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Sinus Lift Using Trans-Alveolar Approach with Platelet Rich Fibrin Followed by Simultaneous Implant Placement in Posterior Atrophic Maxilla - A Clinical and Digital Volumetric Tomographical Analysis

Dr. Pranav S Patil[1], Dr. M. L. Bhongade[2], Dr. Prasad V Dhadse[3]

[1]P. G. student Department of Periodontology & Implantology, Sharad Pawar Dental College and Hospital, Sawangi (M), Wardha, Maharashtra – 442005, India

[2]Profesor and Head of the Department of Periodontology & Implantology, Sharad Pawar Dental College and Hospital, Sawangi (M), Wardha, Maharashtra – 442005, India

[3]Professor, Department of Periodontology & Implantology, Sharad Pawar Dental College and Hospital, Sawangi (M), Wardha, Maharashtra – 442005, India

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Abstract: ***Background**: The purpose of this case series was to evaluate the survival rate and gain in the apico-coronal height around implants placed in the posterior atrophic maxilla with the help of Platelet Rich Fibrin (PRF) and Bone Particulate (Biograft). **Materials & Methods**: From September 2014 to March 2015, A total of 12 implants of size 11mm were placed in 9 patients within the age group of 20-55 years were taken up to rehabilitate atrophic maxilla where residual bone height in range of 4-7mm by means of Trans-alveolar sinus lift i.e osteotome-mediated sinus floor elevation (OMSFE) with PRF& bone graft. Initial and final bone height was measured from IOPA, Orthopantomogram (OPG), and Digital Volumetric Tomography Scan (DVT). Periapical radiographs were evaluated before surgery, post-surgery, and after 6 months and 1 year. We analyzed the residual crestal bone height under the sinus, the amount (mm) of height increase after surgery. **Results**: 9 patients treated with the transalveolar sinus-lift technique were included. A total of 12 dental implants and sinus lifts were analyzed. The overall rates of implant success and failure were 100% and 0%, respectively. All patients treated with PRF & bone graft showed a better peri-implant bone formation. No Schneiderian membrane perforations, Postoperative complications, peri-implantitis were observed. The follow up time was for 12 months, The mean residual bone height of the alveolar ridge was 5.5 mm (range, 4–7 mm). The mean increase in the height of implant sites by transalveolar approach with Platelet Rich Fibrin (PRF) and Bone Particulate (Biograft) was 6.3 mm (range, 3.5–7mm). The mean healing time for the loaded implants was 4 months until abutment insertion (range, 3–5 months). Twelve implants showed additional gain in apico-coronal height following the 1-year. **Conclusion**: Trans-alveolar technique can be advised when less than 8 mm of residual bone height is present. PRF and biograft provides addition synergistic effect to gain in apicocoronal height of bone. In case of more severe resorption direct method has to be performed. Therefore, transalveolar sinus-lift technique can be considered to be a safe, minimally invasive technique for sinus augmentation in atrophic maxilla followed by simultaneous implant placement.*

Keywords: Biograft, PRF, Atrophic posterior maxilla, residual bone height, sinus lift procedures

1. Introduction

The ideal goal of modern dentistry is to restore normal form, function and esthetic of oral cavity. Implant dentistry is unique because it having the ability to full-fill all requirement for modern dentistry. The goal, however, is to extend this rehabilitative method to a large number of patients, including those with low quality and/or quantity of bone.[1-4] In the past, an inadequate volume and a low quantity of bone tissue were contraindications to implant treatment. In particular, due to the low bone quality and the tendency for progressive resorption after tooth loss, the posterior maxilla has always been a high risk area for rehabilitation with implant supported fixed prosthesis, atrophic alveolar ridges and/or a highly pneumatized maxillary sinus, conditions that imply a limited amount of residual bone, the task becomes even more difficult. One solution is resorting to reduced length implants, but in this case particular clinical parameters must exist to avoid biomechanical problems due to the poor implant/crown ratio between the length of implant and that of the restoration.

