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Sinus Grafting with Concentrated Growth Factors

Dental Implant Maintenance

A Case-Study of Seven Dental Implants Placed in the Maxillary Sinus with Intentional Schneiderian Membrane Perforation

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Abstract

Background: A growing number of edentulous patients are receiving treatment with dental implants. In cases of vertical alveolar ridge deficiencies of the posterior areas of the maxilla, the prevailing method of treatment is increasingly the sinus floor elevation procedure.

Method: A new and innovative technique named "IPG" utilized for the placement of seven (7) implants in the posterior areas of the maxilla in a 50 year old female patient, is presented. The novelty of the proposed method is that the implants, which were placed in a flapless approach, entered both the sinus cavities with intentional perforation of the Schneiderian membrane. Concentrated growth factors (CGF), as well as alloplastic bone grafting material were employed in this study, following an innovative protocol.

Results: Radiographs were examined at various stages during the process of osseointegration in order to assess the increase and maturation of bone structure formed around the implants and over the sinus floor. Healing was without incident and provided excellent results.

Conclusions: The promising results, derived from the "IPG" DentistEdu technique demonstrate that it can be considered as a reliable alternative to the sinus floor elevation procedure.

KEY WORDS: Dental implants, maxillary sinus, bone augmentation, membrane performation

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INTRODUCTION

Partially or completely edentulous patients typically have a preference for either tooth-supported or implant-supported fixed partial dentures. With removable dentures becoming less acceptable with modern patients, dental practitioners need considerably less effort to convince patients to receive treatment with dental implants than several years ago. In many occasions, during treatment planning, various procedures such as bone augmentation, bone transplantation, or both are considered necessary in order to acquire the desired alveolar ridge dimensions so as to achieve implant stability and long term aesthetic results.[1]

In cases of vertical alveolar ridge deficiencies of the posterior areas of the upper jaw, either extensive bone transplantation techniques are utilized, or in most cases sinus floor elevation procedures are undertaken in order to create the necessary bone height for implant stability to occur.[2] Previous investigations have reported maxillary sinusitis in up to 20% of patients following Sinus Floor Elevation procedures (SFE).[3] The most common complications of SFE procedures include disturbed and delayed wound healing, followed by haematoma, sequestration of bone, and transient maxillary sinusitis.[4,5] In addition, postoperative acute maxillary sinusitis could even cause implant and graft failures. The aforementioned limitations of the SFE procedures necessitate the implementation of new techniques that could provide us and the patient with more stable and predictable results and relieve the latter from a painful and expensive surgical experience.

The rapid placement of implants in the sinus cavity with intentional perforation of the sinus membrane following a certain protocol – called the "IPG" DentistEdu technique – is introduced in this article. The proposed technique combines the use of concentrated growth factors (CGF with stem cells CD34+), bone grafting and implant placement, in such a manner that the sinus can adapt to the new conditions and form new bone around the implants without the need to perform an SFE procedure. Implants can be placed either using a surgical approach, or by utilizing the flapless technique which is greatly advocated by the authors and was also utilized for the patient presented in this article.[6] In this case-study presentation, seven (7) implants were placed in both sinuses followed by a radiographic (Panoramic radiography and Cone Bean Computed Tomography – CBCT scans) and clinical evaluation (by Osstell measurements) after an 8 month follow-up period showing good implant stability. To the best of our knowledge, the proposed technique of intentional direct implant placement into the sinus with intentional sinus perforation has not been previously reported in the literature.

MATERIALS AND METHODS

A 50 year old partially dentate, non-smoker female patient in good health condition and without any chronic diseases visited the Dentist Education Institute postgraduate center in Athens–Greece, requesting an upper jaw rehabilitation with a non-removable prosthesis. With only the anterior dentition present, the patient was having serious difficulties chewing her food. Since the patient had requested a non-removable prosthesis, the option of placing a total of 7 implants (4 in the left and 3 in the right side) was offered to the patient. After informing the patient in details the procedure that was going to be performed, a written consent was signed.

