ORIGINAL RESEARCH

Direct Maxillary Sinus Lift for Single Tooth Implant: A Clinical Study

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ABSTRACT

Purpose: The aim of the study is to evaluate clinically and radiographically the long-term success of one-stage direct (lateral) sinus lift procedure using alloplastic bone graft material and bio-absorbable membrane in conjunction with two stage implant placement in atrophic partially edentulous posterior maxilla.

Materials and methods: One stage direct maxillary sinus lift in conjunction with two stage implant placement was carried out in 10 patients at 11 sites. All the patients were partially edentulous with posterior maxillary alveolar ridge height of > 5 mm and were in the age group of 20 to 50 years. Bioactive glass putty, bio-absorbable collagen membrane and 3.75 × 11.5 mm implants were used. Patients were evaluated clinically and radio-graphically for 18 months after placement of implants at intervals of 6 months to assess increase in residual ridge height, peri-implant condition (marginal bone loss, plaque and gingival index) and implant stability.

Results: Maxillary first molar was the most common site (72.72%) for sinus lift and implant placement. Caries was the most common cause (90.90%) for loss of tooth. Increase in residual ridge height ranged from (71.43-133.33%) as measured by Denta-Scan. Implant survival rate was 100%. Marginal bone loss ranged from (0.6-1.2 mm). Implant stability was measured by periotest (–2 to –6). Only one patient had perforation of sinus membrane, but it was sealed satisfactorily by bio-absorable membrane.

Conclusion: One stage lateral sinus lift procedure with alloplastic bone graft material in combination with 2 stage implant placement has a predictable outcome in patients with severe resorption of posterior maxilla.

Keywords: Direct sinus lift, Single tooth implant, Sinus floor augmentation, Alloplastic bone graft.

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INTRODUCTION

In 1986, Carl E Misch described a treatment approach to the posterior maxilla based on the amount of bone below the antrum.[1] The treatment plan was divided into four alternative treatment options amongst which the Subantral option three (SA-3) is indicated when 5 to 8 mm of vertical bone height is present between the crest of the ridge and the antral floor with a ridge width greater than 2.5 mm; where the sinus membrane can be elevated by lateral window technique[2,3] with immediate placement of an implant.

Considering the above facts, a study was conducted in the Department of Oral and Maxillofacial Surgery, Government Dental College and Hospital, Ahmedabad from November 2009 to November 2010. It evaluated both, clinically and radiographically, the efficacy of the lateral sinus lift along with simultaneous implant placement for the rehabilitation of the partially edentulous posterior maxilla deficient[4] in residual alveolar bone height.[5]

MATERIALS AND METHODS

The study consisted of sample of 10 patient and 11 implant sites, who visited the Department of Oral and Maxillofacial Surgery, Government Dental College and Hospital, Ahmedabad. The patients were selected randomly irrespective of the sex and socioeconomic status.

Following inclusion criteria for patients were taken into consideration:

- Patients requiring implant treatment in the posterior maxilla, between the ages of 20 to 50 years
- A delay of at least 6 months between tooth extraction and an implant placement
- Good systemic health. Absence of maxillary sinusitis
- Presence of normal adjacent teeth or restored teeth
- Demonstrated maladaptive experience or psychotic reluctance to wear a removable partial denture
- Willingness to participate for the duration of the study
- Well informed and motivated patients who gave their consent willingly
- Patients available for regular follow-up

Following exclusion criteria were taken into consideration

- Uncontrolled metabolic diseases, compromised immune system, uncompensated systemic disease, diabetes,

