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Evaluation of Two Types Bone Substitutes in Preprosthetic Periodontal Therapy

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Abstract: *Bone substitutes are found in natural or synthetic form. Different types of bone substitutes are used, including alloplasts or xenografts. These materials should be biocompatible, and have adequate mechanical properties. Bone substitute materials have become a clinical procedure in the treatment of periodontitis. In current practice, various bone substitutes are used, including alloplasts (β-tricalcium phosphate) and xenografts with good results. The aim of this study was to evaluate the efficacy of alloplasts (β-tricalcium phosphate) and xenografts in the preprosthodontic periodontal therapy of intrabony defects. The study was carried out on a group of patients with severe periodontitis treated by periodontal surgery, in which these materials were used as bone substitutes. Patients presented or not performed fixed prosthetic restorations. These biomaterials function as osteoconductive scaffolds. Both materials ensure the filling of bone defects in periodontal intrabony defects through their own capabilities. Alloplasts (β-tricalcium phosphate) and xenografts are effective in periodontal regeneration. The evaluation of periodontal parameters after the surgical interventions with bone substitutes indicates the favorable prognosis over time of the two types of materials used.*

Keywords: *bone substitute, periodontitis, periodontal intrabony defect, prosthetic restoration*

1. Introduction

A bone substitute is a material used to repair a bone defect or deficiency contour and/or volume. Bone substitutes are found in natural or synthetic form. The bone substitute must have the following requirements: it must be biocompatible, bioresorbable, osteoconductive, structurally similar to bone, it must stimulate new attachment. For this reason are used biomaterials, including autografts, allografts, xenografts and alloplasts [1]. Different types of bone substitute materials are used, including alloplasts or xenografts.

Xenografts are bone substitutes in natural form which are obtained from a non-human species. They are obtained from animal sources (bovine, equine or porcine). Xenografts are osteoconductive with limited resorptive potential [2]. They are biocompatible and bioavailable. Xenograft has used as a framework for new bone formation. Bone mineral can be obtained from porcine sources. Porcine-derived xenograft is biomaterial deriving from heterologous bone and soft tissues. It is a cortico-cancellous heterologous bone, frequently used. This bone substitute is a porous anorganic material consisting mostly of calcium phosphate. They are presented in granular form, with particle size of 0.25-1 mm and 1–2 mm. These are are produced by removal of the organic components from porcine bone. The anorganic bone mineral matrix is biocompatible, having interconnected macro- and microscopic porous structure that supports the formation of new bone [3].

Alloplasts are synthetic bone substitutes. Alloplastic materials include ceramics and polymers. The most used alloplastic materials are hydroxy apatite (HA), tricalcium phosphates (TCP) and bioactive glasses. Alloplast materials are synthetic, anorganic, biocompatible, and/or bioactive bone substitutes which represent a possible alternative for the treatment of intrabony defects. They have no risk for cross infection/disease transmission. They are claimed to promote bone healing through osteoconduction. The advantages of alloplast bone substitutes involve their biological stability and volume maintenance [4].

Tricalcium phosphate biomaterials have a similar composition to bone mineral, are osteoconductive,

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and form a strong bone-calcium phosphate biomaterial interface. Tricalcium phosphates has two crystallographic forms; α-TCP and β-TCP.

β-tricalcium phosphate is a alloplastic material frequently used. β-tricalcium phosphate has been shown to stimulate bone formation. β-tricalcium phosphate has biocompatibility and osteoconductivity and is used as a partially resorbable filler allowing replacement with newly formed bone [5].

The bone substitutes materials alloplasts (β-tricalcium phosphate) and xenografts have been used in current practice to fill bone defects in periodontitis, to augment ridge defects, as well as for sinus lift with very good results. Biocompatible bone substitutes represent a possible alternative for the treatment of intrabony defects. The bone substitute material has a strong potential in complete periodontal regeneration. Indication of bone substitute materials are: deep intraosseous defects, furcation defects, ridge augmentation, sinus lift procedure, regeneration around implants, tooth retention, aesthetic, bone defects [6].

