CASE REPORTS

RJME Romanian Journal of Morphology & Embryology http://www.rjme.ro/

Two case reports of vertical and horizontal augmentation with autogenous bone blocks; seven years follow-up

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Abstract

The current very high success rate of dental implants osseointegration has led to patients having increasingly high expectations in regards to aesthetic outcomes; therefore, effective management of soft tissues and healing of attached gingiva and papillae are essential in the effort to obtain satisfying aesthetic results for the patient. Obtaining papillae to address aesthetic requirements cannot be accomplished without bone reconstruction; an adequate volume of bone is essential in providing necessary long-term dimensional stability. The aim of this work was to highlight the advantages of autogenous bone grafting combined with plasma rich in growth factors (PRGF) in order to improve healing and reduce dehiscence risks. Two clinical cases were presented, both with important (horizontal and vertical) bone loss: in the first case, bone augmentation was performed at the same time as tooth extraction with no surgery needed for reconstruction of dental papillae, keratinized and attached mucosa; in the second case, vertical augmentation was performed by placing the bone graft in contact with an uninfected tooth. In both cases, aesthetic outcomes were as desired at the completion of treatment and also satisfactory at seven years follow-up.

Keywords: autogenous bone grafts, bone augmentation, growth factors (PRGF), osteoblasts, osteogenesis.

Introduction

Numerous techniques and materials (autogenous, allogenic or alloplastic bone grafts) have been recommended in the last 20 years to reconstruct bony defects of the alveolar crest; however, the autogenous bone keeps on having the best predictability and prognosis. The autogenous bone has mechanical properties due to the cortical component and osteogenic properties due to the spongy component, which cannot be achieved by any allograft, xenograft, or alloplastic materials [1, 2]. Inserting the implants in the anterior maxillary region and, obtaining an optimal esthetic result is impossible in the case of vertical and horizontal atrophies and large bone defects. Moreover, the insertion is highly hampered by anatomical obstacles and extraction sockets. In such cases, bone regeneration techniques are necessary, such as: ridge splitting and expansion [3–5], guided bone regeneration [6–8] distraction osteogenesis [1, 2, 9,], onlay [10, 11], inlay or veneer grafts [12]. In numerous clinical situations, the dental extraction, traumas or various pathologies lead to the resorption of the alveolar crest. As a result, the crest width is often less than 4 mm; if an implant was inserted in such a situation, it would be out of the bone contours and its treads would be left uncovered on the vestibular side. In such situations, the bone augmentation must be performed before the implant placement. Moreover, the high aesthetic requirements of the patients, with or without gingival smile, represent an indication for block grafts in bone atrophies before the insertion of the implant [13].

The vertical bone augmentation is much more difficult and with a less favorable prognosis than the horizontal augmentation because of the soft tissue scar contractions and the difficult protection of the grafted zone from the masticatory forces [14, 15]. As in most cases, the osteodistraction cannot be carried out because of insufficient natural bone stock; the only available option remains the onlay graft [14].

The success of the bone regeneration techniques depends, mainly, on the re-vascularization of the graft, which begins in the first hours after the surgery procedure. The osteoblasts and osteocytes can survive up to four days, based on their resources and through nutritive support by diffusion. If the graft is not vascularized within this period, most of the bone cells will die. The grafted cells' survival is in accordance with the osteogenic potential of the graft and depends on several factors: (*i*) the quality of the surgical act (as little physical and chemical traumas as possible, as little external exposure of the graft as possible); (*ii*) the early re-vascularization, which depends on the preparation of the grafted zone and the type of the graft; (*iii*) the immobilization of the graft [1, 2].