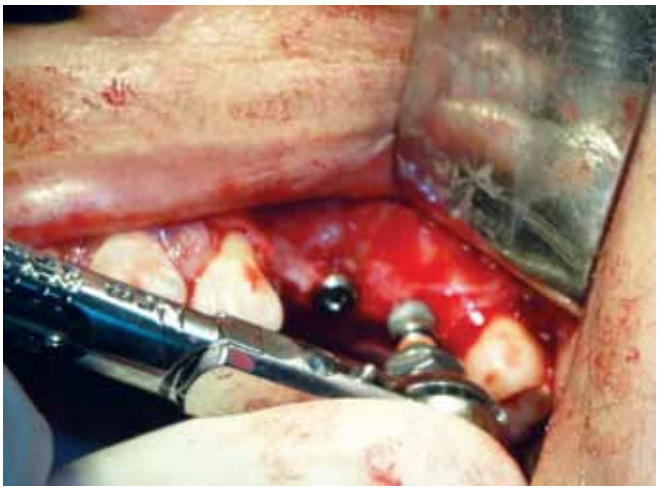

Fig. 1: Implant placement

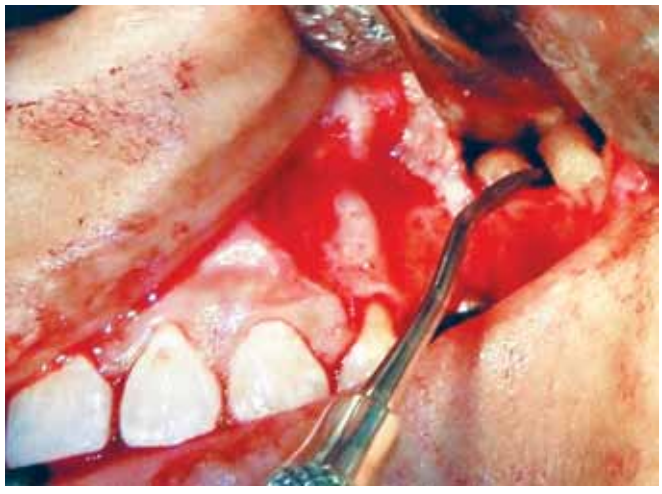

Fig. 2: Bone grafting with alloplastic bone graft

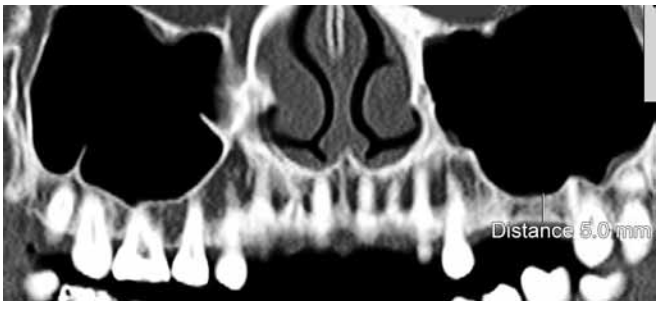

Fig. 3: Preoperative panaromic view bone height 5 mm

hematologic disorders, pregnancy, prior radiotherapy of the surgical site, chemotherapy, osteoporosis or any other systemic illness which may affect the prognosis of the treatment

- Patients with long-term habits of smoking, gutkha chewing, tobacco chewing, alcoholism, drug addiction, etc.
- Debilitating temporomandibular joint pathosis and untreated dental disease
- Inadequate mouth opening, which cannot allow placement of instruments necessary for implant insertion
- Active or recurrent maxillary sinusitis
- Previous history of Caldwell-Luc surgery
- Uncontrolled periodontal disease or refusal to undergo periodontal therapy
- Psychological conditions like depression, anxiety and prisoner status
- Unrealistic esthetic expectation.

Surgical Technique

Under local anesthesia, an incision was made, 2 to 3 mm on the palatal side[6] of the crest of the ridge with a releasing incision at least 15 mm mesial to the antral opening. A bony window, round to elliptical in shape, was cut. With a surgical curette, the underlying membrane was lifted from the inside wall of the sinus.[7] When the sinus membrane was intact, a bellows effect was observed as the patient breathed. In case of a tear occurring in the membrane,[8] a small piece of resorbable collagen membrane could be placed against the tear, where it would easily adhere. If a larger perforation[9] were to occur in the membrane, laminar bone (membrane like sheets of DFDB) could be used for repair or it could be sutured with 6-0 resorbable sutures.

1:20 reduction handpiece was used at the low speed (800 to 1200 rpm) high torque (35 Ncm) along with copious irrigation (external and internal) of normal saline to prevent thermal injury to the bone. A self tapping implant[10] was placed in the prepared site and then the osteotomized segment was supported on the implant head (Fig. 1). Alloplastic bone graft (Bioactive glass,[11] Novabone putty[12]) was placed in the lateral window and the implant surface was covered with the same (Fig. 2). The lateral window was then covered with the collagen membrane to avoid the fibrous adhesion between the inner surface of the flap and bone graft. After the placement of the membrane, the mucoperiosteal flap was repositioned and sutured with the help of (3-0) 2328 Vicryl. Postoperative instructions, such as refraining from nose blowing and sucking with a straw were given to the patients.