These materials have good clinical results based on their biocompatibility, improvement of clinical attachment levels, reduction of probing depths, and hard tissue fill of the intra-bony defects. Among the properties of bone substitute materials that indicate the choice of the type of material in the treatment of advanced periodontitis are: osteoconductivity, osteoinduction, progressive resorption capacity, interaction with the receiving site [7].

A special aspect is given to partially edentulous patients with periodontal disease treated with incorrect fixed prosthetic restoration that led to the aggravating of periodontitis.

Current concerns in the treatment of severe periodontitis are aimed at the use of bone substitute materials of different origins. Periodontitis have become a challenge for dentists in terms of treatment and prosthetic rehabilitation. Untreated, periodontitis develops with the destruction of periodontal tissues. At this stage appear periodontal intrabony defects, tooth mobility, tooth loss. Classical periodontal surgery has a limited potential in restoring periodontal tissues. Bone substitutes are used to contribute bone formation and periodontal regeneration.

Currently, bone substitute materials that have demonstrated clinical efficacy, functional periodontal repair, filling of apparent bone defects, and pocket reduction are preferred [8].

2. Materials and methods

The aim of this study was to evaluate the effectiveness of two different bone substitutes materials alloplast β-tricalcium phosphate (RTR Cone) and porcine-derived xenograft (Gen-Os Osteobiol) in the preprosthodontic periodontal therapy of intrabony defects. Bone substitutes were used comparatively, RTR Cone, developed by Septodont and Gen-Os Osteobiol developed by Tecnoss. The mode of action of the bone substitutes RTR Cone and Gen-Os Osteobiol was evaluated. The study was conducted over a period of five years on a group of 38 patients with severe periodontitis, presenting or not fixed prosthetic restoration. The group one of patients, men and womens, included 20 patients who benefited from alloplast (RTR Cone), and group two, 18 patients benefited from xenograft (Gen-Os Osteobiol) in periodontal surgical interventions.

RTR Cone is a alloplast material indicated as a replacement of bone lost, treatment of defects in bone or bone graft material. It is gradually reabsorbed. Made with β-tricalcium phosphate granules coated with a matrix of highly purified collagen fibers of bovine origin. Contributes to renew bone integrity in the next 3-6 months. Micro and macroporous osteoconductive structure that promotes the growth of new dense bone. Cone of 0.3 cm^3 (Ø 6 mm, H 10 mm).

Gen-Os Osteobiol is xenograft (cotico-cancellous bone mix) indicated in periodontal regeneration of deep infrabony defects, in replacement of bone lost, or bone substitute material. Gen-Os OsteoBiol is xenograft deriving from heterologous bone and soft tissues. It is a cortico-cancellous heterologous bone. It is biocompatible, it consists of a mineral component and an anorganic matrix. It has osteoconductive properties. Re-entry time is 4-5 months, depending on grafting site characteristics. Its composition allows a progressive resorption of osteoclastic type, with in parallel a similar rate of new bone formation. Standard granules between 0.25-1 mm.

The method of obtaining the data was achieved through the clinical evaluation of the prosthetic restorations, the periodontal parameters and through the radiological evaluation of the alveolar bone.

The examination of the patients was carried out before and after the addition surgery with bone substitutes.

The patient examination scheme includes: assessment of fixed prosthetic restoration, of abutment teeth in individual testing, periodontal indices, vertical bone resorption measured on all sides of teeth.

Some of partially edentulous patients, who participated in this study, also presented fixed prosthetic restorations, incorrectly adapted marginally, anchored on natural teeth. Most of the restorations aggregate on natural teeth were metallic or metallic-acrylic, less metallic-ceramic. The common feature was revealed by the coronal margins of the prosthetic restorations, too wide or too long at the cevical level. The age of prosthetic restorations varied between 5 and 15 years. Crowns that are too long or too wide at the cervical level favor the appearance of pockets, accentuating the periodontal disease accompanied by the related symptoms: pain, tooth mobility, gingival retraction, gingival bleeding, periodontal pockets, vertical bone resorption.

During the clinical examination, specific parameters were monitored in the case of periodontal disease.

Clinical parameters were measured preoperative and postoperative.