Cone Beam Computed Tomography (CBCT) scans confirmed the alveolar ridge deficiency in both sides with a highly resorbed and short ridge of 1–2 mm in height in the area of the upper right 1st molar (#3), and 2–3 mm in the area of the upper left 1st molar (#14), (Figure 1). Since no pathology was found in the posterior segments of the maxilla, the assessment of the CBCT scan allowed for a precise planning of the sites for implant placement. These sites were decided to be at tooth area #5 (upper right first premolar), #4 (upper right second premolar), #3 (upper right first molar), #12 (upper left first premolar), #13 (upper left second premolar), #14 (upper left first molar), and #15 (upper left second molar). Implant placement was planned to be performed atraumatically using the flapless technique which was preferred over the traditional surgical approach in order to reduce the chance for postoperative infections and provide less discomfort to the patient.[7]

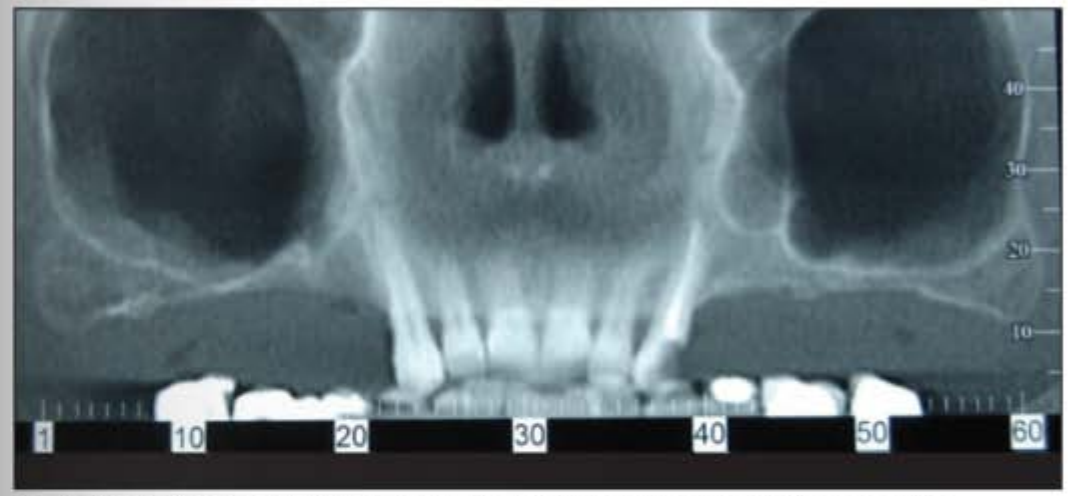

Figure 1: Computed tomography scan of both sinuses in which the bilateral alveolar ridge deficiency is obvious.

Surgical Procedure and Concentrated Growth Factors (CGF)

As part of the authors everyday clinical practice for all surgical procedures, concentrated growth factors (CGF) with stem cells CD34+, in all its various forms was prepared.[8] At first blood was drawn from the patient utilizing eight sterile tubes (9 ml each) and centrifuged in a special centrifuge device (Medifuge, Silfradent srl, St. Sofia, Italy) for approximately 13 minutes (Figure 2). For optimum quality of CGF matrices the blood samples were centrifuged immediately after the blood was drawn.

After centrifugation, in each sterile tube four components can be easily identified from top to bottom: (a) a superior phase represented by the serum (blood plasma without fibrinogen and coagulation factors), (b) an interim phase represented by a very large and dense polymerized fibrin buffy coat, (c) a liquid phase containing the white blood

Figure 2: Special centrifuge for the preparation of CGF (Medifuge, Silfradent, Italy).

Figure 3a: Sterile tubes after centrifugation.

Figure 3b: Separation of the dense platelet-rich coagulation sample from the CGF matrix using scissors.

