

Effectiveness Of Direct Sinus Lift With Simultaneous Implant Placement And Bone Grafting

Dr. Deval Mehta*, Dr. Setu P. Shah**, Dr. Nishith M. Shah***

*Professor and HOD, **Senior Lecturer, ***P.G. Resident, Department of Oral and Maxillofacial Surgery, College of Dental Sciences and Research Centre, Ahmedabad, Gujarat, India.

Abstracts: Background & Objective: The present study was conducted with the aim to clinically and radiographically evaluate the efficacy and efficiency of the direct sinus lift with simultaneous implant placement and bone grafting, and to evaluate bone height with the merits and demerits of lateral approach for sinus membrane elevation. **Methodology:** This randomized prospective study consisted of 10 patients who met the inclusion and exclusion criteria. The patients were selected irrespective of the age, sex & socioeconomic status, with the residual alveolar bone height between 1 to 4 mm in the edentulous posterior maxillary region. Direct sinus lift was carried out with simultaneous implant placement. Bovine graft (xenograft) was used as a sole grafting material. Patients were followed up for 36 months of prosthetic rehabilitation. **Results:** Pre-operative alveolar bone height was on an average 2.9 mm (ranging from 1 to 4 mm) with the standard deviation of 0.67 mm. After 36 months of loading, there wasn't any clinical or radiographical complication. On an average 13 mm bone height was evident (ranging from 11.5 to 14 mm) with the standard deviation of 0.81 mm. **Conclusion:** Direct sinus lift is an excellent technique for the rehabilitation in the cases with severely atrophic posterior maxilla. [Shah S NJIRM 2016; 7(2): 81 - 86]

Key Words: Direct sinus lift, simultaneous implant placement, bovine bone.

Author for correspondence: Dr. Setu P. Shah, Department of Oral and Maxillofacial Surgery, College of Dental Sciences and Research Centre, Ahmedabad: 382115, Gujarat, India. E-mail: drshahsetu206@gmail.com

Introduction: On the horizons of Oral and Maxillofacial Surgery, implant dentistry is one of the most upcoming and progressive fields from both clinical and research point of view. Dental implant is an alloplastic material that is surgically inserted into a residual alveolar ridge, primarily to serve as a prosthodontic foundation. Over a period of time, tooth replacement by implant has become successful in view of efficacy and efficiency with functional compliance and longevity.

Implant placement in posterior maxilla is more challenging owing to the limited quantity of bone and presence of maxillary sinus. Poor quality and quantity of the bone in the posterior maxilla is due to tooth loss¹, pneumatization of maxillary sinus following tooth loss^{2,3,4,5}, long period of edentulism^{6,7} and poorly fitting removable dentures.

So, though the implants are becoming a standard line of treatment for patients when there is adequate bone and no contraindications, the treatment of patients with pneumatization of the sinus and insufficient remaining bone to engage end-osseous implants remains a challenge.⁸ This clinical problem can be negotiated by various techniques for sinus floor augmentation with the frequent use of different bone grafts and bone substitutes. Grafting promotes bone formation to enable implant placement.^{8,9,10}

In 1975, Dr. Hilt Tatum developed a lateral approach surgical technique for sinus membrane elevation and

simultaneous implant placement.^{5,6,8,11,12} Along with the sinus membrane elevation various bone grafting materials including autogenous bone (iliac crest¹³, mandibular symphysis¹⁴, anterior ramus^{13,14}, tuberosity¹⁴, tibial marrow and calvarium^{13,15}), freeze-dried bone allograft (mineralized or demineralised), xenografts¹⁶, hydroxyapatite (HA) preparations¹⁷ (resorbable or non-resorbable), calcium sulfate preparations¹⁸, artificial bone substitutes (absorbable gelatin sponge¹⁰ and growth factors embedded in different carrier materials) have been successfully used to augment the floor of the maxillary sinus.^{1,9} The bone augmentation is expected to result in primary implant stability, promote osseointegration, prevent overloading and provide higher success rate with predictable long term results.^{5,9,11,19,20}

The present study was conducted in the Department of Oral and Maxillofacial Surgery of College of Dental Sciences and Research Centre, Ahmedabad with the aim to clinically and radiographically evaluate the efficacy and efficiency of the direct sinus lift with simultaneous implant placement and bone grafting, and to evaluate bone height with the merits and demerits of lateral approach for sinus membrane elevation.