The clinical parameters monitored are: plaque index (PI), gingival index (GI), gingival bleeding index (GBI), pocket depth (PD).

Plaque indices were used to assess bacterial plaque. Plaque index (PI) ranges from (0-3), where code 0 is the absence of plaque and code 3 thick plaque accumulation. Bacterial plaque visible or not, as well as the appearance or not of bleeding on palpation are recorded on the all faces of the teeth. The retention of bacterial plaque and the appearance of gingival inflammation are the initial signs that indicate periodontal damage.

Gingival indices (GI) were used to evaluate the state of the gingival mucosa. Gingival index (GI) evaluates the degree of gingival inflammation from (0-3), where code 0 is a gingiva of normal clinical appearance, and code 3 is advanced inflammation, congestive, stasis, spontaneous bleeding.

Gingival bleeding index (GBI) uses formal calculations.

During the clinical examination, the pocket depth (PD) were measured. Measurements were made to assess the degree of severity of the periodontitis. The measurements were performed in the oral cavity on six areas, called sextants. They are in the maxilla and mandible both in the anterior area and in the right and left lateral areas of each arch. Probing depth measurements were carried out by using a periodontal probe and measuring the distance between free gingival margin and the base of the periodontal pocket. The periodontal variables were assessed at six different sites around each tooth. The depth of the periodontal pockets was noted. Deep periodontal pocketing ≥ 5 mm it has been found. Radiographs was used to evaluate bone loss.

The evaluation of the patients led to the following findings: the depth of the periodontal pockets was ≥ 5mm, dental mobility of different degrees, radiologically, vertical bone resorption. The periodontal intrabony defects presents one-wall, two-wall, three-wall or combination. Also, presents extension of defect to buccal or lingual walls, or circumferential defects.

The following mean values for clinical parameters were found preoperative. Initial, plaque index (PI) , mean value and standard deviation for group 1 was 1.3±0.48 and for group 2 was 1.3±0.67. Gingival index (GI) mean value and standard deviation for group 1 was 1.4±0.51 and for group 2 was 1.4±0.69. Probing depth (PD) mean value and standard deviation for group 1 was 5.5±0.52 mm and for group 2 was 5.4±0.51 mm.

Gingival bleeding index (GBI) had values 55% for group 1 and 60% for group 2. Mucosal inflammation is present in 70% of cases.

The followed protocol was the removal of incorrect fixed prosthetic restorations, then surgical interventions with bone substitute for the periodontal intrabony defects and after the healing period, the replacing of the prosthetic restoration. After hygenisation the oral cavity through the usual treatments, and carrying out the specific medication, periodontal surgery with open flap debridement and bone substitutes were done. The open flap surgery were carried out following the usual surgical protocol (Figure 1). The sutures were removed after 8-10 days (Figure 2).

Figure 1. Periodontal intrabony defects

Figure 2. Postoperative aspect

Postoperative follow-up of patients was for a period of five years. The criteria used to assess the treatment are as follows. Regarding the abutments teeth, namely the absence of mobility, pain and infectious processes. Regarding the success of the prosthetic restoration, the stability, aesthetics and complications were checked. The evaluation of the periodontal parameters was followed after the periodontal surgery and after the correct performance of the necessary fixed prosthetic restorations. The correlation between alveolar bone resorption and the design of prosthetic restorations was followed. Corroboration of clinical and radiological data will highlight the impact of prosthetic restorations on the supporting structures.

3. Results and discussions

No significant differences were found between the two bone substitutes alloplast (β-tricalcium phosphate) and porcine-derived xenograft in relation to postoperative prognosis in the case of periodontitis. Both materials give a favorable prognosis.

This alloplast material is indicated in different clinical cases in oral surgery, periodontal surgery and implantology. It progressively resorbs. It is able to serve as a framework for new bone formation. Resorbable in the long term and have the potential for replacement by host bone. This biomaterial can also be applied in bone defects that do not close.

This xenograft is able to resorb progressively while new bone formation takes place. The biomaterial provides support in bone neoformation helping to preserve the original graft volume. Xenograft bone substitute is one of the materials of choice used for the sinus lift. Both materials have particularities. The xenograft used has the ability to double its volume in contact with liquids.

