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CASE REPORT

Localized Maxillary Ridge Augmentation with Mineralized Plasmatic Matrix for Dental Implant Placement

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ABSTRACT

Preimplant augmentative surgery is a prerequisite in many cases in the anterior maxilla to achieve a stable, long-term esthetic final result. The aim of this case was to evaluate the outcome of ridge augmentation with cancellous freeze-dried albumin coated allograft incorporated in mineralized plasmatic matrix in the anterior atrophic maxilla followed by placement of dental implants.

Keywords: Implant placement, Mineralized plasmatic matrix, Ridge augmentation.

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INTRODUCTION

The availability of adequate bone volume for dental implant placement is often affected by trauma, pathology, periodontal disease, and tooth loss. Bone resorption in the maxillary ridge frequently results in a knife-edged deformity, which complicates implant placement and stabilization[1,2]

Nowadays, a predictable augmentation of severely atrophied alveolar ridge defects still remains a matter of interest in implant dentistry. Although many augmentation procedures, such as bone blocks, bone splitting or distraction osteogenesis, were reported to be associated with high clinical success and implant survival rates,[3] these techniques are surgically demanding and, therefore, limited to experienced surgical specialists.

The less invasive principle of guided bone regeneration also resulted in a promising horizontal (4–5 mm) and vertical (2–7 mm) bone gain,[4-6] however, it was frequently associated with wound dehiscence and premature membrane exposures, thus compromising the clinical results.[7,8] For most of techniques, autogenous bone is still considered to be the gold standard grafting material, mainly due to its osteogenic, osteoinductive, and osteoconductive properties.[9]

However, some potential drawbacks are related to its available quantity at specific intraoral donor sites, an increased morbidity, and patient discomfort.[7,10] In addition, a potential clinical drawback of autogenous bone is related to graft resorption, which was particularly pronounced for cancellous bone, ranging between 12 and 60% (1–5 years) postloading of implants.[7]

In previous years, allogenic bone blocks were considered to serve as an alternative to the abovementioned augmentation procedures commonly used for the rehabilitation of advanced ridge defects, as it offers reduced morbidity.[11-13] The ideal bone graft substitute should possess at least some physicochemical properties, such as biocompatibility, osteoconductivity, and resorbability.

Allogeneic bone graft is usually the second choice for bone augmentation. It was found that, the biocompatibility of freeze-dried human bone allograft with mesenchymal stem cell (MSC) can be improved by albumin coating. The freeze-dried albumin layer withstands the agitation under dynamic cell culture conditions and does not influence the mechanical strength of the human bone, however, significantly increases the proliferation rate of MSCs on the surface. After implantation in a delayed bone-healing model, albumin coating improved the ingrowth of new bone from the host. Interestingly, albumin only works on human bone surface but not on hydroxyapatite or bovine bone scaffolds.[14]

Platelet-rich fibrin (PRF) is a second-generation platelet concentrate yielding fibrin membranes enriched in platelets and growth factors, made using anticoagulant-free blood.[15-17] Both platelet-rich plasma (PRP) and PRF membranes form resorbable fibrin-like networks facilitating efficient cell migration and proliferation to guide tissue regeneration.[18] The PRF affords slow, sustained release of significant quantities of key growth factors for up to 28 days. Thus, PRF stimulates tissue regeneration for an adequate time during wound healing,[19,20] as its natural fibrin framework protects growth factors from proteolysis.

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Recently, PRF has been shown to regulate HSP47 and lysyl oxidase protein expression in human osteoblasts. These proteins facilitate cell attachment, proliferation, and matrix synthesis. Therefore, PRF may aid in bone healing, regeneration, and repair.[19]

Platelet-rich fibrin preparation is thus very simple, requiring no anticoagulant, bovine thrombin, or any other gelling agent. The data on the biologic properties of PRF in terms of bone regeneration, however, are sparse. In searching for regenerative biomaterials that afford both biological and mechanical properties and resolve the drawbacks of titanium mesh and bone blocks exposure, mineralized plasmatic matrix (MPM) was developed.

