

Direct maxillary sinus lift; complications influence on fixture survival

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Objectives: The objectives include highlighting one of the advanced surgeries in dental implantology, the clinical outcome of post-surgical complications and comparing the success rate difference between direct sinus lift (DSL) and cases were lifting not need.

Methods: This retrospective study was organized in Al-Salam Teaching Hospital from 2007 to 2010. Seventy-seven patients underwent DSL surgery as a site preparation for dental implant with superline dental implant system. From the total 1872, we choose 75 patients who do not need sinus lifting. The cases were divided into two groups: Group A are the cases in whom dental implant was performed without sinus augmentation or lift (No SA.) and Group B are the cases in whom dental implant was performed with sinus augmentation lift (DSA.).

Results: Perforation was the most serious complication which needs to be avoided in DSL cases. It needs special skill, gentle alert works. Accurate management of the complications can give good result without affecting success rate.

Conclusion: Careful analysis via imaging, precise surgical techniques, and an understanding of the anatomy of the surgical area are essential in preventing complications. One should be aware of the possible complications related to implant placement so that the patient can be properly informed.

Keywords: Direct sinus lift, bone augmentation, dental implant, complications, advanced surgeries.

Introduction

Proper height, width, and density of the alveolar process are important factors for implant success. In some circumstances, implantologist can face height and width deficiency as a physiological subsequent response to tooth extraction. This is mainly seen in posterior edentulous maxilla considered as limiting factors for dental implant placements. Unfortunately, loss of occlusal forces which activate bone remodeling is the main cause of resorption of both jaws, end with subsequent atrophy can obligate surgeon to change line of treatment passing to bone augmentation.¹ Added to that, presence of maxillary sinus floor in the posterior areas with osteoclastic activity of the periosteum leads to the enlargement of the sinus pneumatization at the outlay of alveolar ridge height beneath the maxillary sinus.² The direct maxillary sinus augmentation or lift surgeries defined bone substitute embedding below sinus membrane to attain sufficient thickness for fixture stability.³ In cases where the height of residual bone is less than 5.0 mm, sinus lifting through a lateral window approach is suggested as the treatment of choice.⁴

Sinus lift surgeries are similar to any surgical procedure, can carry a lot of complications if not managed well and accurate. Post-operative bleeding from the nose, sinusitis, pain, perforations of the Schneiderian membrane known as common complications after such surgery.⁵ The risk of Schneiderian membrane perforation is the most common complication of this technique.⁶

Direct access and conception of the entire sinus is the advantage for use of this surgery in spite of presence of previously mentioned complications. Anatomic considerations may limit the surgery. Patients usually complain from per procedural discomfort. Also, the procedure requires surgical expertise.⁷

Implant placement after sinus lift will improve implant survival, marginal bone loss, and periimplant clinical parameters similar to those obtained with conventional implant placement in native bone. However, there are more incidences

for surgical complications in association with the sinus lift procedure.⁸

Implant survival with favorable outcomes have been reported in a number of systematic reviews including those of Pjetursson, Tan, Zwahlen, and Lang (2008), Esposito et al. (2010), Corbella, Taschieri, and Del Fabbro (2015), Thoma et al. (2015), Danesh-Sani, Engebretson, and Janal (2017), Ting, Rice, Braid, Lee, and Suzuki (2017) and Starch-Jensen et al. (2018).⁹

Implant success was defined as no pain or tenderness upon function, no mobility, +2 mm radiographic bone loss from initial surgery, and no exudates history.¹⁰

The aforementioned techniques for sinus floor augmentation surgery required advanced training of the surgeon, presented frequent intraoperative complications, and were considered technique-sensitive.¹¹

Objectives:

- Highlighting one of advanced surgeries in dental implantology.
- The clinical outcome of post-surgical complications.
- Compare the success rate difference between direct sinus lift (DSL) and cases where lifting not needed.
- Emphasize different published articles as compare.

Inclusion criteria:

- Patient with diminished height (less than 5 mm).
- Single tooth loss or more.
- Areas of loosed teeth extend from second premolar to wisdom tooth.
- Patients agree to share in the research with predictable follow-up.

Exclusion criteria:

- Systemically unfit patients.
- Drugs allergies that affect post-operative healing.
- Patients rejected to share.
- Poor follow-up cases.
- Indirect surgery cases.

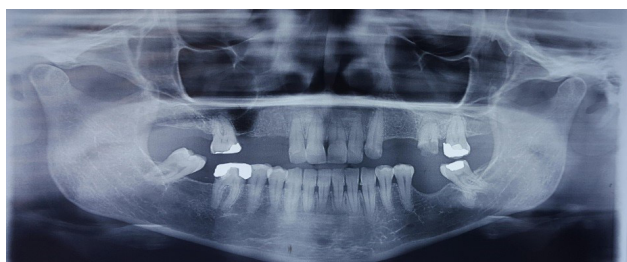


Fig. 1 Radiographical view, detects need for DSL.