Postoperatively, the patients healed in the same way and postoperative inflammation is greatly reduced under the conditions of using the two materials. The pain is absent under the conditions of antialgesic medication and disappears after 2-3 days. The healing time with the two materials is almost similar (Figure 3). Gingival reattachment begin after 7-10 days postoperatively. After periodontal surgery, the gum reattaches, reforming the gingival sulcus.

The efficiency of two types bone substitutes in new bone formation is almost similar, and superior to other bone substitutes. Both materials ensure bone healing, without causing postoperatively recurrences. They completely restore the bone defect, with a time margin between 3-6 months depending on the complexity of the intervention. In periodontitis, at the level of the periodontal intrabony defects, the bone is completely restored in a period of 5-6 months, when it reaches stability. After surgery, in the interval of 1-5 years, the disappearance of the periodontal intrabony defects was highlighted by the measurements.

The following mean values for clinical parameters were found postoperative, Plaque index (PI) mean value and standard deviation was 0.6±0.51 in group 1 (treated by alloplast) in the interval 1-5 years postoperatively. In the same interval, plaque index (PI) mean value and standard deviation was 0.6±0.69 in group 2 (treated by xenograft).

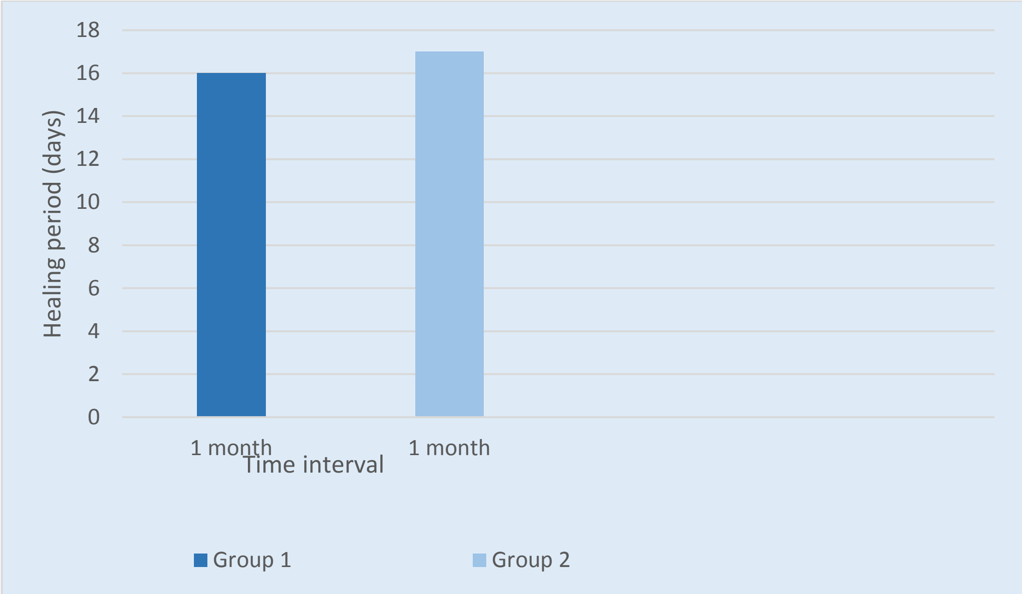

Figure 3. Postoperative healing in Group 1 (treated by alloplast) and Group 2 (treated by xenograft)

Gingival index (GI) mean value and standard deviation was 0.5±0.52 in group 1 in the interval 1-5 years postoperatively. In the same interval, gingival index (GI) was 0.5±0.7 in group 2.

Probing depth mean value and standard deviation was 2.1±0.3 mm in group 1 (treated by alloplast), in the interval 1-5 years postoperatively (Table 1). Probing depth mean value and standard deviation was 2.1±0.32 mm in group 2 (treated by xenograft), in the interval 1-5 years postoperatively (Table 2).

The gingival bleeding index (GBI) was 9% for group 1 and 12% for group 2. Spontaneous bleeding, or bleedind on palpation was also detected after an interval of 4.5-5 years. Bleeding on palpation or spontaneous also depends on the alignment of the teeth, on the presence of tremors, or diastemas, which favor this.

