CLINICAL TRIAL REGARDING THE SIZE OF THE IMPLANTS INSERTED IMMEDIATELY OR DELAYED USING EXTERNAL SINUS LIFTING TECHNIQUES

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Keywords: immediate insertion, delayed insertion, external sinus, sinus augmentation techniques Abstract: Introduction: Inserting the implants in the upper jaw posterior area remains a challenge for any implantologist when the bone offer is poor, a difficult approach, near anatomical structures and the risk of perforating the sinusal membrane. Many prosthetic techniques have been tested in case of bone atrophy, by protecting the sinusal area, but the most optimal intervention on the sinus remains separating the sinusal membrane and augmentation. Materials and methods: This retrospective study is part of a bigger project which aims the osseointegration of S-Line implants in Osteon allografts, taking place for a period of 1 year in the Oral Implantology Clinic within the Military Hospital of Sibiu in partnership with the manufacturing company. Results and discussions: This study included implants that were prosthetically loaded with metal-ceramics reconstructions always secured and not including adjacent natural teeth. Selected patients were not exposed to other alveolar ridge augmentation techniques; the width of the ridge was above 5 mm. For all the patients in the study we have inserted implants for every missing tooth in the upper jaw lateral area, providing a safe mechanical support. Subcortical clogging technique was not used to avoid aspiration of the implant in the sinus. Conclusions: In the limits of this study the data has argued that beta-tricalcium phosphate of Osteon in sinus lifting is a secure material, predictable, with no signs of adverse reactions and no invasive.

INTRODUCTION

Before the 80's, the loss of bone offer in the upper jaw posterior area excluded the insertion of implants with fixed prosthetical support.

Experimental studies of Bonye, James and Tatum (1,2) regarding the grafts in the upper jaw sinus, a larger number of new procedures and studies have documented the use of different implants and materials for grafting.

For placing the implants in the upper jaw posterior area, augmenting the sinusal board became a routine procedure (3) that can lead to a high rate survivability of the implants.(4)

Autograft bone is considered to be the golden standard reconstructive material in bone growing with bone-favourable, bone-proliferative and bone-inductive proprieties, but not all patients are willing to accept a new intraoral surgical site.

The second option with lateral approach (Tatum Technique) and granular graft augmentation is applied where the bone height is less than 5 mm. The granular graft is left there to heal and integrate for 6-8 months regarding the lateral depth of the site, the proportion of the autograft bone or the graft volume. The clinician evaluates the bone graft when placing the implant in the matured graft to estimate the healing time and bone-integration. 5 to 8 months must pass before the prosthetic reconstruction, depending on the bone density in the moment of the implant insertion, the most common density of the sinusal bone graft being D4 bone.

A few anatomic concepts make us better understand the surgical approach technique of the upper jaw sinus when augmenting and inserting the implants. The upper jaw sinus is the biggest para-nasal sinus, with pyramidal shape, the base being vertical on the median surface of the lateral nasal wall. The sinusal board is placed 5-12 mm under the nasal board. The scales are 15-20 cc for volume, 32-34 mm for length, 28-37 mm for height and 23-25 mm for width. The upper jaw sinus is surrounded by six bony walls, the board extends with age and with the loss of sinusal teeth it extends to the remaining alveolar ridge.(5)

The alveolar bone in the posterior area of the upper jaw is lost when using partially mobilized prosthetics or by having an edentulous ridge for a long time. Under the mobilized prosthetics the loss of bone is caused by compressive forces leading to pressure necrosis. Yet, some patients that do not use prosthetics have severely obsolete ridges. This is caused by unused atrophy, parodontal disease, traumatic extractions, systemic diseases.(6)

Sinusal augmentation procedures have been introduced to offer an adequate support for implantation in the lateral area of the upper jaw which is highly resorbed. New surgical techniques and tools have simplified the upper jaw's surgery. Thereby, piezosurgery osteotomy enables the attainment of a bone gap without impairing the soft tissue, and piezoelectric elevation of the membrane avoids perforations.(7)

In addition to technical competence, the clinician has to be versatile in indications, contraindications and the anticipation of each and any therapeutic approach in prosthesis on implants of the upper jaw posterior area. Therefore, after extracting an upper molar, if the clinician understands that an implant can be immediately inserted with augmentation and restoration after 5 months, the idea of prosthesis on implants becomes attractive. If we wait for post-extraction healing time, followed by the sinusal augmentation procedure and insertion of implants in a third surgical stage it is unlikely that such an algorithm will be chosen.(8)

Another indication for the sinus lifting in upper terminal edentation is represented by decreased inter-arch space, the presence of a lowered upper jaw tuberosity or a collapsed

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occlusion and a thin layer of bone, the sinus lifting offers the possibility of later osteoplasty adjusting the vertical occlusion space.(9)

Approaching the treatment plan for creating prosthetic abutments in the edentulous upper jaw posterior area was organized by C. Misch in four alternative treatment options, which depends on the bone height available between the sinusal board and the margin of the residual ridge.

