in situ as onlay grafts for horizontal bone augmentation.

Case Report

A 36 year-old healthy male with good oral hygiene required implant supported prosthesis for his two maxillary central incisors and right lateral incisor (tooth 11,12,21). ***(Fig1,2)*** Pre-surgery radiographic examination showed insufficient bone volume for placement of implants 3.3 mm in diameter. ***(Fig.3)***

After administration of local anesthesia, crestal and vertical incisions were made to expose the labial surface of the absorbed alveolar ridge and two autogenous bone block was harvested apical to the recipient site from the basal base and ß-TCP bone graft (RTR Syringe package, Septodont, France) was placed in the donor site and dressed on the autogenous block. ***(Fig.4-9)*** Then the incision was closed after a titanium mesh and a barrier membrane was covered. ***(Fig.10)*** Routine anti-inflammatory therapy and prophylactic antibiotics were prescribed.

Six months later, a reentry surgery was performed. The bone graft material has been replaced by new formed bone which is an inspiring result as compared with six months ago. Two implants were inserted at tooth 12 and 21with good primary stability. ***(Fig.11-13)*** CBCT examinations presented favorable outcome of the horizontal bone augmentation. ***(Fig.14-15)***

Fig. 1: Pre-surgery oral examination showed acceptable vertical height of the frontal bony shelf in anterior maxillary.

Fig. 2: Pre-surgery oral examination from occlusal view indicated horizontal bone defect.

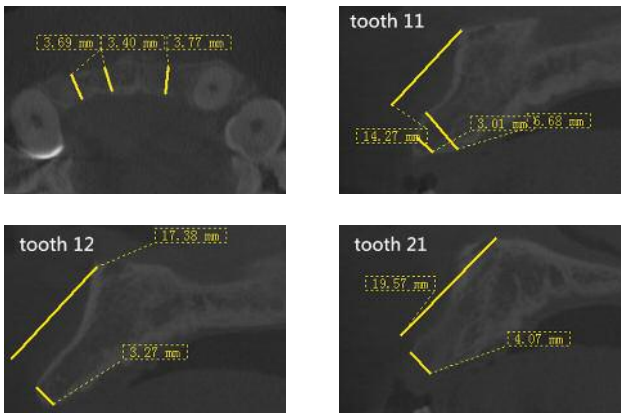
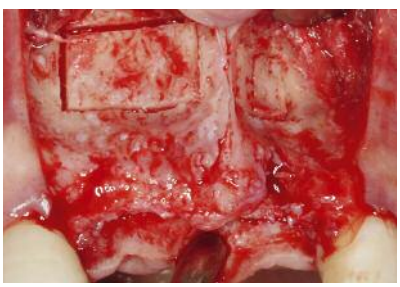


Fig. 3: Presurgery CBCT examination showed width and height of alveolar ridge before bone augmentation.

Fig. 4: Vertical and crestal incision was made to expose the labial surface of anterior alveolar bone.

Fig. 5: Two bone blocks outlined by ultrasonic instruments from basal base apical to the recipient site.



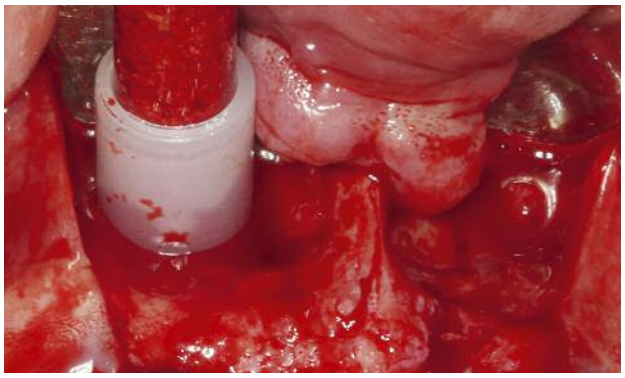


Fig. 6: Use the filter of the syringe package sucking blood in surgical area.

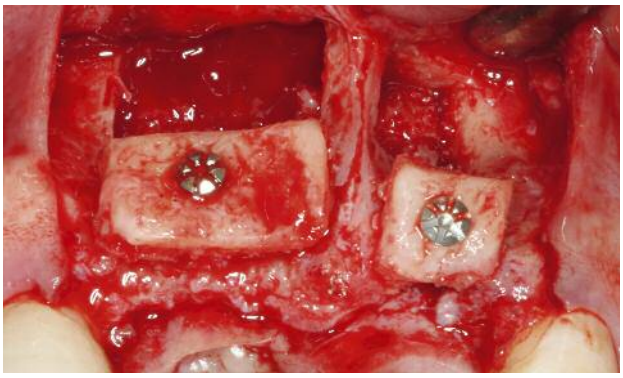


Fig. 7: Fix two blocks on the alveolar ridge with titanium screws.