Table 1. Clinical parameters pre and post-operative in group 1 (treated by alloplast)

Group	N	Parameter	Status	Mean±SD
Group 1	20	Plaque index	Initial	1.3±0.48
			Postoperative	0.6±0.51
		Gingival index	Initial	1.4±0.51
			Postoperative	0.5±0.52
		Probing depth (mm)	Initial	5.5±0.52
			Postoperative	2.1±0.3

SD= standard deviationș, N= number of patients

Table 2. Clinical parameters pre and post-operative in group 2 (treated by xenograft)

Group	N	Parameter	Status	Mean±SD
Group 2	18	Plaque index	Initial	1.3±0.67
			Postoperative	0.6±0.69
		Gingival index	Initial	1.4±0.69
			Postoperative	0.5±0.7
		Probing depth (mm)	Initial	5.4±0.51
			Postoperative	2.1±0.32

SD= standard deviationș, N= number of patients

The comparison of the mean values of gingival index between group 1 (treated by alloplast) and group 2 (treated by xenograft) shows the favorable post-operative results (Figure 4).

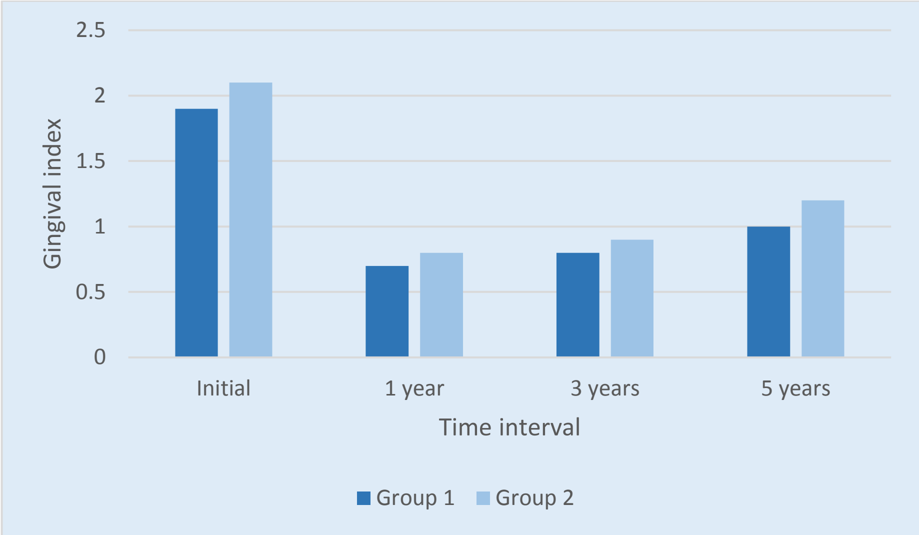

Figure 4. Gingival index mean values pre and post-operative in Group 1 (treated by alloplast) and Group 2 (treated by xenograft)

Probing depth mean values indicates a good reattachment (Figure 5). Dental mobility has reduced within physiological limits.