The MPM preparation features the simplicity of the PRF protocol, however, yields a liquid platelet/fibrin concentrate that can become bound to bone particles. Scanning electron microscopy reveals that MPM creates a dense fibrin network woven around the mineral blocks. Bone grafts can be readily conformed and the surgical site fortified by the various contained products. The surgical procedure is essentially unchanged but becomes easier and safer.[20]

The MPM features the use of plastic tubes without additives, deferring initiation of the intrinsic pathway of coagulation. The contribution of a mineral phase (high level calcium and thromboplastin) in the plasma fraction from the tubes induces the extrinsic pathway of coagulation. Usefully, a homogeneous filling material, a fibrin membrane, and the beneficial biologic properties of PRF (listed above) become simultaneously available. In addition, the volume of product obtained is high, which is of great importance in clinical practice. Rapid blood collection and patient compliance during the operation, however, are essential.[21]

CASE REPORT

A 26-year-old male patient presented with defected anterior maxillary ridge (upper right central). He required an implant supported fixed restoration. Upon clinical and radiological examination (using CBCT) (Figs 1 and 2), we found that there was a soft tissue deficiency and a significant labial bone lose "dehiscenced labial bone." Immediate implant placement was not possible, so ridge augmentation using MPM was planned. A prophylactic oral antibiotic, Augmantin@ 625 mg tid was used routinely, beginning 1 day prior to the procedure and continuing for 6 days postoperatively.

Before the surgery was performed, preparation of the MPM started, two tubes of 10 mL of venous blood were taken from the patient and placed in a centrifuge at 2500 rpm/minute for 15 minutes. At the end of the centrifugation, the blood in the tube was separated into two compartments; one yellow and one red. The yellow part is withdrawn with a syringe to be mixed with (albumin coated bone allograft manufactured by OrthoSera@). They were mixed using a probe, until the formation of a single homogeneous mixture of fibrin network with integrated bone graft particles inside was obtained, which was rich in platelets, leukocytes, and mesenchymal cells (Fig. 3).

The surgical site was then exposed under local anesthesia with a pedicle conventional flap, with two vertical