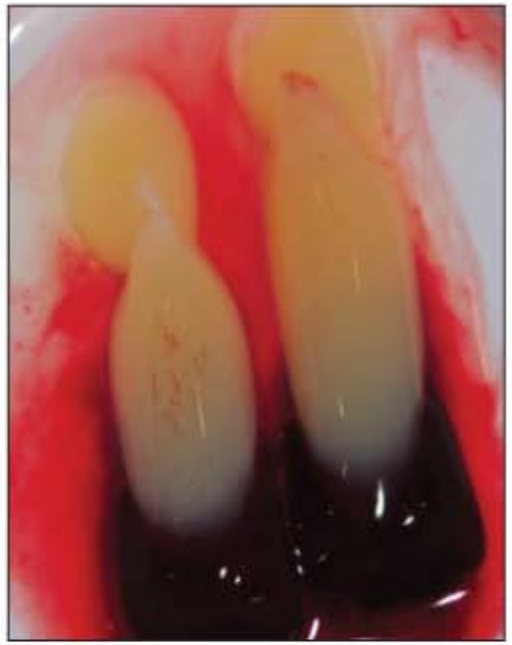

Figure 3c: The CGF-CD34+ matrix.

cells and (d) the lower red blood cell portion, a viscous and dense platelet-rich coagulation mass (Figure 3a).[8] A large number of growth factors and stem cells CD34+ are aggregated in the middle layer (between the dense polymerized fibrin buffy coat and the upper 3-4 mm of red blood corpuscles mass of the bottom layer. This growth factor-rich segment is separated from the rest of the red corpuscles using scissors (Figure 3b) in order to obtain the CGF-CD34+ matrix (Figure 3c).

Afterwards, Povidine-iodine solution (Betadine) was first employed extra-orally for disinfection of the surgical site in order to reduce the probability of microbial contamination, and then infiltration was performed using a 2% lidocaine solution containing a ratio of 1:100,000 epinephrine. In each predetermined site, the osteotomy was extended all the way through the whole bone height available. Drilling did not stop only until the sinus membrane was intentionally perforated. A CGF matrix, created in the previous process of blood centrifugation, was then cut in half approximately. One half of the matrix was inserted through the osteotomy site and into the sinus through the membrane perforation using the fibrin injector (Silfradent-Italy – Figure 4a), which proved to be a great tool for the swift insertion of the fibrin gel block (Figure 4b).

The remaining half of CGF matrix (highly concentrated growth factors and stem cells) was then cut into small pieces and mixed with a small quantity of the alloplastic bone grafting material Combioss (0.5ml, by Silfradent-Italy – Figure 5a). This mixture is then placed within the osteotomy site (Figure 5b). For faster osseointegration of the implants, each implant was immersed into a Liquid Phase of the Concentrated Growth Factors (LPCGF) in order to create a "bioactive" membrane around it. The LPCGF was prepared by squeezing some of the remaining seven CGF-CD34+ matrices by means of the CGF-forceps (Silfradent, Italy – Figure 6a) and was collected in a sterilized container. Each implant was carefully and fully immersed into the liquid phase CGF (Figure 6b). All implants were then placed using a hand wrench and the insertion torque was measured to be between 20-25 N/cm^2. The low insertion torque values are expected due to the small bone heights at all the implant sites.

RESULTS

All implants in-situ 8 months later are depicted in Figure 7. The proposed clinical protocol was evaluated be means of Panoramic radiography and CBCT scans and clinically in terms of Osstell readings and stability values.

Figure 4a: Fibrin injector (Silfradent-Italy).

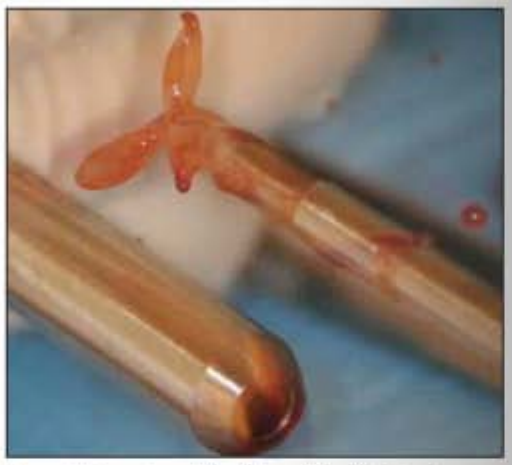

Figure 4b: Insertion of the fibrin gel block within the osteotomy site.