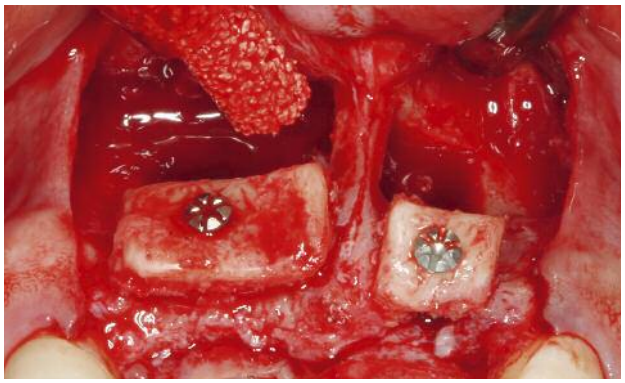


Fig. 8: Inject R.T.R. graft into the donor site.

Fig. 9: Finish dressing R.T.R. graft on the blocks.

Fig. 10: Flap closed with a releasing incision.

Fig. 11: Occlusal view six months later.

Fig. 12: Horizontal alveolar ridge was augmented by new formed bone.

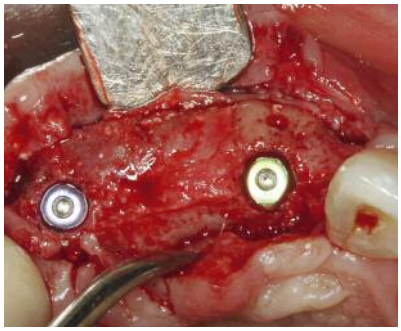


Fig. 13: Two implants were placed in the anterior maxillary.

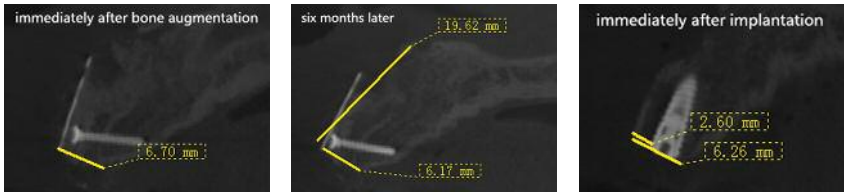


Fig. 14: CBCT of tooth 12 immediately after bone augmentation , six month later and immediately after implantation.

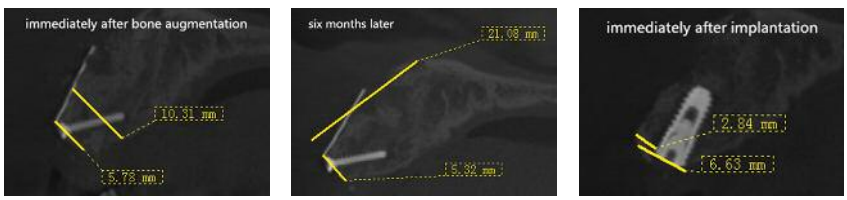


Fig. 15: CBCT of tooth 21 immediately after bone augmentation , six month later and immediately after implantation.

Discussion

This case report showed the potential advantage of ß-tricalcium used with onlay graft for bone augmentation. The clinical and radiographic results show that this synthetic graft has been replaced by new formed bone six months later. Among all the graft materials, tricalcium phosphate is of special interest because it is a resorbable and osteoconductive biomaterial. (15) The in vivo osteoconductivity of synthetic bone graft is dependent on several properties including surface morphology, chemical composition and geometry at both the macro- and micro-scale. The pore size and interconnectivity of biomaterials can significantly influence the exchange of fluids through grafts and the delivery of ions, nutrients within and through the bone substitute. (16,17,18)

The bone graft used in this case consists of pure ß-tricalcium with an appropriate macro- and micro-scale which turn to be good osteoconductivity and make this graft a potential scaffold for osteoblasts. Moreover, pure ß-TCP can be totally absorbed in 6 months thus leaving no residuals in the implant area which may influence the remodeling of bone regeneration. (15)

ß-TCP used with autogenous bone block as onlay graft for anterior bone augmentation in this case gained inspiring result which is a motivation for more oral surgeons to conduct similar cases. Despite the favorable result of the primary surgery, long term observation is still needed for a series of clinical cases.