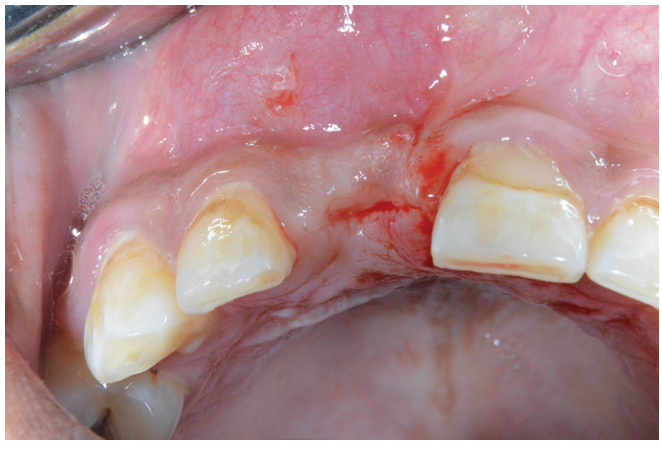

Fig. 1: Clinical examination

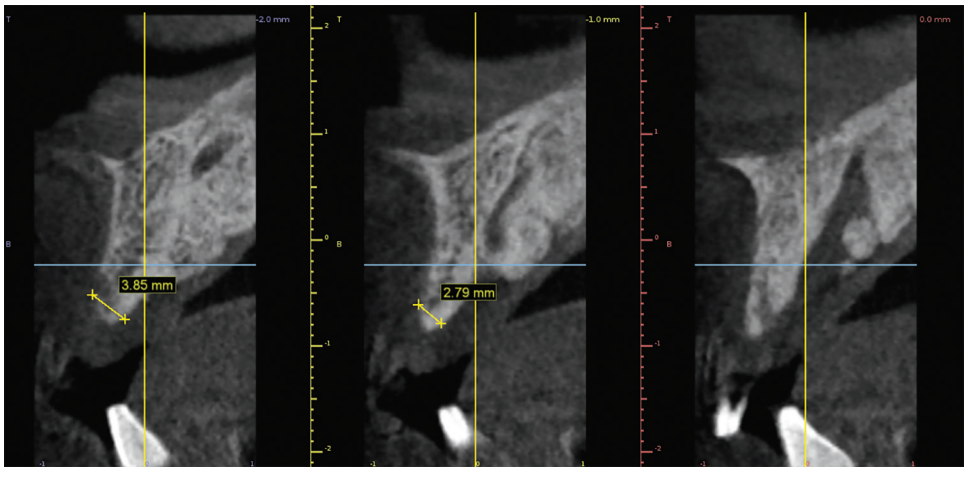

Fig. 2: Radiological examination using CBCT

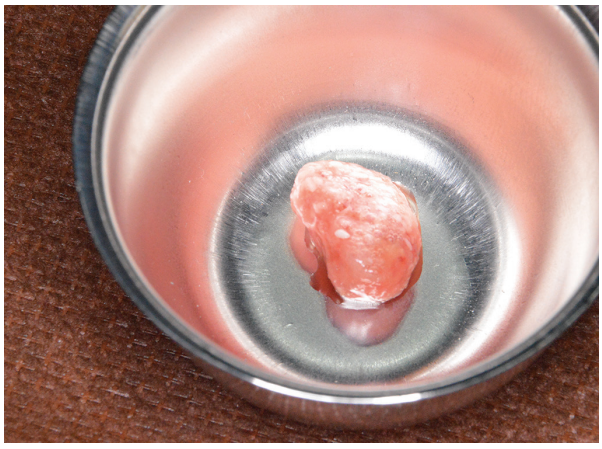

Fig. 3: Miniralized Plasmatic Matrix preparation

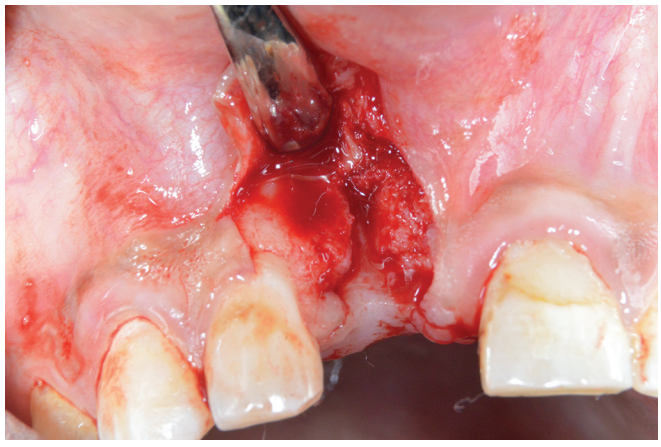

Fig. 4: Flap reflection and mechanical debridement

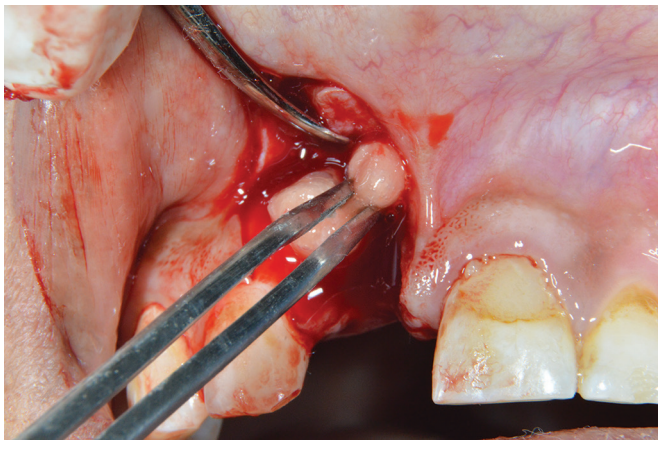

Fig. 5: Mineralized plasmatic matrix placement

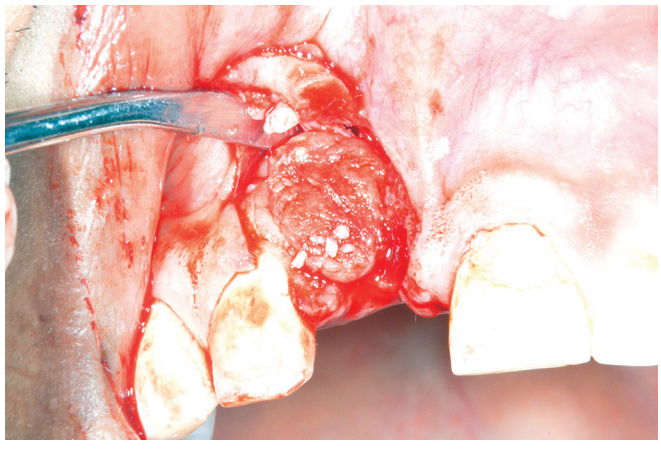

Fig. 6: Mineralized plasmatic matrix in adaptation in place