Material and Methods: 10 patients were included in the randomized prospective study with the chief complain of missing teeth in maxillary posterior jaw region. Bovine bone was used as a sole grafting material.

Approvals of Institute Research Council and Ethical Committees were obtained prior to commencement of the study.

Inclusion criteria :-

- Patients with minimum age of 18 years.
- Patients requiring implant treatment with less than 5 mm height of the residual alveolar ridge in maxillary posterior jaw region.
- Patients with maladaptive experience or psychotic resistance to wear a removable partial denture.
- Well informed and motivated patients who gave their consent willingly for the procedure and for participation in the study.
- Patients available for regular follow up.

Exclusion criteria :-

- Patients with compromised medical conditions.
- Patients with long term oral destructive habits like smoking, gutkha chewing, tobacco chewing, alcoholism, drug addiction etc.
- Patients having pathology in maxillary sinus.

The routine preoperative preparations were performed which includes diagnostic impressions (Figure 1c) & splint formation (figure 1d), radiographs like I.O.P.A. (Intra Oral PeriApical), O.P.G. (Orthopantomogram) (figure 1e) & C.B.C.T. (Cone Beam Computed Tomography) & blood investigations. Written and informed consent from the patient and patient's relative for anesthesia, surgery, implant placement and bone grafting was obtained. Antibiotics, analgesics, mouthwash and nasal decongestants were started preoperatively. Procedure was performed under local anaesthesia by giving posterior superior alveolar, infra-orbital and greater palatine nerve blocks with 2% lignocaine HCL with 1:80,000 adrenaline concentration followed by local infiltration.

Crestal incision was given slightly on the palatal aspect of the maxillary posterior edentulous ridge keeping in mind the greater palatine artery which proceeds close to the crest of the ridge. A vertical relieving incision was given on distal aspect of the incision. Full thickness mucoperiosteal flap was raised to expose the lateral surface of the maxilla.

Access window preparation on lateral surface of maxilla was done. The access window was not over-prepared to prevent membrane perforation. Sinus membrane elevation was done with sinus membrane elevators. The sinus membrane was continuously inspected for perforations throughout the procedure.

Cancellous granules were mixed with the normal saline and sinus was augmented inferior to the membrane with the mixed graft. Osteotomy was done and self tapping, tapered, threaded, acid etched and sand blasted, titanium implant was placed in the prepared site. (Figure 2) Cover screw was placed over the implant.

Figure 1(a): Pre-operative clinical photograph
1(b): Pre-operative C.B.C T
1(c): Diagnostic cast
1(d): Diagnostic splint
1(e): Pre-operative O.P.G with splint in place.

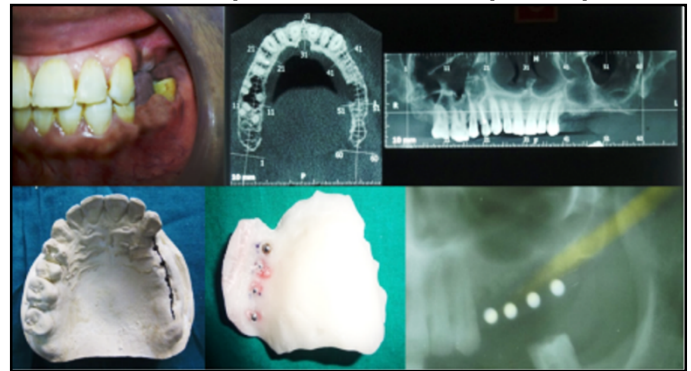
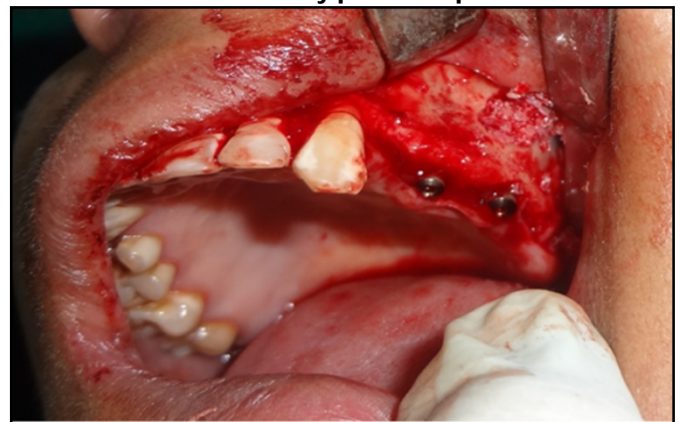