Stage II

Surgical exposure of the implant[13] and placement of the healing cap were done 6 months after placement of the implant. After 15 days of stage II, an abutment was attached to the implant and prosthesis was fabricated. All the patients were kept on regular follow-up.

RESULTS

Follow-up was done 6 months after sinus lift and simultaneous implant placement (time allowed for graft maturation and implant healing) and at the interval of 1 and 2 years after final prosthesis. Standardized IOPA, Digital OPG and CT scan/Dentascan[14] were taken preoperatively and at 6 months follow-up intervals (Figs 3 to 6).

Table 1: Statistics evaluation of bone height: preoperative and postoperative after sinus lift and augmentation

	Preoperative bone height	*Postoperative bone height*
Mean	5.81	10.49
Standard deviation	0.714	0.975
T = 12.8236		
Df = 20		
Std. error of difference = 0.364		

Two tailed p-value is < 0.0001 and this difference is considered to be extremely statistically significant.

Confidence Interval

The mean of preoperative bone height minus postoperative bone height equals —4.68 (Table 1). Ninety-five percent confidence interval of this difference: From –5.433 to –3.913.

There is significant increase in residual bone height over a period of 6 months following sinus floor augmentation, in the range of 3.7 to 6.1 mm (on an average of 4.67 mm). Hence, an 80.37% bone gain was noted on an average. One year after loading of implant (18 months after one stage lateral sinus lift) reduction in graft height was <1 mm and 2 years after loading of implant (30 months after one stage lateral sinus lift postoperatively) was more than around 0.2 mm annually.

DISCUSSION

In two out of ten patients (20.0%), Schneiderian membrane perforation occurred during surgery which was of approximately 0.5 cm size and was successfully repaired by sealing the perforation with resorbable collagen membrane. Although one patient (9.09%) had experienced pain and a mild attack of maxillary sinusitis after 2 months, the next follow-up visits were absolutely normal. Postoperative healing was subsequently uneventful.

After 7 days of sinus lift surgery, the surgical site was evaluated clinically for local inflammation, persistent pain, wound dehiscence and maxillary sinusitis. Only one site (9.09%) was found with local pain at the surgical site in which Schneiderian membrane perforation had occurred intraoperatively. The same patient had suffered from the maxillary sinusitis after a period of 2 months which was treated with medications and further follow-up was uneventful.

The average residual alveolar bone height was 5.81 mm (*see* Table 1) preoperatively and after sinus floor augmentation, the residual alveolar bone height was in the range of 8.8 to 12 mm (average 10.49 mm) (*see* Table 1). The increase in residual ridge height was very significant in the range of 3.7 to 6.1 mm (average 4.68 mm) after sinus floor augmentation over the period of 6 months following surgery (Table 2).

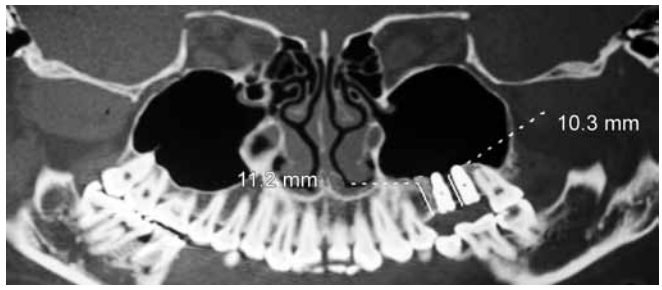

Fig. 4: Postoperative panoramic view (bone height 11.2 mm)

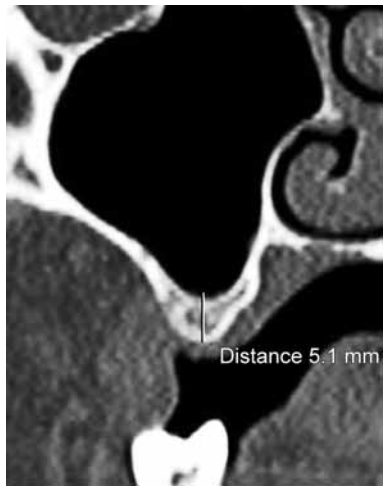

Fig. 5: Preoperative sagittal view (bone height 5.1 mm)