In these cases, implant require careful planning and may need pre-prosthetic surgery involving bone grafting of the maxillary sinus (or antrum of Highmore), which is aimed at correcting bone quantity defects and creating optimal conditions for inserting implants in the posterior areas of the jawbones. However, long term success of endosseous implants depends on the degree of osseointegration and this in turn depends on both primary stability, due to the compactness of bone cortex and bone quality, and on secondary stability that is the result of the progressive growth of bone tissue around the entire surface of implant.

In Summers‟ technique, an osteotome is inserted through the edentulous alveolar crest at the inferior border of the maxillary sinus floor. Which forms a space for bone graft and simultaneous implant placement. some authors[5-8] introduced modifications to the Summers‟ technique based specifically on the use of different biomaterials and on the expansion and compression of the alveolar crest to lift the sinus floor of the maxilla. Grafting material is used in combination with trans-alveolar or OMSFE to create more bone volume to aid in support of the implant. However, there is no conclusive data in the literature reporting on the possible advantage and maturation of a bone graft at the apical portion of the implant.

The aim of this study was to evaluate the efficacy of Platelet Rich Fibrin (PRF) and Bone Particulate (Biograft) by transalveolar sinus-lift technique where residual sub antral height was in range of 4-7mm for the purpose of gaining knowledge about this technique, outlining its predictability, and establishing its clinical effectiveness in general implant practice.

2. Materials and methods

Between September 2014 to March 2015, A total of 12 implants of size 11mm were placed in 9 patients within the age group of 20-55 years were taken up to rehabilitate atrophic maxilla by means of Trans-alveolar sinus lift i.e osteotome-mediated sinus floor elevation (OMSFE) with PRF& biograft. The estimated Residual sun antral bone height (RSBH), as measured on a preoperative radiograph (IOPA), Orthopantomogram (OPG) was 4 to 7 mm. A post-operative Digital Volumetric Tomography Scan was obtained to measure the e Gain in bone height. Intraoperative radiographic measurements were performed during surgery to more accurately assess the RSBH, so that the depth of sinus penetration could be estimated after implant placement.

PRF Preparation

PRF was prepared in accordance with the protocol developed by Choukroun et al.[9] Just prior to surgery, intravenous blood (by venipuncturing of the antecubital vein) was collected in a 10-ml sterile tube without anticoagulant and immediately centrifuged in a centrifugation machine at 3,000 revolutions (approx 400 g) per minute for 10 minutes. Within a few minutes, the absence of anticoagulant induced the activation of platelets contained in the sample, thus triggering a coagulation cascade. The result was a fibrin clot located in the middle of a mass of acellular plasma, with a maximum number of platelets and more than half of the leukocytes caught in the mesh of fibrin. PRF plugs are preferred over the membranes because they are simpler to insert, compress, and apically displace in the prepared osteotomy.

Trans-alveolar/OMSFE/PRF+ Biograft Surgical Technique

Prior to the surgical procedure, the patients were instructed to rinse with 10 ml of a 0.12% Chlorhexidine gluconate solution (Hexidine, ICPA health product Ltd, India) for one minute as a pre surgical disinfectant. The surgical protocols emphasized on complete asepsis and infection control.

Briefly after induction of local anesthesia (block and infiltration using 2% Lidocaine with 1:1, 00,000 epinephrine), using no. 15 blade a horizontal incision 1 to 2 mm apical to crest palatally and two vertical incisions extending bucally beyond the mucogingival junction were given. Full thickness mucoperiosteal flap was reflected using the periosteal elevator. With surgical stent, the implant position was marked on the alveolar crest with a 2mm round bur. A surgical stent was used for the precise placement of the pilot drill. After pilot drill application, the implant site was prepared with the corresponding size of parallel drill to a depth of 1mm short from the sinus floor. Once the osteotomy was ready, expansion of the osteotomy site was carried out with flat tipped osteotomes and mallet to expand the bone.