Figure 2: Graft in the prepared window with simultaneously placed implants



After packing of graft around the implant, between the implants and below the sinus membrane, the mucoperiosteal flap was repositioned for the primary closure without tension. Interrupted watertight

sutures were given with the 3.0 black silk suture. Proper post-operative instructions were given and medications were continued for 7 days.

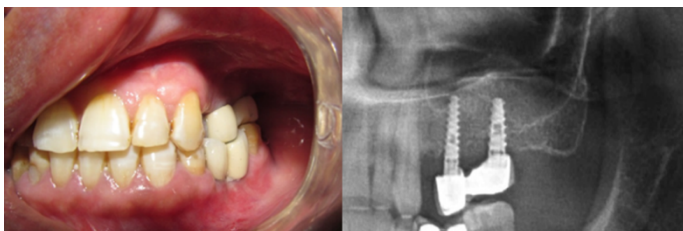
Patients were recalled on 3rd day, 7th day and after 1, 3 and 6 months of sinus lift procedure for clinical and radiographical evaluation.

Second stage procedure was performed after 6 months. Crestal incision over the implant fixture was given and uncovering of implant was performed. A cover screw was removed and healing abutment or gingival former was screwed onto the implant. Interrupted sutures were given with 3.0 black silk and removed after 1 week of second stage procedure. The site was allowed to heal for 2 weeks before initiation of the restorative phase.

Prosthetic fabrication was carried out after 2 weeks of second stage procedure. Healing cap was removed and abutment was screwed into the implant and prepared if necessary. IOPA was taken to confirm the proper seating of the abutment. Impressions were taken with the elastomeric impression material and were sent to the laboratory for the fabrication of the crown. The prepared crown was checked for its passive fit to the abutment. If needed occlusal adjustments were also performed prior to cementation. Cementation of the prosthesis was carried out with zinc phosphate cement. (Figure 3a) Necessary follow up was done after 36 months of prosthetic rehabilitation (42 months of implant placement). (Figure 3b)

Figure 3(a): Clinical photograph after 36 months of prosthetic rehabilitation

3(b): O.P.G after 36 months of prosthetic rehabilitation



Results: The ratio of male to female patient was 1:1 in this study. The mean age of the patients included in the study was 45.5 years with standard deviation of 7 years. Out of the included cases, in 60% the right posterior maxillary area was edentulous. (Table 1, 2) Pre-operative alveolar bone height was on an average

2.9 mm (ranging from 1 to 4 mm) with the standard deviation of 0.67 mm. On radiographical examinations after 6 months of the sinus lift procedure, the alveolar bone height was on an average 13.9 mm (ranging from 12 to 15 mm) with the standard deviation of 0.94 mm. So, the average bone gain after 6 months of direct sinus lift procedure was on an average 11 mm (ranging from 8 to 14 mm) with the standard deviation of 1.48 mm.

The implants were loaded after 6 months of the direct sinus lift procedure. After 36 months of loading, there wasn't any clinical complication and no implant mobility, abutment loosening or fracture and prosthesis loosening or fracture in any case. Pocket depth of 0.9 mm on an average was measured (ranging from 0 to 2 mm). On radiographic examination, all the patients had shown total crestal or vertical bone loss of 0.95 mm on an average (ranging from 0.5 to 1.5 mm). Also, on an average 13 mm bone height was evident (ranging from 11.5 to 14 mm) with the standard deviation of 0.81 mm which was pre-operatively 2.9 mm on average (ranging from 1 to 4 mm) with the standard deviation of 0.67 mm (Chart 1).