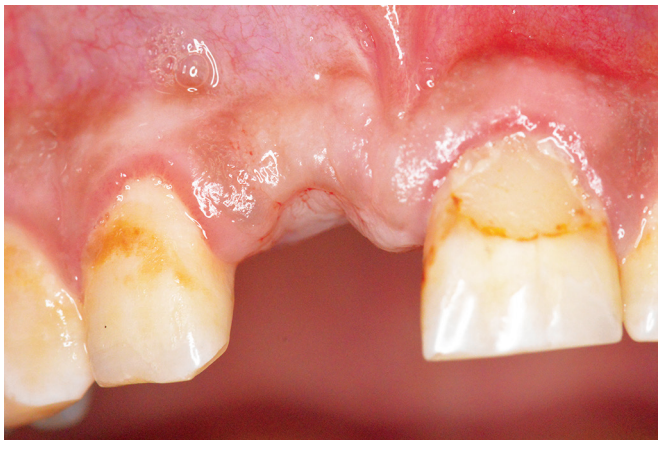

Fig. 7: Clinical evaluation after 4 months

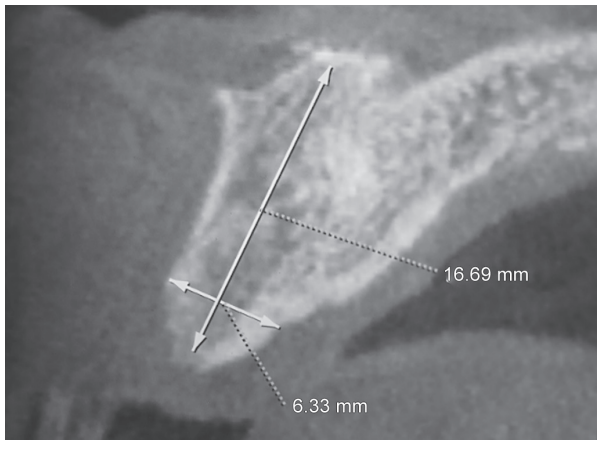

Fig. 8: Radiological evaluation after 4 months

incisions, the site was thoroughly debrided by mechanical means "curettage and irrigation" to remove granulated tissue (Fig. 4).

The MPM, which has been obtained, was placed in the defected anterior maxillary ridge; the edges of the mucosal flaps were approximated to each other and sutured using 3-0 Monocryl sutures. Working time was approximately 30 minutes (Figs 5 and 6).