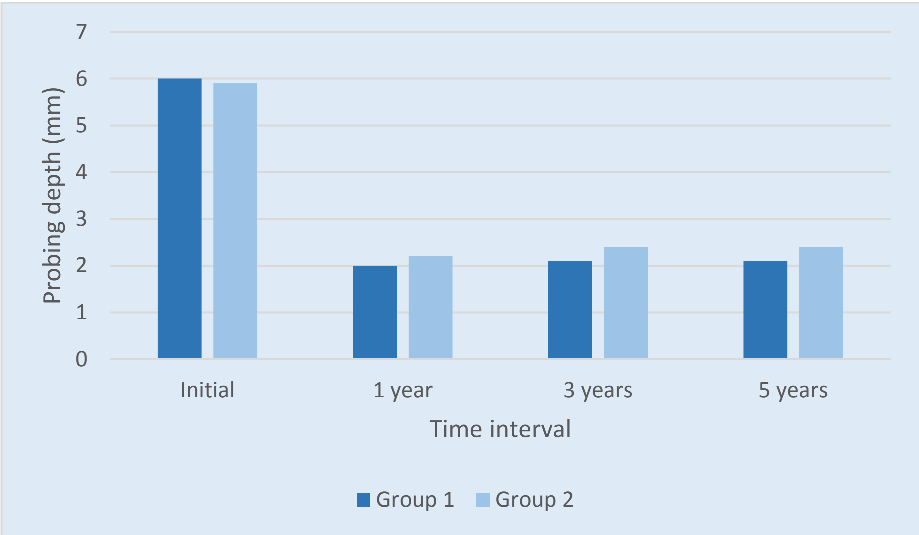

Figure 5. Pre and post-operative probing depth mean values in Group 1 (treated by alloplast) and Group 2 (treated by xenograft)

Alloplast (β-tricalcium phosphate) has optimal results in a short time due to its cone-shaped presentation, which maintains the initial height of the bone defect. After an interval of 6-9 months, in periodontitis, the results with alloplast and xenograft are almost similar.

On radiography, neoformation bone is present in both types of materials. The radiographic appearance with both materials shows homogeneous neoformation bone. The appearance of xenograft on X-ray is slightly more opaque than alloplast material due to components and it has.

The rate of resorption of the postoperatively filler material is important, the materials are progressively resorbed. The resorption rate of these two materials is almost similar, as the generation of new bone by osteoconduction. The resorption of the filler material is influenced by its composition.

The action of these two bone substitutes is similar due to their composition which includes calcium phosphate. Granule size influences bone regeneration capacity, applicable to both biomaterials. The results over time with both bone substitutes are almost similar due to the appropriate granule size. Bone regeneration is evident with both types of materials.

The structure of both bone substitutes allow vascularization. This is achieved by porosity and biochemical support. Latter can support colonization and retention of osteogenic cells and nutrients through increased capillarity. The establishing of a vascular network will provide nutrients, soluble factors, and minerals. The porous structure of bone substitute is essential for the development of vascularization. Pore size has a role in bone growth and can enhance it when it is from about 80 to 200 μm, ensuring cell colonization. Porosity fraction in the bone substitutes ensure to a higher bone-inducing protein absorption. Interconnected pores are an important characteristic [9].

Porcine-derived xenograft ensures complete vascularization in the wound through the ability of the granules to combine with the products in the wound. Due to the collagen content, once hydrated it becomes hydrophilic. It combines well with blood and is very stable once applied in the bone defect. Xenograft bone substitute, being an anorganic component of bone of animal origin, has an osteo-conductive potential, forming chemical bonds with the products from the wound. This xenograft through its collagen content improves blood clotting and the subsequent invasion of regenerative cells [10].

Studies on the angiogenic potential of porcine-derived xenografts and bovine-derived xenografts in the culture of periodontal ligament cells showed the improvement of the secretion of vascular endothelial growth factor by periodontal ligament cells. On the other hand, a significant increase in endothelial cell proliferation was observed in cultures with both media conditioned by porcine-derived xenografts, but not by bovine-derived xenografts. Porcine-derived xenografts by cortico-cancellous composition has a progressive resorption of osteoclastic type, with in parallel a similar rate of new bone formation. Porcine-derived xenografts attracts bone cells and induces the formation of new bone slightly faster compared to β-tricalcium phosphate [11].

Alloplast (β-tricalcium phosphate) can accelerate bone remodeling by facilitating the colonization of osteogenic cells and nutrients through increased capillarity and appears to have the potential to influence angiogenesis. *β*-tricalcium phosphate combines with proteins or mineral substances in the wound and also ensures complete vascularization in the wound. *β*-tricalcium phosphate ensures the formation of new bone, thanks to calcium salts, which are fixed in the bone and transformed into osteogenic cells. β-tricalcium phosphate resorbs in approximately 13-20 weeks after implantation and is then completely replaced by remodeled bone [12].