Chart 1: Comparison of bone height

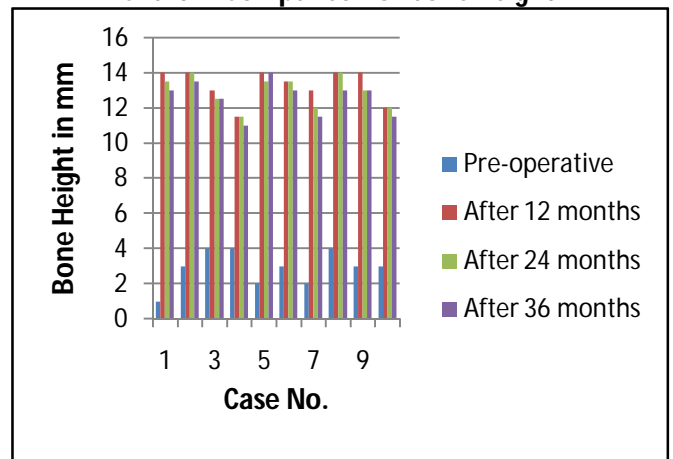


Table 1: Distribution of patients according to age & sex

Male	Female	Age	Mean	Median	Mode	Standard Deviation
0	0	21-30	45.5	46	44.5	7
2	1	31-40				
1	2	41-50				
2	2	51-60				
5	5	Total				

Table 2: Causes of tooth loss, duration of edentulism, pre-operative residual alveolar bone heights & quality

Case No.	Site	Sex	Cause of tooth loss	Residual height in mm	Bone Quality
1	M.L.P	F	Caries	1	D4
2	M.L.P.	M	Periodontitis	3	D4
3	M.R.P.	M	Periodontitis	4	D4
4	M.R.P.	F	Fractures tooth	4	D4
5	M.L.P.	F	Caries	2	D3
6	M.R.P.	M	Periodontitis	3	D4
7	M.L.P.	M	Periodontitis	2	D4
8	M.R.P.	F	Caries	4	D4
9	M.R.P.	F	Fractures tooth	3	D3
10	M.R.P.	M	Caries	3	D3

M.L.P. – Maxillary Left Posterior, M.R.P. – Maxillary Right Posterior

Discussion: Direct sinus lift with simultaneous implant placement procedure have certain advantages:-

- Window allows exposure & elevation of the sinus membrane from all sinus bony walls (the lateral wall of the nasal cavity, the maxillary tuberosity, inferiorly to the floor & to the posterior wall of the maxillary sinus) to form a large host site which is crucial for bone graft consolidation during phase I bone formation.¹¹
- Rare chances of mis-alignment of the implant because of provision of direct vision of the surgical site.^{11,14}
- Ability to diagnose membrane perforation & to treat it under direct vision.²¹
- Direct addition of the graft material through the drilling site ensures even distribution of it in all the directions resulting in the dome shaped elevation around the implant apex.²¹
- The greater the surface area of the recipient site, the greater number of stem cells & endosteal osteoblasts that will potentially available.¹¹
- Average gain in bone height is significantly more⁴ due to possibility of higher elevation of sinus membrane via direct sinus lift procedure.¹⁴
- The technique exhibited more osteoid matrix formation.²⁰
- High predictable results can be obtained.^{11,12,20}
- Safe surgical procedure with low prevalence of complications.²²

Three dimensional computed tomography (3D-C.T.)⁶, denta-scan or C.B.C.T. image analyses provides useful information that can avoid unnecessary complications (perforation of maxillary sinus membrane) during sinus augmentation procedures by facilitating adequate & timely identification of the anatomic structures inherent to the maxillary sinus.³

The maxillary sinus makes a good graft recipient for augmentation material because of the good surrounding bone. The rate of survival of the implants in the augmented posterior sinus appears to be better than that in posterior maxilla with poor quality of bone.

Because of immunologic acceptability, various mechanisms for bone regeneration & due to its osseo-inductive & osseo-conductive properties, autogenous bone (AB) is so called “Gold standard” graft material.^{5,11,12,19} But maxillary sinus floor augmentation is an elective procedure in which the priority should always be to reduce patient morbidity to a minimum.