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References

01 Levin L. Dealing with dental implant failures. J Appl Oral Sci 2008;16:171-175.

02 Hill NM, Horne JG, Devane PA. Donor site morbidity in the iliac crest bone graft. Aust N Z J Surg 1999;69:726-728.

03 Isaksson S, Alberius P. Maxillary alveolar ridge augmentation with onlay bonegrafts and immediate endosseous implants. J Cranio maxillofac Surg 1992;20:2-7.

04 Chiapasco M, Zaniboni M, Rimondini L. Autogenous onlay bone grafts vs. alveolar distraction osteogenesis for the correction of vertically deficient edentulous ridges: a 2-4-year prospective study on humans. Clin Oral Implants Res 2007;18:432-440.

05 Felice P, Marchetti C, Iezzi G, Piattelli A, Worthington H, Pellegrino G, et al. Vertical ridge augmentation of the atrophic posterior mandible with interpositional bloc grafts: bone from the iliac crest vs. bovine an organic bone. Clinical and histological results up to one year after loading from a randomized-controlled clinical trial. Clin Oral Implants Res 2009;20: 1386-1393.

06 Wang M. Developing bioactive composite materials for tissue replacement. Biomaterials 2003; 24:2133-2151.

07 Schmitt CM, Doering H, Schmidt T, Lutz R, Neukam FW, Schlegel KA. Histological results after maxillary sinus augmentation with Straumann® BoneCeramic, Bio-Oss®, Puros®, and autologous bone. A randomized controlled clinical trial. Clinical Oral Implants Research 2013; 24:576-585.

08 Klijn, R.J., Meijer, G.J., Bronkhorst, E.M. & Jansen, J.A. A meta-analysis of histomorphometric results and graft healing time of various biomaterials compared to autologous bone used as sinus floor augmentation material in humans. Tissue Engineering Part B: Reviews 2010; 16: 493–507.

09 Tamimi F, Torres J, Al-Abedalla K, Lopez-Cabarcos E, Alkhraisat MH., Bassett DC., Gbureck U, Barralet JE.. Osseointegration of dental implants in 3D-printed synthetic onlay grafts customized according to bone metabolic activity in recipient site. Biomaterials 2014; 35:5436-5445.

11 Brkovic BM, Prasad HS, Rohrer MD, Konandreas G, Agrogiannis G, Antunovic D, Sándor GK. Beta-tricalcium phosphate/type I collagen cones with or without a barrier membrane in human extraction socket healing: clinical, histologic, histomorphometric and immunohistochemical evaluation. Clin Oral Investig 2012; 16: 581-590.

12 Stavropoulos A, Windisch P, Gera I, Capsius B, Sculean A, Wikesjö UM. A phase IIa randomized controlled clinical and histological pilot study evaluating rhGDF-5/ß-TCP for periodontal regeneration. Journal of Clinical Periodontology. 2011; 11:1044-1054.

13 Suba Z, Takács D, Matusovits D, Barabás J, Fazekas A, Szabó G. Maxillary sinus floor grafting with beta-tricalcium phosphate in humans: density and microarchitecture of the newly formed bone. Clin Oral Implants Res. 2006; 17:102-108.

14 Hirota M, Matsui Y, Mizuki N, Kishi T. Combination with allogenic bone reduces early absorption of beta-tricalcium phosphate (beta-TCP) and enhances the role as a bone regeneration scaffold. Experimental animal study in rat mandibular bone defects. Dent. Mater. J. 2009; 28: 153.

15 Rodella LF, Favero G, Labanca M. Biomaterials in Maxillofacial Surgery: Membranes and Grafts. International journal of Biomedical science 2011; 7: 81-88.

16 Gendler E. Perforated demineralized bone matrix: a new form of osteoinductive biomaterial. J Biomed Mater Res 1986;20:687-697.

17 Habibovic P, Yuan H, van der Valk CM, Meijer G, van Blitterswijk CA, de Groot K. 3D microenvironment as essential element for osteoinduction by biomaterials. Biomaterials 2005;26:3565-3575.

18 Walsh WR, Vizesi F, Michael D, Auld J, Langdown A, Oliver R, et al. ß-TCP bone graft substitutes in a bilateral rabbit tibial defect model. Biomaterials 2008;29:266-271.