The first option allows placing the implant by a standard procedure, the posterior area of the upper jaw having a height bigger than 12 mm and width of 5 or more mm. If the width is between 5 and 2.5 mm the ridge has to be increased in width through splitting and augmentation techniques.

The second option is elevating the sinusal board through *greenstick* osteotomy, recovering 2-3 mm in height. Sinus lifting technique through ridge approach is applied to ridge bone that has a minimum height of 8 mm.

The last two options stand for this study. When the bone height is at least 5 mm, it is recommended the grafting of the bone through a lateral gap and placing the implant in the same session, the healing time starching between 5 and 8 months.(10)

MATERIALS AND METHODS

The data was collected from consultation and treatment files, and images from radiologic files and imagistic archive located in Dental Medicine Ambulatory. Taking in consideration that external sinus lifting technique is indicated where the sinusal board has a height limited to 5-6 mm in the upper jaw posterior area, there had been selected only the cases that would fit into the parameters of these measurements. We have chosen the vertical dimension criteria of the sinusal board and not the bone quality (density) for keeping a constant analysis of the results. Patients included in the study have been grouped in two batches: batch I included patients with external sinus lifting thereupon inserting Implantium S-Line implants (Dentium S-Koreea) simultaneously augmenting the sinusal board with allografts type Osteon (Dentium S-Koreea).

Figure no. 1 Sinusal augmentation, 1 part, with delayed loading



Figure no. 2 Insertion of implants at 8 months at augmentation



Batch II included patients with lateral gap sinus lifting in which the insertion had been delayed, after the maturation of bone allograft type Osteon (Dentium S-Koreea) using the same implants, Implantium S-Line, finally registering the dimension of the inserted implants and comparative evaluation of the data. For the accuracy of the calculations, there have been selected only the cases that used Implantiun S-Line of 10 and 12 mm height, 3.8 and 4.2 mm diameter (figures no. 1,2,3).

Figure no. 3. Implants' insertion at the same time with sinusal augmentation



RESULTS

The average vertical height of the alveolar bone measured from the top of the alveolar ridge to the sinusal board was on average of $3.5 \text{ mm} (\pm 2.5 \text{ mm})$, a height between 2-5 mm, being the main selection criteria for both groups.

The first group included 20 patients. In 4 cases, the intervention was bilateral and in 16 cases, the intervention on the upper jaw sinus had a unilateral approach. 52 Implantium S-line (Dentium S-Korea) implants had been inserted with a length of 10 and 12 mm, average length of the dental body being of 10.97 \pm 0.49 mm. The diameter of the 10 and 12 mm length implants was 3.8 mm with a splayed cervical platform of 4 mm, connection system type *switch-platform* and 4.3 mm implants with cervical platform of 4.5 mm, an average diameter of 4.4 \pm 0.54 mm.

The second group included only 11 patients, 4 of which had implants inserted bilateral on Osteon graft and 7 patients unilateral, in total of 15 surgical locations. 44 implants had been inserted with the average length of the S-Line implant body of 8 mm and maximum length of 12 mm. The average length of the inner-bone dental body was 9.54 ± 0.31 mm. The diameter of the implants was 3.8 mm with cervical platform of 4 mm and 4.3 mm implants with splayed cervical platform of 4.5 mm, the last ones mostly having 10 mm length.

The implants inserted for both groups of patients had been kept under surveillance up to 1 year after the insertion; during this period of time, there had been no failure and no other form of complication after the prosthetic loading (mucositis, peri-implantitis, looseness or fracture of the screw,etc.).