The first osteotome used at the implant site was a flat ended small diameter tapered osteotome. With light malleting, the osteotome was pushed towards the compact bone of the sinus floor. After reaching the sinus floor, the osteotomes were pushed about 1mm further with the help of a mallet using light force, in order to create a ‚greenstick‟ fracture of the compact bone of the sinus floor. The second tapered osteotome, with a diameter slightly larger than the first one, was used with the same length as the first osteotome and was used to increase the fracture area of the sinus floor. The third osteotome was a straight osteotome with a diameter about 1-1.5 mm smaller than the implant to be placed. Before placement of the grafting materials, the sinus membrane perforation was tested using the Valsalva Maneuver (nose blowing) method. The nostrils of the patient were compressed, and the patients were asked to blow against resistance. If the air leaked out of the implant site, indicating sinus membrane perforated. In presence of sinus membrane perforation no grafting material was placed into the sinus cavity. If the sinus membrane was judged to be intact, the preparation was filled with mixture of Platelet Rich Fibrin (PRF) and Bone Particulate (Biograft). For the preparation of PRF 20 ml of whole blood was drawn into 5 ml of sterile glass tubes without anticoagulant and then immediately centrifuged in a centrifugation machine. Blood was centrifuged at 3000 rpm for 10 min. The resultant product consisted of the following three layers: the topmost layer consisting of the acellular PPP (Platelet Poor Plasma), PRF (Platelet Rich Fibrin) clot in the middle, RBC‟s (red blood cells) at the bottom. Subsequently, PRF was separated from the red blood cells by using scissors. The PRF was mixed with bone graft and then pushed slowly into the sinus cavity with the same third osteotome. This procedure was repeated four to five times until about 0.2-0.3 gm of grafting material was pushed into the sinus cavity below the sinus membrane. Finally, before implant placement, the preparation was again checked for patency, and the Valsalva maneuver was repeated. The implant was then slowly wrenched into position so that the membrane should not tear as it was elevated. After implant placement, the extent of the sinus displacement obtained was calculated as the distance between the length of implant and the available bone as measured during surgery. Another periapical radiograph was then taken with usual procedure at the end of

surgery. The implant neck was countersunked 2 mm from the crestal bone margin and approximately 3 mm below the free gingival margin and a torque driver set at 35 Ncm was used to evaluate the primary stability of implant. Finally, after implant stabilization the buccal flap was positioned around the implants and was sutured to the palatal flap using simple interrupted sutures. Complete tension free soft tissue closure was achieved and the implant was left submerged and isolated from the oral cavity. The second stage flapless surgery was performed at 5-6 months after the first surgery. The implants were uncovered by a trephine bur (diameter 5-6mm) and a gingival former was connected to allow guided soft tissue healing for 3-4 weeks. Patients were advised antibiotics (Amoxicillin 500mg tid) and analgesics after surgery and continued for atleast 5 days post-surgery. Abutment connection was carried out immediately after removal of the gingival former. After minor modification of the abutment height or axis, impression cap and polishing cylinders were inserted on the implants to transfer the implant position to the master cast accurately. Standard trays and polyvinyl siloxane impression material was used. Single free standing porcelain fused to metal crown was fabricated in the laboratory using the implant analogue embedded in the master cast. Particular attention was paid to the accurate fit of the crown margins on the implant shoulder and to the occlusal centric and eccentric contacts. After placement of definitive metal ceramic reconstruction, the patient was recalled after 3 months, 6 months and 12 months for further re-evaluation.

Post-operative evaluation was performed at 3, 6 & 12 months after placement of definative metal – ceramic restoration. The clinical parameters including full mouth plaque index (FMPI) [10] and full mouth papillary bleeding index (FMBI) [11] were recorded for each patients. In addition, Modified plaque index, & Modified bleeding index, [12] probing measurements, clinical implant mobility scale[13] and radiographic alveolar crestal bone height on mesial and distal site of each implant were recorded using an Intra Oral Periapical Radiograph (IOPA). A post-operative Digital Volumetric Tomography Scan was obtained after 5-6 months of implant placement and the Distance from implant shoulder to floor of the sinus i;e Gain in bone height i.e the amount of bone formed around the implant and bone formed apical to the implant were measured. In addition bone mineral density of augmented bone (D1 to D4) was recorded. Any biological complications such as peri – implant mucositis (heavily inflamed soft tissue without bone loss), peri-implantitis (bone loss with suppuration or heavily inflamed tissue) and fistula were observed. Examples of possible prosthetic complication like loosening of abutment screw, chipping of ceramic crown and fracture of implant were also examined. Oral hygiene instructions were reinforced, if needed professional supragingival polishing was carried out.