The regeneration of the newly formed bone depends

on the multiple factors, including: (*i*) the cellular mechanism of proliferation and synthesis of the osteoid (osteogenesis), (*ii*) the cells' migration into the grafted bone (osteconduction), and (*iii*) the resorption and remodeling into mature bone, capable of fulfilling its functions (osteoinduction). The involvement of the growth factors in osteogenesis is inherent and can be stimulated through enriching the level of growth factors with platelet-rich plasma (PRP). It is known that osteoconduction requires the adhesion of the molecules present in PRP and is consequently improved by their increased concentration in the graft. It has been demonstrated that PRP accelerates the bone formation, both native bone regeneration and bone graft performed with autologous bone, allogenic material, bone substitutes or composite graft [14].

Aim

In the present work, we aimed to highlight the efficacy of autogenous bone used in alveolar ridge reconstruction of the anterior zone and also the clinical aspect after seven years follow-up.

Case presentations

Two clinical cases with relevant bone loss were analyzed: the first case showed horizontal bone loss due to tooth fracture, while the second case presented vertical bone loss due to a long-term edentation. Patient informed consent was obtained for the following medical procedures. Before surgery, 80 mL of blood were withdrawn from a peripheral vein, in order to prepare the plasma rich in growth factors (PRGF), in accordance with the method proposed by Anitua.

Case No. 1

In the first case, a healthy 45-year-old male, T.J., presented in private surgery, in March 2009, with a gingival smile line and the central incisor (tooth 1.1) with coronal-radicular fracture that occurred approximately four months earlier (Figure 1a). A review of his social history revealed five years smoking cessation after approximately 18 years smoking of 20 cigarettes daily. Following tooth extraction, a large horizontal bone defect was noticed (Figure 1b), which would have hindered implant placement; under local anesthesia, at mental nerve on both sides with vestibular and lingual infiltration of chin region, an incision was carried out, between teeth 3.3 and 4.3, at 0.5 cm below the muco-gingival line, on the buccal aspect, following a slightly obtuse angle to the bone. A fissure bur (Busch®) was used to cut the block graft of the desired dimension, leaving a 5 mm security margin with respect to the apex of the mandibular incisors and inferior mandible border; the mesio-distal extension stopped at mandibular canine root (Figure 1c). After the bone block was mobilized (Figure 2a) with a flat chisel, it was firmly fixed into the defect area with two screws (Trinon®) (Figure 2b). The entire graft was covered with fibrin membrane (Figure 2c) and after periosteum release and thorough undermining of the buccal mucosa, which separated any muscle attachments to the flap, the wound was sutured with 0-4 Polypropylene (Figure 3a). The donor site was packed with collagen fleece and sutured in two layers (Figure 3b). At four months, good healing could be observed (Figure 3c) and a wrong incision was performed cutting the left papillae (Figure 4a). An implant of 5 mm diameter and 15.5 mm length (T.B.R.®) (Figure 4b) was inserted with a 45 N/cm torque and a non-functional immediate restoration was completed in the same day (Figure 4c). After a 12-week healing period (Figure 5a) a zirconia ceramic crown restored the implant and tooth 1.2 (Figure 5b). One year after prosthetic restoration, papillae filled the tooth-implant gap with the correspondingly desired result (Figure 5c); the seven years follow-up revealed papilla loss and bone graft stability (Figure 5, d and e).

Figure 1 – ***(a) Clinical feature revealing crown-root fracture; (b) Clinical feature after tooth extraction – loss of entire buccal plate; (c) Bone harvesting from chin.***