β-tricalcium phosphate has the mineral component, which provides the necessary matrix for new bone formation. *β*-tricalcium phosphate is a biocompatible and bioresorbable material with properties similar to the anorganic phase of bone. Resorption of *β*-tricalcium phosphate depends on dissolution by biological fluids in the absence of osteoclasts surrounding the materials and by the presence of osteoclast-mediated resorption based on osteoclast-like giant cells in defect areas in many studies. Its resorption is slower than the resorption of calcium sulfate [13].

Studies have shown that β-tricalcium phosphate stimulates bone formation, being comparable or superior to hydroxyapatite, in most cases. Cultured human fibroblasts have been demonstrated to attach readily to the surface of calcium phosphate ceramics [14].

Both bone substitutes provide complete filling of bone defects compared to other materials. The efficiency of these two biomaterials is almost similar in the formation of new bone in periodontal pockets. The new bone is stable in both situations (Figure 6).

These two types bone substitutes are used in the periodontal regeneration with very good results. After an interval of 1-1,5 months, gingival reattachment is present with both mentioned materials, and the level of gingival reattachment indicates postoperative healing [15]. After surgery, at 1-1,5 month well defined epitethelial attachment with fully epithelialized gingival sulcus is present [16].

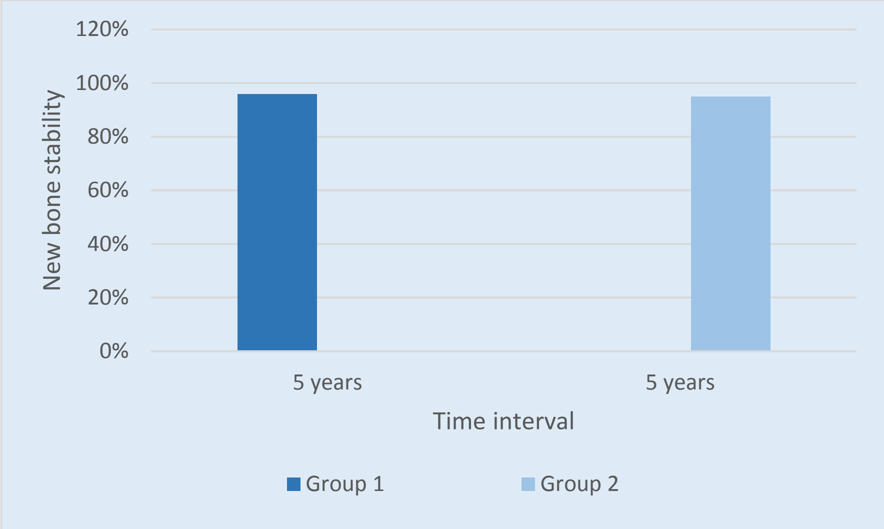

Figure 6. New bone stability in Group 1 (treated by alloplast) and Group 2 (treated by xenograft)

For this reason, the long-term prognosis of patients with the mentioned addition materials is very good. After the periodontal surgery with the use of bone substitute materials, the removed of the periodontal pockets was achieved. Bone regeneration was complete. Studies indicate the reduction of the depth of the periodontal intrabony defects after surgical grafting treatment by approximately 3.3 ±1.4 mm [17]. Complete regeneration depends on the number of bony walls, it is almost maximum in the case of three-wall defects and less in the case of two-wall defects [18]. Specialized studies indicate that the number of walls of bone defects conditions the results. The configuration of the defect plays an important role in the bone subtitute outcome as the biomechanics of regeneration [19]. Three-wall intraosseous defects provide a good scaffold because they remain surrounded by bone on three sides and tooth on the fourth, thus providing good stability to the graft material [20].

Properly performed fixed prosthetic restorations perfectly adapted marginally and proximally contribute to maintaining the positive result over time. Adaptation of prosthetic restorations in occlusion is essential [21]. In fixed prosthetic restorations performed after periodontal surgery their occlusal equilibration has a role in managing the marginal periodontium. Occlusal forces must be transmitted in the long axis of the teeth. It also removes any phenomenon of occlusal overload, which may have consequences for the teeth. The stimulus act on the marginal periodontium in the conditions of the existence of interdental spaces, causing gingival inflammation, gingival bleeding and with the consequence of aggravating periodontitis.