Statistical analysis: [14]

The means and standard deviations (Mean± SD) values were calculated for all clinical and radiographic parameters. The mean data was analyzed for the statistical significance by standard statistical method. Student's paired t-test was used to compare data from baseline to those at 6months and at 12 months for all the patients. If the probability value (p) was more than 0.05, the difference observed was considered non-significant and if less than 0.05, it was considered significant.

3. Results

A total of 12 dental implants and sinus lifts were analyzed in 9 patients. The overall rates of implant success and failure were 100% and 0%, respectively. All patients treated with PRF & bio graft showed a better peri-implant bone formation. No Schneiderian membrane perforations, Postoperative complications & periimplantitis were observed. All implants could be placed according to their predetermined optimal prosthetic positions. Primary stability was achieved in all cases without any difficulty. In most patients, postoperative swelling was normal and was at its maximum at 48 hours after the surgery. The swelling gradually subsided and was usually gone by 1 week after the surgery. Pain was negligible in most cases, with minimal discomfort caused by swelling. After surgery, 4 patients experienced nasal congestion and headache that subside within a few days with the use of nasal decongestants and prolonged antibiotics after sinus lift procedure.

The follow up time was for 12 months, The mean residual bone height of the alveolar ridge was 5.5 mm (range, 4–7 mm). The mean increase in the height of implant sites by transalveolar approach with Platelet Rich Fibrin (PRF) and Bone Particulate (Biograft) was 6.3 mm (range, 3.5–7mm). Implant stability assessed by measuring CIMS score. All implants showed clinical implant mobility score (CIMS) of zero at 3 months after fixed prostheses. Measurements of clinical parameters including mean modified plaque index (MPI), modified bleeding index (MBI), probing pocket depth (PPD), gingival recession (GR), and width of keratinized gingiva (WKG) are within normal limit. Mean MPI, MBI, PPD, GR and WKG at 3 months after fixed restoration were 0.58mm, 0.14mm, 1mm, 0.24mm, 2.75mm respectively indicating satisfactory plaque control and gingival condition around implant. All the 12 surgical sites healed uneventfully.

4. Discussion

The purpose of the present study was to evaluate the outcome of maxillary sinus augmentation by transalveolar approach / indirect (crestal) approach using PRF in combination with bone graft and success rate of simultaneously placed two stage implants. The study emphasized the effectiveness of maxillary sinus floor augmentation procedure using indirect (cestal) approach with PRF and particulate grafting material in terms of gain in bone height and the success rate of simultaneously placed implant by assessing peri-implant changes both clinically and radiographically. The results showed that transalveolar approach /indirect (crestal) sinus augmenatation procedure using PRF in combination with bone particulate grafting material with simultaneous implant placement resulted in statistically significant gain in bone height.

The most common intra operative complication of sinus elevation surgery is the perforation of the schneiderian

membrane. The membrane perforation rate in crestal sinus floor surgery using conventional method ranges from 0 % to 21.4 % (Tan et al 2008)[15]. In the present study, no membrane perforation was clinically observed.

An important debate topic in implant dentistry is the choice of grafting materials for sinus augmentation procedures. These graft materials include autograft, allografts, xenografts, alloplasts, bioactive agents, or a combination (composite) of grafts. The Academy of Osseointegration Consensus Conference in 1996 defined sinus augmentation using a bone graft and considered autogenous bone is the most predictable and effective therapeutic modality for such procedures (Jensen et al 1998)[16]. Autogenous bone as a graft material demonstrates a high capacity to promote osteogenesis and an optimal ability to become incorporated without immunologic sequelae [17-21]. Recently, bone substitutes such as xenografts or artificial bone have been employed more often for sinus floor augmentation instead of autogenous bone grafts, mainly because of the morbidity associated with autogenous bone harvesting at intraoral and extraoral sites [22].