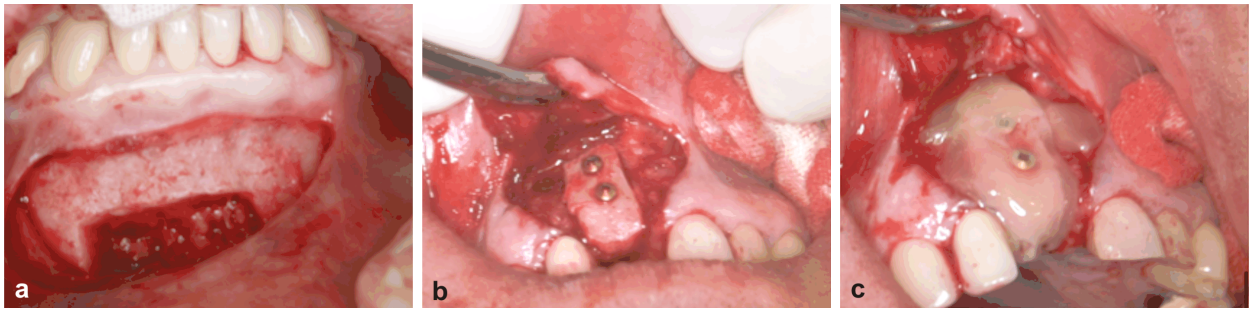

Figure 2 – ***(a) Chin aspect following bone harvesting; (b) Bone fixation on buccal plate with screws; (c) Covering of bone graft with fibrin membrane.***

Figure 3 – *(a) Wound closure after periosteum release; (b) Chin wound closure; (c) Healing after four months.*

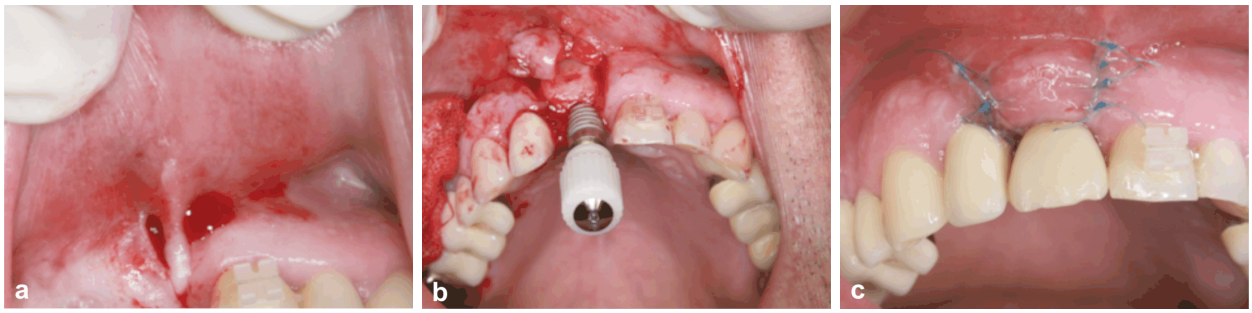

Figure 4 – *(a) Incision for implant placement; (b) Implant placement; (c) Non-functional immediate restoration.*