The results of the study carried out on two groups of patients treated or not with bone substitutes, indicated that the porcine-derived xenograft significantly improved the clinical and radiographic results during the study. For maxillary sinus augmentation and around dental implants, xenograft bone substitute has a maximum result [22].

The use of β-tricalcium phosphate showed very few complications like infection. Although its suitable mechanical resistance, β-tricalcium phosphate is still inferior to mechanical properties of cancellous bone or of a bone allograft. From the point of view of regenerative potential, β-tricalcium phosphate (β-TCP) bone substitutes are similar to autogenous bone [23].

β-tricalcium phosphate have been used in clinical studies to repair periodontal defects and alveolar bony defects. Tricalcium phosphate has better absorption than hydroxyapatite (HA) and is more porous than hydroxyapatite (HA). The compressive and tensile strength of tricalcium phosphate is similar to that of cancellous bone. Therefore, it is used in regions with no mechanical load [24].

Studies performed on groups of patients with intrabony defects treated with guided tissue regeneration and autogenous spongiosa, alone or combined with HA/β-TCP bone substitutes or bovine-derived xenograft (BDX), do not show significant differences in clinical parameters. At 12 months, HA/β-TCP and BDX treatment produced similar improvement in intrabony tissue regeneration [25].

Studies of sinus augmentation with bovine hydroxyapatite (BHA), biphasic calcium phosphate (BCP) and pure β-tricalcium phosphate (β-TCP) showed: each material contributed to the formation of new bone, but its architecture was different. 2 months after surgery, the (BHA), formed a bone bridge between the particles, while the β-TCP substitute shows that it is undergoing bone formation [26].

Studies done on sections of mandibular defects filled with autograft, xenograft or alloplast β-tricalcium phosphate (β-TCP) at intervals of 1, 2, 4, 8 weeks showed that autografts and β-TCP produced slightly more new bone during initial healing (after 4 weeks) [27].

The study shows that β-tricalcium phosphate and calcium sulfate treatment resulted in a favorable clinical improvement of periodontal intraosseous defects one year after surgery. Mean differences were found in the case of probing depth of a reduction of 1.98+/-1.16 mm between the initial value and one year postoperatively [28].

Xenografts present a minor risk of rejection, due to their porcine origin. Alloplasts also have a minor rejection risk, even synthetic ones. Xenografts of bovine origin can present or induce diseases, such as bovine spongiform encephalopathy, in a very low percentage. Xenografts of porcine origin can produce or induce certain diseases (porcine endogenous retrovirus) in a very low percentage [29].

The maintenance of the patient from 3, 6 months with the implementation of the oral hygiene protocol plays an important role. Early management of intrabony defects should take into consideration the influence of such factors, as smoking, poor oral hygiene, tooth mobility, and defect morphology, on periodontal regeneration [30].

The advantages of using these bone substitutes materials are the following: periodontal regeneration and optimal gingival reattachment, restoration of the periodontium that makes disease reversal possible. They also improve tooth implantation, function and aesthetics. Clinical results can be maintained over long periods (>10 years) [31, 32].

Different types of bone substitute and also their combinations are used with varying degrees of success. Complete periodontal regeneration is predicted with any currently used regenerative therapy, periodontal bone substitutes show strong potential [33].

4. Conclusions

Bone substitutes are used to promote bone formation and periodontal regeneration. Different types of bone substitute are used, including alloplasts or xenografts. Biomaterial requirements include osteoconductivity and biocompatibility. Bone substitutes have progressive resorption, with in parallel a similar rate of new bone formation. These properties allow good volume preservation and a healthy new bony tissue. The bone substitutes alloplasts (β-tricalcium phosphate) and xenografts ensure the formation of capillary networks, through angiogenesis, in a similar way, and subsequently generate new bone through osteoconduction.The two bone substitute materials have a almost similar behavior in the formation of new bone and in the reconstruction of bone defects generated by periodontal intrabony defects. Alloplasts (β-tricalcium phosphate) and xenografts are effective in periodontal regeneration by restoring clinical parameters. The maintenance of the patient and the choice of the bone substitute ensure the success of the treatment.

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