Figure 5a: A mixture of highly concentrated growth factors, stem cells CD34+ and bone grafting material.

Figure 5b: Placement of the aforementioned mixture in the osteotomy site.

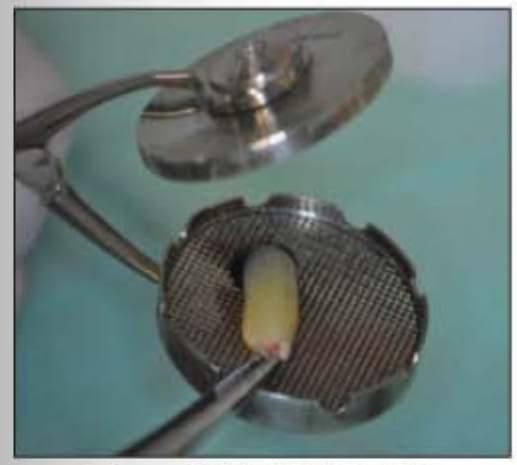

Figure 6a: Process of LPCGF with CD34+ production utlizing the CGF-forceps.

Figure 6b: Implant immersions into LPCGF, towards the creation of a bioactive membrane around it.

Figure 7: Surgical site of all placed implants 8 months after.

Radiographic Evaluation

The panoramic radiographs in Figure 8 shows the patient's mouth before and after the implants placement following the proposed clinical protocol, whereas Figure 9 shows some of the CT scans showing new bone formation around the implants. The new bone formation within the sinus cavity and around the implant in tooth area #4 (middle implant in the right sinus) can be seen in Figure 10.

Clinical Evaluation

Following implant placement, the primary stability of each implant was investigated by means of Resonance Frequency Analysis (RFA) using the Osstell device.[10] The RFA technique is essentially a bending test of the bone-implant interface in which an extremely small bending force is applied by stimulating a transducer. It can provide valuable and reliable clinical infor-

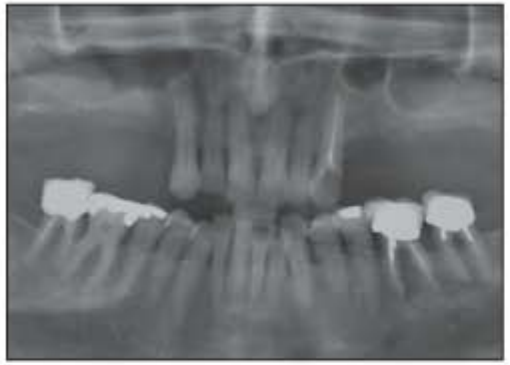

Figure 8a: Panoramic radiograph before implant placement.

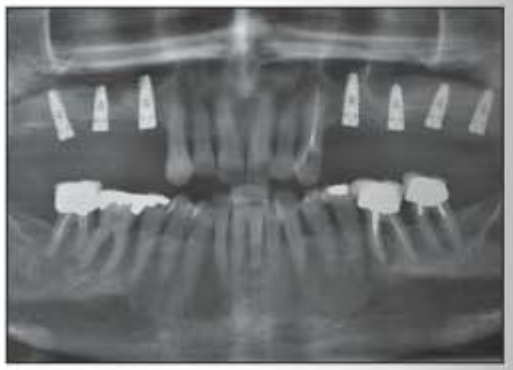

Figure 8b: Panoramic radiograph after the implant placement.