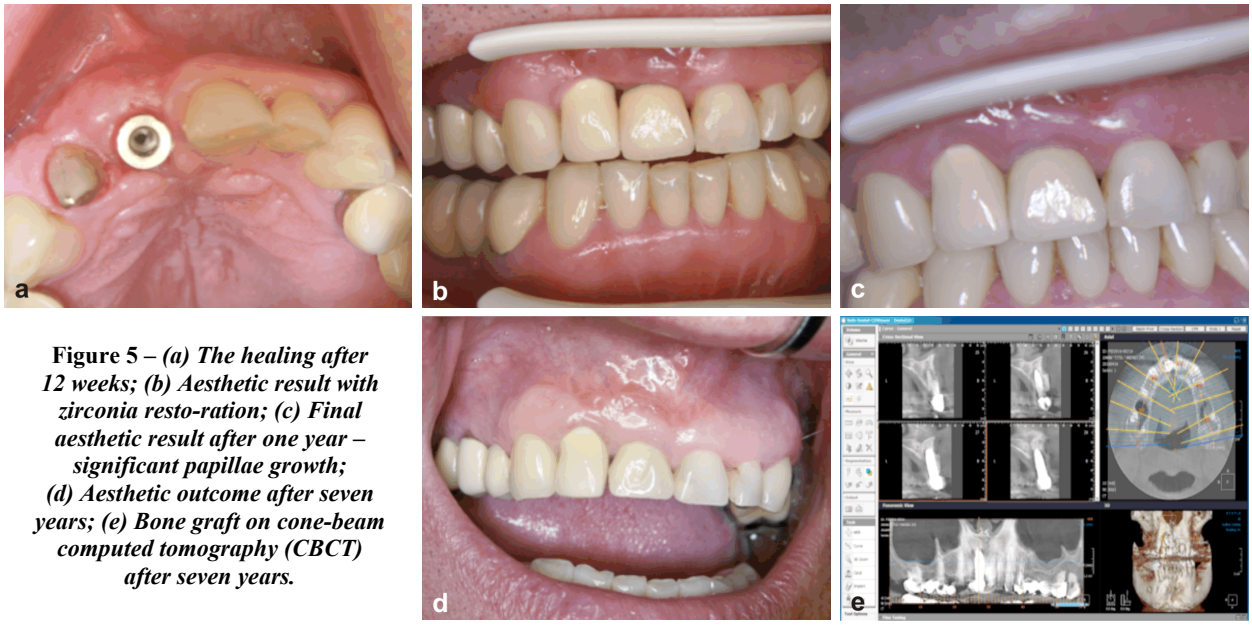

Figure 5 – *(a) The healing after 12 weeks; (b) Aesthetic result with zirconia resto-ration; (c) Final aesthetic result after one year – significant papillae growth; (d) Aesthetic outcome after seven years; (e) Bone graft on cone-beam computed tomography (CBCT) after seven years.*

Case No. 2

In the second case, a healthy 46-year-old female, A.J., presented in private surgery in February 2010. She had no smoking history and the clinical exam revealed low smile line and tooth 1.1 missing (Figure 6a). After flap raise, it could be noticed that the interdental septum was missing with significant vertical bone loss (Figure 6b). A bone block was harvested from the chin using the same surgical technique as in the first case. The bone block was placed into PRGF and allowed to soak while the other procedures were performed: harvesting of cancellous bone from cancellous compartment, the packing of donor site with collagen fleece, and the root planning of the tooth 1.2 (Figure 6c). The bone block was then split into two pieces and each piece was firmly fixed on buccal and palatal plate with one screw (Trinon®) (Figure 7, a and b) and all gaps underneath and around were then filled with cancellous particulate bone (Figure 7c). The entire grafted area was covered with fibrin membrane (Figure 8a) and the wound was sutured after periosteum release with 0-4 Polypropylene (Figure 8b). After six months, the probing depth was about 4 mm (Figure 8c) and the graft was reddish and well integrated (Figure 9a).

An implant of 5 mm width and 15.5 mm length (T.B.R.®) was inserted (Figure 9b) using motorized expander drills and drilling without cooling at 50 rpm. The bone fragments recovered from the drill was used to cover the buccal plate, the implant neck and the defect between the graft and the lateral incisor (Figure 9c). The entire graft was covered with several layers of fibrin membrane (Figure 10a). Because of high stability (40 N/cm insertion torque) the healing abutment was placed at the time of implant insertion (Figure 10b) and the probing

depth after a healing period of four months was about 2 mm (Figure 10c). The final aesthetic result was satisfactory due to the low lip line (Figure 11, a and b) and stable after seven years follow-up (Figure 12, a and b).