So the donor site morbidity cannot be ignored when AB is used for maxillary sinus floor augmentation. Harvesting AB from intraoral sites can be associated with a number of problems like devitalisation of anterior mandibular teeth, changes in facial aesthetics, possible damage to mental & inferior alveolar nerves, increased risk of mandibular ramus fracture & does not always results in availability of enough grafting material for the reconstruction of severely atrophic posterior maxilla. Bone harvest from extraoral sites may cause haemorrhage, instability of the sacro-iliac joint, hernia through the donor site, adynamic ileus, or gait disturbances.^{12,23} So, it shows very clearly that autogenous bone with all its pitfalls in harvesting, donor site morbidity, sparse availability, uncontrolled resorption & marked loss of volume may not be the superior graft material for sinus floor augmentation. As a consequence, the use of AB for sinus floor augmentation hasn't been used that regularly now-a-days.²³

Allogenic grafts & xenogenic grafts function strictly as a scaffold for osseointegration.¹¹ A histomorphometric analysis of sinus elevation with various grafting materials showed that after 9 months of the procedure no statistically significant differences could be detected between various grafting materials.²⁴ Also bone substitute materials are just as effective as

autologous bone, whether used alone or in combination with autograft.²⁵

Considering the above facts, xenograft (bovine bone) was used in the study in particulate form (1 to 2 mm size) as a sole grafting material in all sinus augmentation procedures.^{2,4,16,20} Results of the study has also proved the superiority of the bovine bone graft over autogenous graft, as also supported by recent literature.⁹

Organic material from the xenograft was completely removed to leave the mineralized bone architecture, which renders it non-immunogenic & presumably safe from possibility of infection.^{2,4} Also clinical results have shown that it is a useful scaffold for bone regeneration.² It also has the advantage of being stable & having an osseointegrative property that allows for direct contact with the newly formed bone. The resorptive process proceeds slowly enough to provide sufficient time for the bone maturation.^{2,4} This quality prevents both "slumping" (loss of graft height) & adds approximately 25% to the overall mineral content of the matured graft. Histological studies showed 25% vital bone formation, 25% residual xenograft & 50% marrow in the matured sinus graft. The resulting 50% total mineralized tissue (new bone + residual graft) makes the site equivalent in density to that of D2 (dense) bone.²

Residual particles of xenograft are surrounded in part by new vital bone that is how they present the pattern called as "bone bridging". So the graft doesn't interfere with the osseointegration.^{1,2,5} Hence bovine bone graft alone now being the "Platinum standard".²⁶ In this study, rough surface implants were used which provide frictional resistance that results in slight bone compression which can improve the initial implant stabilization. Also rough surface implants achieve greater bone to implant apposition & interfacial strength than implants with machined surfaces.¹¹

Conclusion: So, lateral sinus lift procedure is the best available solution for insufficient quantity of the alveolar bone during the implantation into the posterior part of the maxilla. It not only allows for a conservative & aesthetic alternative for treating partial edentulism, but it also provides a stable foundation for treating complete edentulism. The procedure is safe and easy to master. Its role in current dental implantology is still non-replaceable.

References:

1. Kolerman et al. Histomorphometric analysis of maxillary sinus augmentation using an alloplast bone substitute. *J Oral Maxillofac Surg* 2012;70:1835-1843.
2. Stephen Wallace. Maxillary sinus augmentation : Fixed restorations in the compromised posterior maxilla : A peer review.
3. Park et al. Analysis of the anatomy of the maxillary sinus septum using 3-dimensional Computed Tomography. *J Oral Maxillofac Surg* 2011;69:1070-1078.
4. Pal et al. Direct vs. indirect sinus lift procedure: A comparison. *National Journal of Maxillofacial Surgery* 2012;3(1):31-37.
5. Kunal Jodia et al. Sinus elevation with an alloplastic material & simultaneous implant placement : A 1-stage procedure in severely atrophic maxilla. *J Maxillofac Oral Surg* 2014;13(3):271-280.
6. Zijdeveld et al. Anatomical & surgical findings & complications in 100 consecutive maxillary sinus floor elevation procedures. *J Oral Maxillofac Surg* 2008;66:1426-1438.
7. Papa et al. Outcome of 47 consecutive sinus lift operations using aragonitic calcium carbonate associated with autologous platelet-rich plasma : Clinical, histologic, & histomorphometrical evaluations. *J Craniofac Surg* 2009;20:2067-2074.
8. Manso & Wassal. A 10-year longitudinal study of 160 implants simultaneously installed in severely atrophic posterior maxillas grafted with autogenous bone & a synthetic bioactive resorbable graft. *Implant Dentistry* 2010;19(4):351-360.
9. Fugazzotto & Vlassis. Long term success of sinus augmentation using various surgical approaches & grafting materials. *Int J Oral Maxillofac Implants* 1998;13:52-58.
10. Sohn et al. New bone formation in the maxillary sinus using only absorbable gelatin sponge. *J Oral Maxillofac Surg* 2010;68:1327-1333.
11. Peleg et al. Predictability of simultaneous implant placement in the severely atrophic posterior maxilla : A 9 year longitudinal experience study of 2,132 implants placed into 731 human sinus grafts. *Int J Oral Maxillofac Implants* 2006;21:94-102.
12. Cho-Lee et al. A 12-year retrospective analytic study of the implant survival rate in 177 consecutive maxillary sinus augmentation procedures. *Int J Oral Maxillofac Implants* 2010;25:1019-1027.

13. Cricchio et al. Sinus bone formation & implant survival after sinus membrane elevation & implant placement : A 1 to 6 year follow-up study. *Clin. Oral Impl Res* 2011;xx:1-13.
14. Woo & Le. Maxillary sinus floor elevation : Review of anatomy & two techniques. *Implant Dent* 2004;13:28-32.
15. S. Sakka & C. Krenkel et al. Simultaneous maxillary sinus lifting & implant placement with autogenous parietal bone graft : Outcome of 17 cases. *Journal of Cranio-Maxillo-Facial Surgery* 2011;39:e187-191.
16. Hurzeler et al. Maxillary sinus augmentation using different grafting materials & dental implants in monkeys. Part I. Evaluation of anorganic bovine derived bone matrix. *Clin Oral Impl Res* 1997;8:476-486.
17. Quinones et al. Maxillary sinus augmentation using different grafting materials & osseointegrated dental implants in monkeys. Part II. Evaluation of porous hydroxyapatite as a grafting material. *Clin Oral Impl Res* 1997;8:487-496.
18. Leonardis & Pecora. Prospective study on the augmentation of the maxillary sinus with calcium sulphate : Histological results. *J Periodontol* 2000;71:940-947.
19. Del Fabbro et al. Review implant survival rates after maxillary sinus augmentation. *Eur J Oral Sci* 2008;116:497-506.
20. Esfahanizadeh et al. Comparison of lateral window & osteotome techniques in sinus augmentation: Histological & histomorphometric evaluation. *Journal of Dentistry* 2012;9(3):237-246.
21. Jose Vina-Almunia et al. Influence of perforation of the sinus membrane on the survival rate of implants placed after direct sinus lift. Literature update. *Med Oral Patol Oral Cir Bucal*. 2009;14(3):e133-136.
22. Cristina Sanchez-Recio et al. Maxillary sinus lift performed using ultrasound. Evaluation of 21 patients. *Med Oral Patol Oral Cir Bucal* 2010;15(2):e371-374.
23. Nkenke & Stelzle. Clinical outcomes of sinus floor augmentation for implant placement using autogenous bone or bone substitutes : A systematic review. *Clin Oral Impl Res* 2009;20(Suppl.4):124-133.
24. Jorg Handschel et al. A histomorphometric meta-analysis of sinus elevation with various grafting materials. *Head & Face Medicine* 2009;5:12.
25. Jesica Cabezas-Mojon et al. Meta-analytic study of implant survival following sinus augmentation. *Med Oral Pathol Oral Cir Bucal*. 2012;17(1):e135-139.

26. Stephen Wallace. Evidence-based decision making & practical surgical management for sinus augmentation surgery. ADI masterclass 2006.

Conflict of interest: None

Funding: None

Cite this Article as: Mehta D, Shah S, Shah N. Effectiveness Of Direct Sinus Lift With Simultaneous Implant Placement And Bone Grafting. <i>Natl J Integr Res Med</i> 2016; 7(2): 81-86