Exposure technique of the implants in the second surgical stage used an M shaped flap, described by Paolantoni and co. This technique prevents the vestibular marginal recession and achieves an esthetic shaping of the soft tissues around the implant, assures the prosthetic-gum integration of the implants inserted in the edentulous lateral upper jaw area.(11)

DISCUSSIONS

Sinus lifting depends on the graft material that is being used, before, the golden standard was the autograft bone but in present days this is substituted by allografts or xenografts. By using bone substitutes, the surgery needed for harvesting the autograft can be eliminated but the bone substitutes must be resorbable and fully replaced by a new, functional bony formation. Most bone augmenting products were synthetic hydroxylapatite, bovine bone, tricalcium beta-phosphate, demineralised frozen dry bone or bioactive glass. This study uses allograft that contains beta-tricalcium phosphate contained in Osteon. There are many studies about using beta-tricalcium phosphate grafts in sinus lifting procedures and it is known that this material is osteoconductive, bone regenerating, acts in biodegradation and volumetric stability of the graft. Porous biomaterials with beta-tricalcium phosphate contained in Osteon act like a frame for bone tissue regeneration, and guides the migration of cells and blood vessels through the pores, using this biomaterials can trigger bone apposition on the sinusal level. Implant surgeon resorts to techniques that improve bone offer for using implants that are long as possible and as large in diameter in lateral area where the stress has a high value, such implants have a high rate of success.

Inserting implants in the posterior area of the upper jaw that are < 10 mm can lead to sinusal perforation because of the reduced height of alveolar ridge, in addition terminal edentulous upper jaw submits more challenges like low access, limited view, reduced space and inferior quality bone. Altogether if the remaining bone has a height above 5-6 mm, then the augmentation procedure and the implant insertion can be done simultaneously.

When the ridge is severely resorbed and has a height less than 5 mm (1-5 mm), the augmentation of the sinusal board is recommended through a lateral gap, expecting 6-8 months for maturation of the biocompatible and bioresorbable granular graft, inserting the implants in a second surgical stage. This procedure is also predictable, but the patient tends to a discomfort state due to a second surgical intervention, prolongation of the treatment, and sometimes the quality of the new formed bone does not assure the primary stability for the implants. Besides the volume of the alveolar bone that is important, bone density, cortical quality of the alveolar bone allows inserting the implants simultaneously with sinusal board lifting through lateral approach in situations of severely resorbed ridges, having the same survival rate as the delayed insertion or a small diminished success rate. When the cortical of the sinusal board is reduced, the primary stability (above 15 Ncm²) can be obtained even if the height of the bone is 2 mm and width above 6 mm.

Sinus lifting through lateral approach is a surgical procedure that needs a previous optimal evaluation (CT, CBCT, OPT) and an operative protocol strictly kept to eliminate the possible complications. A new intervention after a failure in sinus lifting is not likely due to surgical scars and fibrosis of sinusal membrane. High failure risk places the implantology surgeon in an unpleasant situation and determines him to choose shorter implants (7-8 mm) which are in contradiction with the optimal purpose of augmenting the sinusal board. This study supports the idea that in the upper jaw lateral area, where the occlusal stress is important in assuring the success of prosthetics on implants, the implants inserted must have more than 10 mm length and a diameter of at least 4 mm. Likewise, this study recommends that clinicians overlap the augmenting techniques over the insertion of optimal implants for the lateral area when the bone offer assures primary stability.

This study proves that the length and diameter of the implants and adapting the forces from lateral area is more meaningful when implants are immediately inserted rather when the insertion is delayed, where implants under 10 mm length were used. The study confirms the biomechanical concept which shows that the results and predictability of the prosthetic structures are better when the implanting support is composed of implants with length above 10 mm and diameter more than 4 mm. The study had found that delayed insertion after sinus lifting is possible, but radiographic images have shown a reduction in volume between the two surgical interventions due

to reorganizing and resorption of the beta-tricalcium phosphate graft.

SLA surface of the S-Line implants are perfectly adapted for osseointegration in the sinus lift graft, and the design with splayed cervical platform allows docking in the cortical bone and an excellent primary stability.

Simultaneously inserting an implant and graft, through the lateral gap the implant finds a spot between the graft material and some bone remnants that remained between the base of the implant and the sinusal membrane and by keeping the detached bone shutter the sinusal membrane can be raised more than planned. This is the reason why the sinusal cavity created after raising the membrane must be filled without pressing the graft material.

CONCLUSIONS

Using bigger implants with sinusal augmentation techniques removes the risk and keeps us away from the tendency of using shorter and inadequate implants for the stress in the lateral area. There have been differences between the lengths of the implants used for the two lots of patients. Sinus lifting with simultaneous insertion we had the possibility of using longer implants by 1.41 mm.

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