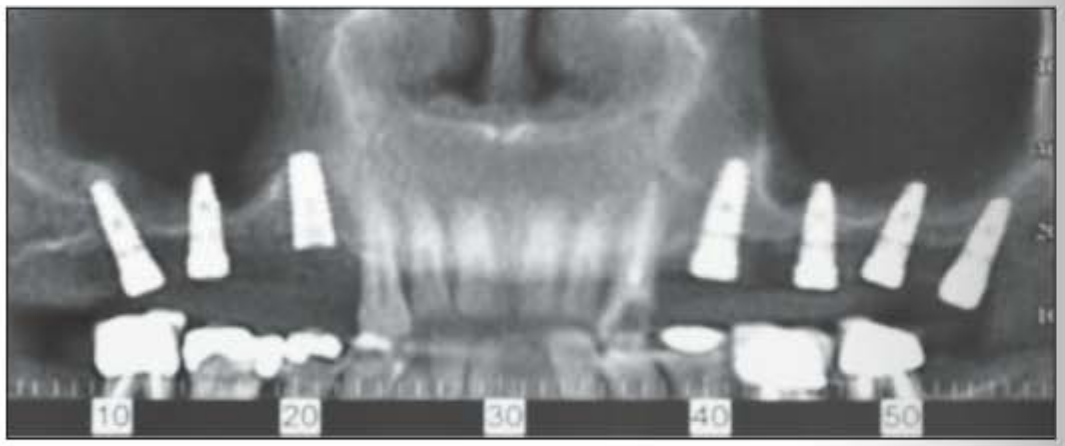

Figure 9: Computed tomography scan of the surgical site 8 months after the procedure.

mation regarding the state of the bone-implant –interface since the use of the Osstell device provides the dental practitioner an Implant Stability Quotient (ISQ) value. The measurements can range from 0 to 100 ISQ units, where the higher the ISQ values the more stable the implant. To perform the RFA test, a metal rod is first attached to the implant with a screw connection. The rod has a small magnet incorporated to its top that is stimulated by magnetic pulses from a handheld electronic device. Analysis of the resonance frequency of the rod is then automatically performed by the device and an ISQ measurement is provided (Figure 11). For all seven implants placed using the IPG-Dentist Edu technique, the ISQ range of values was between 61 and 69, which shows high stability for all implants placed.

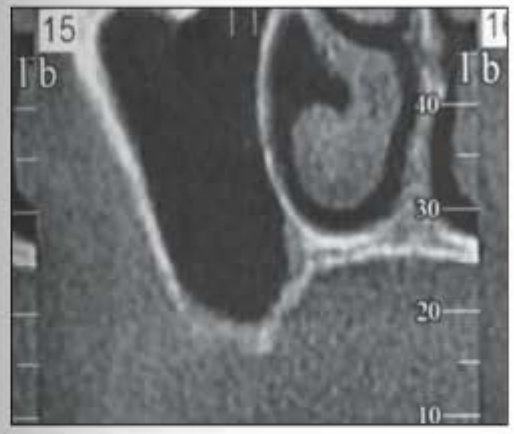

Figure 10a: Implant in tooth area #15 in which the ridge height did not exceed 2mm.

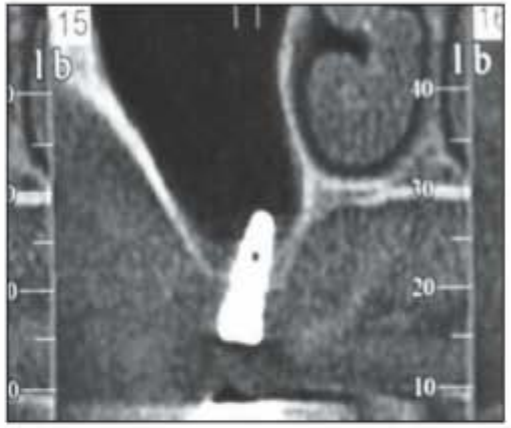

Figure 10b: The same site 8 months after the implant placement following the proposed protocol where the ridge now nearly covers the full length of the implant.