After 10 days, sutures removal was carried out. After 4 months, clinical and radiographic evaluation was carried out, which revealed excellent soft tissue healing, and fully keratinized and radiographic evidence of bone fill were recorded (Figs 7 and 8).

The augmented ridge was then exposed under local anesthesia with a labial triangular conventional flap, with distal vertical incision, to expose the ridge with minimal

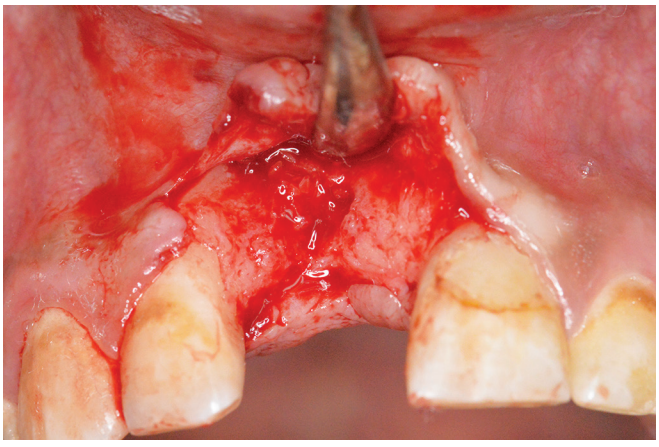

Fig. 9: Exposure of the augmented ridge

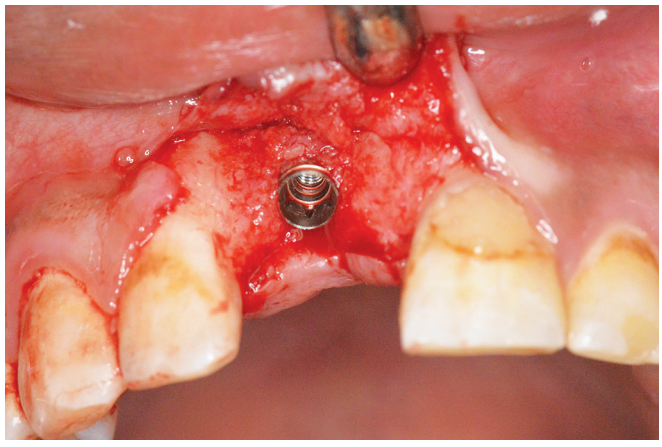

Fig. 10: Implant placement

flap incisions (Fig. 9). Implant placement was carried out, slight deficiency of the crestal bone was noticed, which was compensated by additional bone grafting (Fig. 10).

DISCUSSION

An important aspect of implant dentistry is biomechanics. Long-term results are directly related to occlusal loads exerted by the final prosthesis. Overloading can lead to biological and/or mechanical complications. A force applied along the axis of an implant will be distributed around the implant, and the supporting bone will have a high load-bearing capacity. However, in the anterior maxillary area, the forces applied have a significant transverse direction resulting in a bending moment that can be detrimental to both implant and supporting tissues.[23,24]

However, placing narrow implants, tilted buccally, having oversized clinical crowns may result in unfavorable biomechanics, leading to severe complications in the anterior area. Therefore, preimplant augmentative surgery is an important step in most cases in the anterior maxilla. A variety of bone-grafting materials have been used with different biological mechanisms, such as osteogenesis, osteoinduction, and osteoconduction.[25-27]

Autogenous bone harvested from either extraoral or intraoral sites is regarded as the "gold standard", and it remains the material of choice for cortical-cancellous blocks. However, its use has many drawbacks as risks of donor site morbidity: Infections, immediate postoperative pain and edema, neurosensory deficits, and hematomas. A variety of alternative allogeneic, alloplastic, and xenogeneic bone grafting materials have been proposed in recent years, based on different biological mechanisms and bone regeneration principles, such as tissue engineering, and the osteoinductive and osteoconductive potential of different scaffolds.[10]