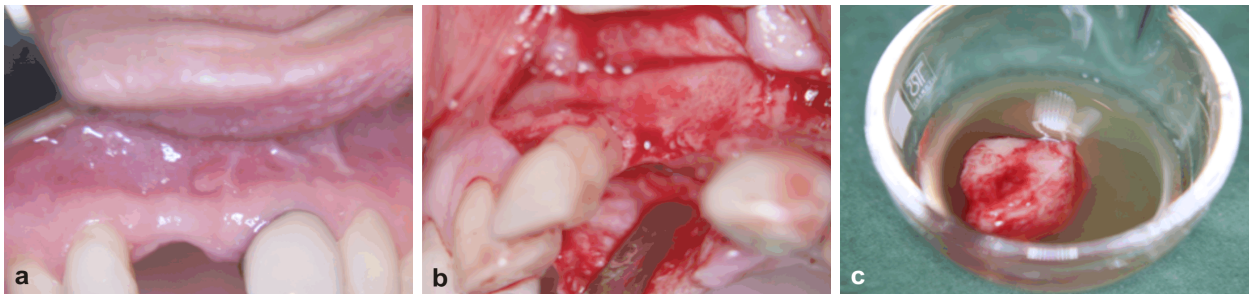

Figure 6 – ***(a) Clinical feature after tooth 1.1 removal; (b) Clinical feature with interdental septum, buccal and palatal plate missing; (c) Bone harvested from chin, soaking in plasma rich in growth factors (PRGF).***

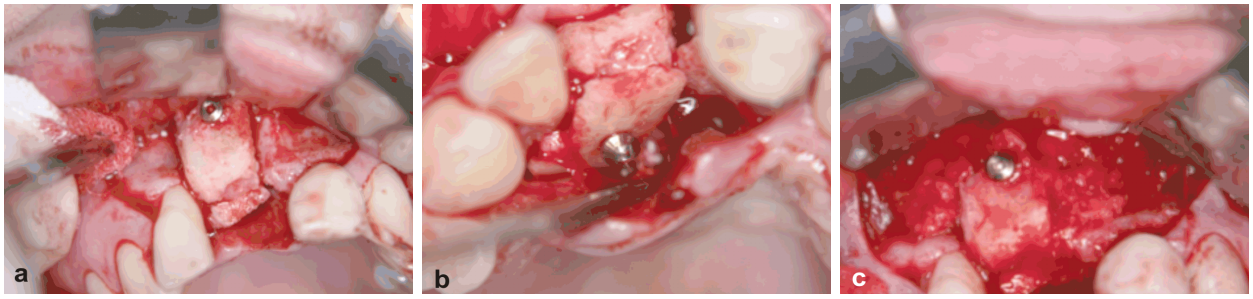

Figure 7 – ***(a) Bone fixation on buccal plate, after graft splitting; (b) Bone fixation on palatal plate after graft splitting; (c) Gaps filled with cancellous bone.***

Figure 8 – ***(a) Graft covered with fibrin membrane; (b) Wound closure after periosteum release; (c) Healing after six months.***

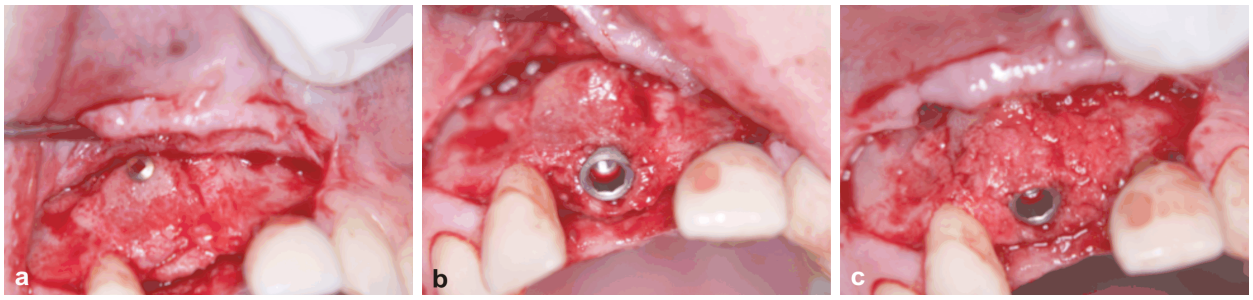

Figure 9 – ***(a) Graft integration after six months; (b) Implant placement into the grafted bone; (c) Bone augmentation with bone obtained from the drill.***