PRF is a second-generation autologous platelet concentrate and is a fibrin mesh consisting of leukocytes and cytokines. It activates the vascular system and angiogenesis and releases various growth factors, which are involved in soft and hard tissue healing [23]. Toffler et al (2010)[24] evaluated effectiveness of PRF alone for sinus augmentation using crestal approach and stated that use of PRF alone without use of any bone graft prevents displacement of the grafting material into the sinus cavity, however Narang et al (2015)[25] stated that the use of particulate bone graft material along with PRF significantly enhances stability of the implants with minimum chances of displacement of the grafting materials into the sinus cavity. Therefore, in the present study, PRF along with bone particulate grafting materials were used during indirect sinus lift procedures. Gain in bone height following crestal sinus lift procedure is one of the criteria to assess success of procedure.

In the present study, the gain in bone height was in the range of was 6.3 mm (range, 3.5–7mm). The present findings are accordance with the other studies reported in literature, Toffler et al, (2010)[24] reported a mean gain in bone height of 3.4 mm following crestal approach sinus lift using PRF. Narang et al, (2015)[25] reported a mean gain in bone height of about 4 mm to 6 mm following placement of PRF and particulate bone graft material using crestal sinus lift approach.

Six months after surgery DVT Scan showed significantly increased bone volume around the implants. Bone density was evaluated using DVT scans and panaromic radiograph according to the Misch classification. In the present study, the density of the new bone like tissue around implants was in the range of D2 to D3, which was comparable to that of the bone normally present in the posterior maxilla.

The overall rates of implant success and failure were 100% and 0%, respectively which is almost similar to the percentage reported in literature. Cavicchia et al. (2001)[26] reported a survival rate of 88.6%, after a mean observation period of 35 months, for 97 implants placed according to the Summers crestal access method. Toffler (2004)[27] reported an overall survival rate of 93.5% for 276 implants loaded for an average of 27.9 months. Lai et al (2010)[28]evaluated survival rate of 77 implants placed after osteotome sinus floor elevation and reported 93.51 % success rate with a 9 months follow-up.

5. Conclusion

The new innovative “Transalveolar approach” technique is alternative to conventional lateral window technique. Misch (1987)[29] considered that 8 mm residual bone height is the limit for the indirect sinus augmentation technique i.e transalveolar approach, while 5– 8 mm bone height is indicated for the 2-stage direct augmentation technique. But in this case series the patients treated with RBH 4-7mm by indirect i.e trans-alveolar approach followed by simultaneous implant placement and shows predictable outcome as similar to those which were obtained by direct technique. Therefore rather for going invasive therapeutic measures transalveolar approach provides a viable option for sinus lifting in severe atrophic maxilla where RBH is in range of 4-7mm.

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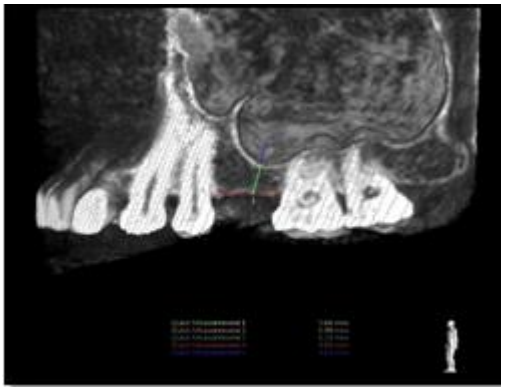