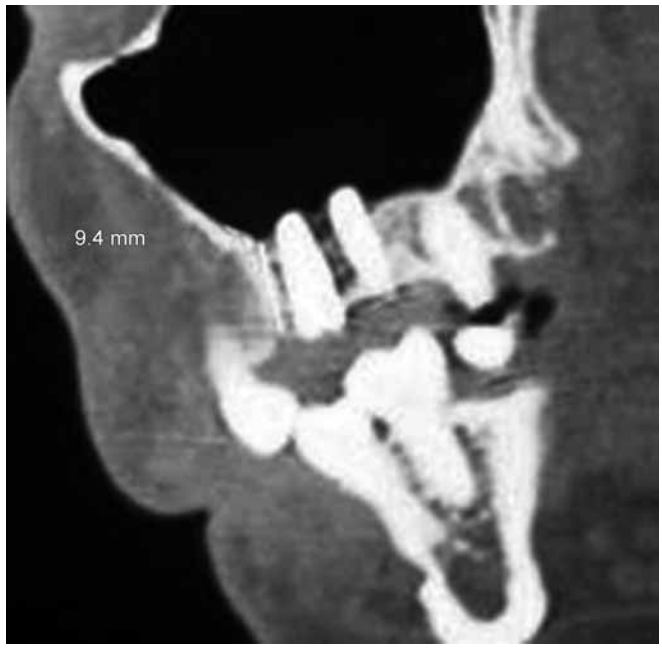

Fig. 6: Postoperative sagittal view (bone height 9.4 mm)

Hence, 80.37% bone gain was noted on an average after sinus floor augmentation with alloplastic bone graft. These findings were compatible with studies by Ziv Mazor, Michael Peleg and Martin Gross[15] who performed sinus floor augmentation for a single tooth replacement in the posterior maxilla which can provide the necessary bone support for holding the implant. After loading of the implants, a slight reduction of ridge height was noted after that stabilization

Table 2: Maxillary posterior alveolar ridge height: preoperative and postoperative after sinus lift and augmentation

No.	Site of sinus lift with simultaneous implant placement	Preoperative residual ridge height in posterior maxilla (mm)	Residual bone height after augmentation (mm)		
			6 months	18 months	30 months
1.	Maxillary right first molar	6.1	11.3	10.6	10.3
2.	Maxillary left second premolar and first molar	5.1 4.8	11.2 10.3	10.5 9.8	10.2 9.6
3.	Maxillary left first premolar	7	12	11.6	11.3
4.	Maxillary right first molar	5.5	9.5	9.1	8.9
5.	Maxillary left first molar	5.1	8.8	8.2	8
6.	Maxillary right first molar	5.8	10.8	10.3	9.9
7.	Maxillary right first molar	5.9	9.8	9.4	9.2
8.	Maxillary left first molar	6	10.1	9.7	9.4
9.	Maxillary right first molar	5.7	10	9.6	9.4
10.	Maxillary right first molar	7	11.6	11.1	10.8

of bone graft (<1 mm after 1 year of loading), a finding coincidental with a study by Nystrom et al.[16]

CONCLUSION

The lateral window technique offers several advantages compared to the crestal approach including access through a larger window into the sinus. However, sinus elevation using the lateral window approach requires extensive surgical manipulation and extended waiting period before uncovering for implant placement. The bone augmentation is expected to result in primary implant stability, promote osseointegration,[17] prevent overloading and provide long-term implant success.[18] The use of this procedure is recommended in the posterior maxilla when the residual bone height > 5 mm.

Lateral sinus lift, despite having some disadvantages, such as in particular high demands on both surgeon and the patient and longer healing period, is in most cases the best available solution for insufficient quantity of the alveolar bone[19] during the implantation in the dorsal parts of the maxilla. Its role in current dental implantology is still non-replacable. The invasiveness of the procedure can be substantially reduced when performed by an experienced surgeon using the presented surgical protocol. The risk of complications remains low.

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