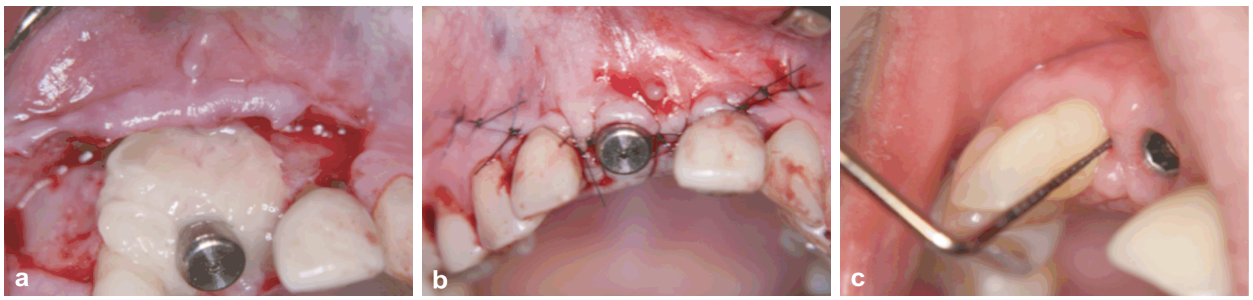

Figure 10 – ***(a) Graft covered with fibrin membrane; (b) Wound suture around the healing screw; c) Probing depth of about 2 mm.***

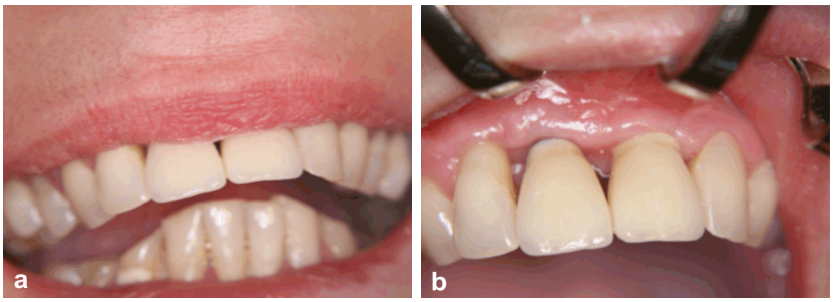

Figure 11 – *(a) Aesthetic result four months after the implant placement; (b) Aesthetic result with lip retracted.*

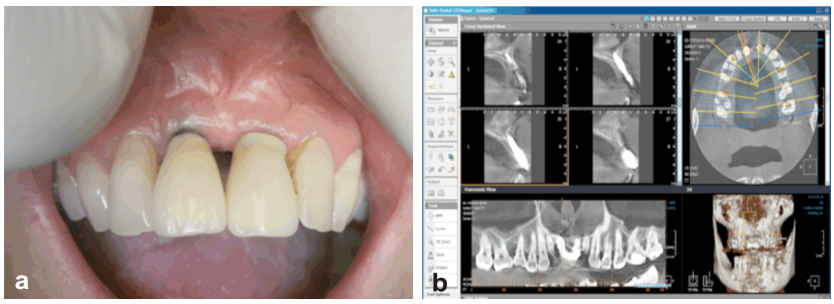

Figure 12 – *(a) Aesthetic outcome after seven years follow-up; (b) Cone-beam computed tomography (CBCT) after seven years follow-up.*

Discussions

The bone collected from the chin is predominantly cortical, with a reduced spongy component, which affects the re-vascularization efficiency. Even though the mandibular bone has an increased density, which makes it optimal for implants' osseointegration, its regenerative potential is reduced [1, 2]. Moreover, the reconstruction of the horizontal defect is more predictable than of the vertical ones, as there are more bone walls. Consequently, the source for the capillaries that will invade the graft is larger. On the other hand, the capillaries must migrate for a shorter distance to completely vascularize the graft. The more the capillaries have to migrate, the more difficult the complete vascularization of the graft is [16]. As a general approach, holes in the recipient site can be made in order to increase vascularization. No holes were made in either of the cases presented above. A more modern and better approach uses longitudinal sectioning of the bone block, thinning of the bone with a bone scraper and filling the gap between the bone graft and the recipient site with small bone particles; the bone graft is acting as a bone barrier against soft tissue penetration into the graft.