Mineralized plasmatic matrix achieved both benefits of hard scaffold material, represented in bone graft material, and the tissue engineering, represented in the PRF which is a source of fibrin network, i.e., the extracellular matrix necessary for migration of specific cells in the tissue regeneration or repair. And, it also contains growth factors necessary for the stimulation of differentiation or migration of cells.[22,28]

The MPM is a cost-effective source of growth factors and is easy to prepare. It is used as alternative to titanium mesh or block bone procedure. Stability of grafted bone is granted against any motion, so the volume of augmentation is maintained during healing period, therefore, the need of block bone and titanium mesh is minimized. Fibrin network entraps platelets and leukocytes to release growth factors, so bone regeneration and soft tissue healing are hurried[22,28]

CONCLUSION

The MPM is a simple procedure, a cost-effective source of growth factors and is easy to prepare. It is effective, as judged by reference to the experience with PRP and PRF documented work. Furthermore, work with more patients, however, is necessary and the biologic qualities of MPM must be better defined.

REFERENCES

1. Wiens JP. The use of osseointegrated implants in the treatment of patients with trauma. J Prosthet Dent 1992 May;67(5): 670-678.
2. Barber HD, Betts NJ. Rehabilitation of maxillofacial trauma patients with dental implants. Implant Dent 1993 Fall;2(3): 191-193.
3. Chiapasco M, Zaniboni M, Boisco M. Augmentation procedures for the rehabilitation of deficient edentulous ridges with oral implants. Clin Oral Implants Res 2006 Oct;17(Suppl 2): 136-159.
4. Simion M, Jovanovic SA, Tinti C, Benfenati SP. Long-term evaluation of osseointegrated implants inserted at the time or after vertical ridge augmentation. A retrospective study on 123 implants with 1–5 year follow-up. Clin Oral Implants Res 2001 Feb;12(1):35-45.