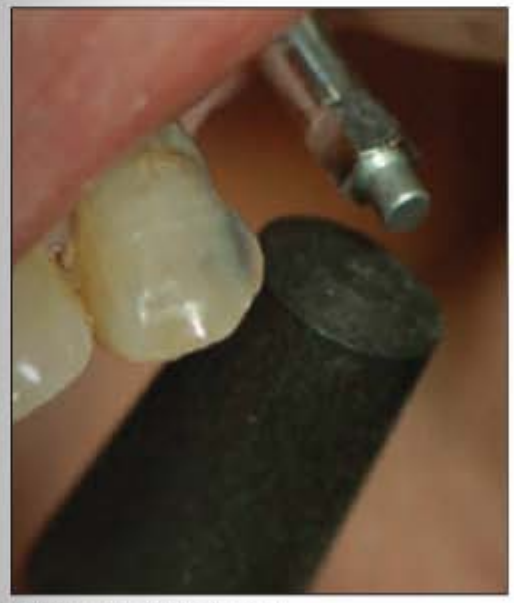

Figure 11: Osstell measurement.

DISCUSSION

The aesthetics and functional integrity of the periodontal tissues, as well as the vertical and horizontal dimensions of the alveolar processes are usually compromised following tooth loss. In such cases, various bone regenerative techniques are employed in order to restore the alveolar processes back to their original shape, allowing for a more predictable long term aesthetic and functional success of the implants placed.

For the posterior segments of the maxilla, a regenerative technique called the "sinus floor elevation procedure" (SFA), has spread widely and is taught extensively. A "sinus floor eleva-

tion procedure" can be carried out before, or in the same day with implant placement depending on each case, but nevertheless, it constitutes a more complex treatment plan and an unpleasant and longer surgical procedure for both the surgeon and the patient. Moreover, the predictability of the treatment outcome also depends on the operator's experience performing this technically demanding surgical procedure. Sinus elevation procedures also increase both the cost and time required for completion of each case. Despite the profound drawbacks, this procedure is generally accepted by patients when they are informed that it is the only way for the posterior areas of the maxilla to be restored with a functional and easily adaptable non-removable prosthesis. Without doubt, patients do not consider SFA as a "minor procedure" and probably would have chosen an alternative non-surgical, non-invasive and painless option if it was offered to them.

The IPG DentistEdu technique described in this study, involves the utilization of bone grafting material, implant placement and concentrated growth factors-CGF (with stem cells CD34+) into the intentionally perforated sinus membranes. This allowed for all implants to be placed atraumatically in both sides of the maxilla and with no sinus elevation procedure. This protocol has demonstrated stable and reliable results with very high implant success rates. The IPG DentistEdu technique has proven to be an absolutely safe procedure without any whatso-ever post-operative complications. Neither of the sinuses presented any signs of infection that affected the well-being of the patient.

Anchorage of the CGF matrix in the sinuses is achieved by platelets released after the penetration and slight haemorrhage of the sinus membranes. Platelets also found in the CGF matrix allow for anchorage on the surface that they are placed on, or at the area where there is trauma. Therefore, when the CGF matrix is placed in the sinus cavities it will not be displaced away from where it is originally placed, forcing the bone to regenerate locally and around the implants. During new bone formation in the sinus cavities following sinus membrane penetration, it is believed by the authors, that the sinus membrane slowly repairs itself and covers the former, while any parts of the sinus membrane under the bone grafting material slowly resorbs.

A metal-acrylic fixed partial denture (with an acrylic masticatory surface) was fabricated, and was preferred over a metal-ceramic because the masticatory forces are generally absorbed better. The fixed partial denture was inserted about 9 months after implant placement in order to allow enough time for new bone growth to occur around the implants. It is believed that a shorter osseointegration period before implant loading could be equally successful in similar cases. Future case studies and research will provide us with the important information of the minimum amount of time that must be allowed before uncovering the implants. Future studies are also required to determine whether the observed augmentation in bone height will be maintained over the long term or, if there will be bone loss due to remodelling.

CONCLUSION

The results of the proposed IPG DentistEdu technique support the concept of a one-stage, flapless implant placement with intentional sinus membrane perforation whenever there is ridge-height deficiency. It must be emphasized that the protocol should be carefully and precisely executed if the desired results are to be expected. Therefore, it is the authors' belief, that adequate training on how to perform this technique has been completed first, before any attempt is made in utilizing this technique on patients. ●

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Disclosure
The authors report no conflicts of interest with anything mentioned in this article.

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