Strategies to improve bone regeneration are based on the enhancement of the body's natural healing processes and employ scaffold materials, signaling molecules and mesenchymal progenitor cells [17]. The proposed strategy to enhance bone regeneration by supplementation of grafting material with autologous platelet concentrates is still under debate: several authors confirm the benefits of PRP [14, 18–23] others deny its benefits [24–29]. Horizontal ridge augmentation enhanced with PRP is suitable for implant placement three months after grafting. This advantage should be considered because onlay grafts undergo significant remodeling that takes 2–3 years, the volume of the graft being reduced by as much as 25% [1, 2] to 40% within six months of placement [14]. Without PRP, the integration period for mandibular bone grafts is almost the same, 3–4 months, but stimulation of the re-vascularization induced by the growth factors and especially the resulting reduction in swelling enhances surgical success. Furthermore, it is known that rapid manipulation and transfer to the recipient bed may be essential for maintenance of cell viability and adequate healing [30]. With this in mind, maintaining placement of the bone within PRGF, thus allowing it to soak with growth factors while the recipient site is prepared, will help the graft re-vascularize.

In the first case, the implant was performed four months after surgery and no significant graft resorption was noticed. In the second case, however, the implant was placed six months after grafting and significant resorption was noticed. Even though the graft was integrated in the first case, the risk for dehiscence was very high; a deep incision was made for flap release that interested even the muscles fibers. A safer approach might be performing the bone graft procedure four weeks' after tooth extraction healing, done along with PRGF placement into the alveolar socket. Deep sectioning of the muscles fibers most likely leads to soft tissue healing without surgery needed for keratinized and attached mucosa. In the second case, a safer approach might be the extraction of tooth 1.1. and bone grafting in the position of both central incisors; placing the grafted bone in contact with the root of a tooth is risky due to the possible contamination, which can lead to graft infection and loss.

Due to very high current successful rates of dental implants osseointegration, the focus has recently shifted to achieving predictable aesthetic outcomes and consequently to the dental papillae in the aesthetic zone. Reconstruction of dental papillae became mandatory in order to fulfill patient's aesthetic demands. From this point of view, the Tarnow 5 mm rule plays a key role in aesthetic outcomes in the frontal area; if the distance between the base of the contact area and crestal bone is 5 mm or less, the papillae will grow almost 100% of the time; for each extra millimeter of bone defect, the probability of papillae growth is reduced by half [31]. In the first case, the papillae filled the entire "black triangle" in almost one year and no temporary crown was used, taking into consideration that there would be no difference in the long-term position of the papillae if a provisional temporary crown was placed [32]. Though the implant was 5 mm in diameter, the biological width was taken into

account [33], the seven years follow-up showed that the papillae was lost due to periodontal disease affecting the lateral incisor. In the second case, the distance from the contact point between the teeth to the bone level was so high, that no papillae growth was expected; the seven years follow-up revealed bone stability and a small gingival retraction at the level of teeth 1.1 and 2.1.

Conclusions

Autogenous bone blocks are valid for both horizontal and vertical augmentation but thin bone barrier and bone particles are nowadays the best choice for autograft bone augmentation. The success of vertical autogenous bone grafts in contact with teeth is always endangered by the possibility of graft contamination. PRGF is generally useful, but especially in vertical augmentation, considering the corresponding high risk of dehiscence. Tooth extraction with simultaneous bone grafting reduces treatment time but is complicated by high risk of dehiscence; thus, tooth extraction with PRGF, bone and soft tissue healing for four weeks prior to grafting may be a safer approach.

Conflict of interests

The authors declare that they have no conflict of interests.

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Received: October 21, 2018 *Accepted: June 22, 2019*