5. Buser D, Ingimarsson S, Dula K, Lussi A, Hirt HP, Belser UC. Long-term stability of osseointegrated implants in augmented bone: a 5-year prospective study in partially edentulous patients. Int J Periodontics Restorative Dent 2002 Apr;22(2): 109-117.
6. Chiapasco M, Romeo E, Casentini P, Rimondini L. Alveolar distraction osteogenesis vs. vertical guided bone regeneration for the correction of vertically deficient edentulous ridges: a 1-3-year prospective study on humans. Clin Oral Implants Res 2004 Feb;15(1):82-95.
7. Chiapasco M, Zaniboni M, Boisco M. Augmentation procedures for the rehabilitation of deficient edentulous ridges with oral implants. Clin Oral Implants Res 2006 Oct;17(Suppl 2): 136-159.
8. Donos N, Mardas N, Chadha V. Clinical outcomes of implants following lateral bone augmentation: systematic assessment of available options (barrier membranes, bone grafts, split osteotomy). J Clin Periodontol 2008 Sep;35(Suppl 8): 173-202.
9. Chiriac G, Herten M, Schwarz F, Rothamel D, Becker J. Autogenous bone chips: influence of a new piezoelectric device (Piezosurgery) on chip morphology, cell viability and differentiation. J Clin Periodontol 2005 Sep;32(9):994-999.
10. McAllister BS, Haghighat K. Bone augmentation techniques. J Periodontol 2007 Mar;78(3):377-396.
11. Araújo, MG, Sonohara M, Hayacibara R, Cardaropoli G, Lindhe J. Lateral ridge augmentation by the use of grafts comprised of autologous bone or a biomaterial. An experiment in the dog. J Clin Periodontol 2002 Dec;29(12):1122-1131.
12. Froum, SJ, Wallace SS, Elian N, Cho SC, Tarnow DA. Comparison of mineralized cancellous bone allograft (Puros) and anorganic bovine bone matrix (Bio-Oss) for sinus augmentation: Histomorphometry at 26 to 32 weeks after grafting. Int J Periodontics Restorative Dent 2006 Dec;26(6):543-551.
13. Holmquist P, Dasmah A, Sennerby L, Hallman M. A new technique for reconstruction of the atrophied narrow alveolar crest in the maxilla using morselized impacted bone allograft and later placement of dental implants. Clin Implant Dent Relat Res 2008 May;10(2): 86-92.
14. Weszl M, Skaliczki G, Cselenyák A, Kiss L, Major T, Schandl K, Bognár E, Stadler G, Peterbauer A, Csönge L, et al. Freeze-dried human serum albumin improves the adherence and proliferation of mesenchymal stem cells on mineralized human bone allografts. J Orthop Res 2012 Mar;30(3):489-496.
15. Dohan DM, Choukroun J, Diss A, Dohan SL, Dohan AJ, Mouhyi J, Gogly B. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part I: technological concepts and evolution. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006 Mar;101(3):e37-e44.
16. Choukroun J, Diss A, Simonpieri A, Girard MO, Schoeffler C, Dohan SL, Dohan AJ, Mouhyi J, Dohan DM. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part V: histologic evaluations of PRF effects on bone allograft maturation in sinus lift. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006 Mar;101(3):299-303.
17. Dohan DM, Choukroun J, Diss A, Dohan SL, Dohan AJ, Mouhyi J, Gogly B. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part II: platelet-related biologic features. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006 Mar;101(13):e45-e50.
18. Wu CL, Lee SS, Tsai CH, Lu KH, Zhao JH, Chang YC. Platelet-rich fibrin increases cell attachment, proliferation and collagen-related protein expression of human osteoblasts. Aust Dent J 2012 Jun;57(2):207-212.
19. He L, Lin Y, Hu X, Zhang Y, Wu H. A comparative study of platelet-rich fibrin (PRF) and platelet-rich plasma (PRP) on the effect of proliferation and differentiation of rat osteoblasts in vitro. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009 Nov;108(5):707-713.
20. Nadon F, Chaput B, Périssé J, de Bérail A, Lauwers F, Lopez R. Interest of mineralized plasmatic matrix in secondary autogenous bone graft for the treatment of alveolar clefts. J Craniofac Surg 2015 Oct;26(7):2148-2151.
21. Rangert B, Krogh PH, Langer B, Van Roekel N. Bending overload and implant fracture: a retrospective clinical analysis. Int J Oral Maxillofac Implants 1995 May-Jun;10(3):326-334.
22. Rangert B, Jemt T, Jörneus L. Forces and moments on Branemark implants. Int J Oral Maxillofac Implants 1989 Fall;4(3):241-247.
23. Palacci P, Ericsson I. Anterior maxilla classification. In: Palacci P, Ericsson I, editors. Esthetic implant dentistry. Soft and hard tissue management. Hanover Park, IL: Quintessence Publishing Co, Inc; 2001. p. 89-100.
24. Belser UC, Schmid B, Higginbottom F, Buser D. Outcome analysis of implant restorations located in the anterior maxilla: a review of the recent literature. Int J Oral Maxillofac Implants 2004;19(Suppl):30-42.
25. Nissan J, Mardinger O, Calderon S, Romanos GE, Chaushu G. Cancellous bone block allografts for the augmentation of the anterior atrophic maxilla. Clin Implant Dent Relat Res, 2011 Jun;13(2):104-111.
26. Mohamed ELM. The use of growth factors fibrin network to enhance architecture, mechanical and biological aspect of the graft particles. Int J Prevent Clin Dent Res 2014 Apr-Jun;1(2):41-44.
27. Ayoub AH, Ramadan ORand Agbor MA "Tissue Engineering, Platelets Concentrates and its Role in Dental Implant Treatment" EC Dental Science 5.1 (2016):969-980.
28. Vignoletti F, Matesanz P, Rodrigo D, Figuero E, Martin C, Sanz M. Surgical protocols for ridge preservation after tooth extraction. A systematic review. Clin. Oral Impl. Res. 23 (Suppl 5), (2012):22-38.