Figure 1: Pre-operative DVT Showing RBH-5.66

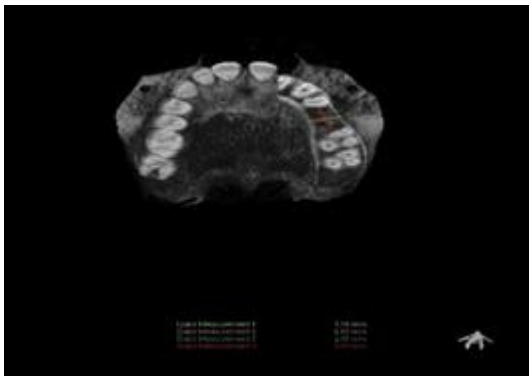

Figure 2: Pre-operative DVT showing Bucco-palatal & M-D dimesions

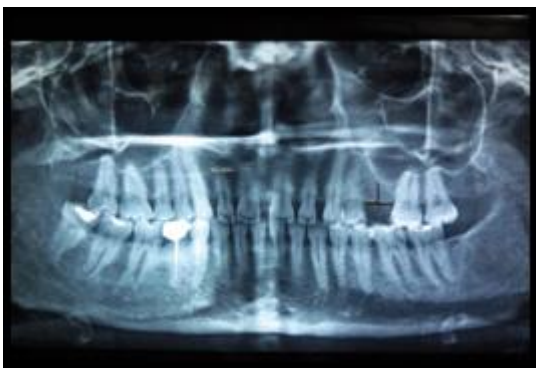

Figure 3: Pre-operative OPG

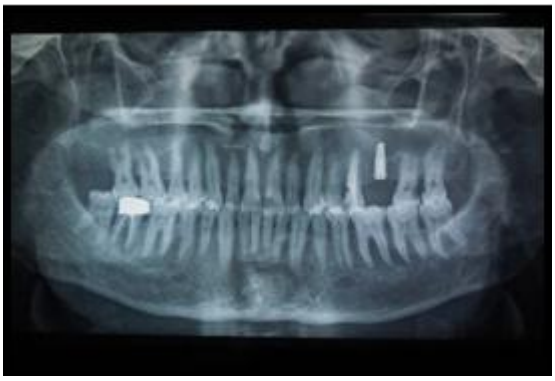

Figure 4: Post-operative view

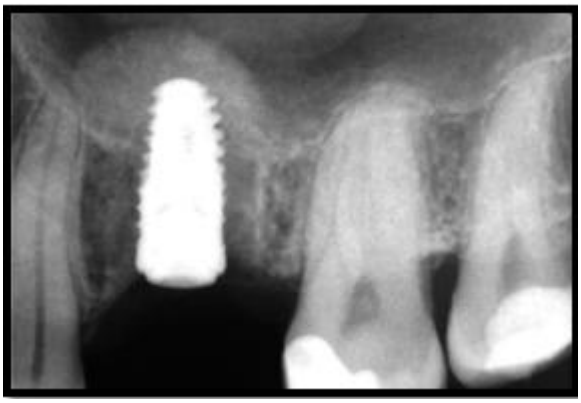

Figure 5: Post-operative IOPA

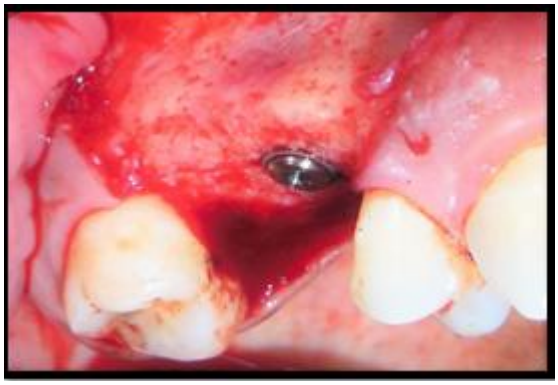

Figure 6: Implant in Position

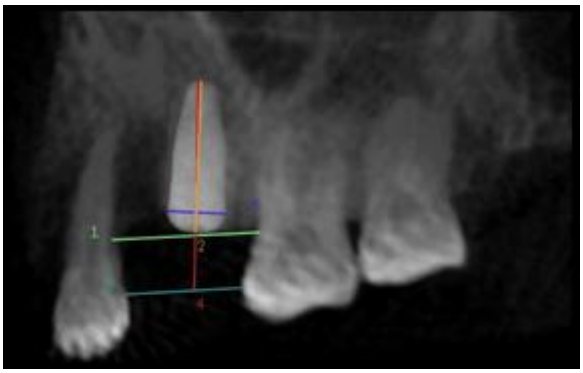

Figure 7: Post-operative DVT showing gain in Apico-coronal height