Materials and methods

This retrospective study included records of all consecutive patients seeking dental implant who required maxillary sinus augmentation with direct technique. These patients initially presented with edentulous atrophic maxillary arch, patients presenting with one or more missing teeth in posterior maxillary arch, either unilaterally or bilaterally (Fig. 1). 1872 patients underwent dental implants surgery in Al-Salam Teaching Hospital since 2007 till 2010. Seventy-seven patients were underwent DSL surgery as a site preparation for dental implant with superline dental implant system. From the total 1872, we choose 75 patients who do not need sinus lifting in the posterior maxilla which extend from second premolar where the situation of the site is slightly identical for comparison. Cases were divided into two groups where Group A are the cases where dental implant was performed without sinus augmentation or lift (No SA.) and Group B are the cases where dental implant was performed with sinus augmentation lift (DSA.).

In both groups, 157 fixtures are placed equally with different diameters and heights. Patients were followed to record the complication that was faced in the post-operative period.

In Group A, fixtures are seated smoothly under local anesthesia. Slight pain performed at day of surgery was recorded in five patients. This type of pain has been reduced by use of paracetamol tab 500 mg twice in the day of surgery only, one patient presented with infection resolved by use of amoxil capsule 500 mg for 3 days with mouth wash by chlorhexidine mouth gargle. The rest of patients show no complications. Prosthetic parts are delivered after 4 months of osseointegration with 100% success rate in the whole follow-up period.

In Group B, patients were prepared to undergo direct sinus lifting by lateral approach flap opened, window done by use of straight hand piece 1:1, 30,000 RPM, small round bur with gentle skilled dealing to prevent perforation of Schneider's membrane. Bone piece was taped to push inward and then gentle separation of the Schneider's membrane underwent by special curved curate and synthetic bone materials placed to elevate the sinus wall more than 10 mm (osteone II type). In some cases, fixture was placed simultaneously with the lift in the presence of 5 mm height, in other cases fixture placement was post-poned after 6 months of bone formation which takes place due to insufficient bone height to perform primary stability. Prosthetic parts are delivered after fixture placement with 4 months.

All patients are followed-up for 5 years after prosthetic loading, where examination of the site takes place: maxillary sinus area, fixture, gingiva, and the prosthetic bridge too clinically. All notes are recorded.

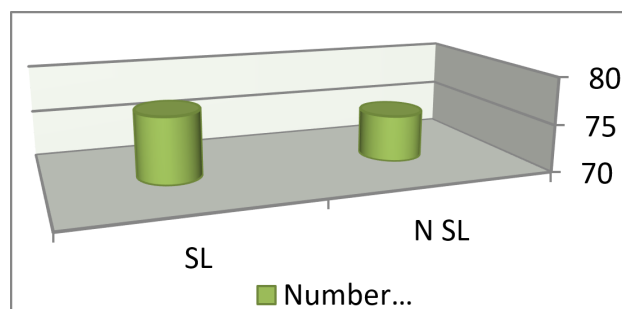


Fig. 2 Patient's distributions according to surgeries types.

Table 1. Complications in sinus lift cases and non-sinus lift cases.

Complications	Sinus Lift cases		Non Lift Cases	
	No. of Pt	%	No. of Pt	%
No complications	54	70.12	69	92%
Pain	13	16.88	5	6.66%
Infection	2	2.59	1	1.33%
Perforations	7	9.09	0	0
Failure of fixtures	1	1.29	0	0
Total	77		75	

*No. of Pt. = Number of patients

Result

From the total 1872 patients, 77 patients required DSA with 157 fixtures after exclusion of many unfit cases. In comparison of these patients with other patients 75 patients were not for augmentation (Fig. 2). Complications have been recorded in Group A (No SA) cases, slight pain was seen in five patients, infection was seen in one patient which was treated smoothly with simple antibiotics while in DSA cases, accidental perforation of membrane is the most serious complication which needed more advanced skill to manage and it occurred in seven cases (Table 1). Membrane perforation managed by use of tissue-guided regeneration membrane separate the Schneider's membrane and augmented bone substitute before closure of the flaps. Severe infection seen in two cases only and managed by heavy dose antibiotics (ceftriaxone vial 1 g) once daily for 5 days. Pain was seen in 13 patients and required paracetamol tablets 500 mg for 4 days.

Statistical Package for Social Service, version 17.0 (SPSS Mann Whitney Test) was used to analyze the complications in both groups. Descriptive analysis are shown in Tables 2 and 3, for Group A and Group B, respectively.

In comparing pain in both groups, p -value was 0.052 (Table 4) which is not significant. This can be attributed to pain as complication will not affect the result of final treatment or affect success of fixture survival.

Regarding infection also, p -value is not significant (0.577) (Table 5). Good observation and follow up with fast and heavy control of infection can give good result as same as non-sinus lift cases.

p -Value was significant (0.008) (Table6). Perforation was the most serious complication which needs to be avoided in DSL cases. It needs special skill, gentle alert works especially in

Table 2. Descriptive analysis of complications of non-SL patients.

Complications	N	Min	Max	Mean	Score % of freq.		Std. Dev
					0	1	
Pain	75	.00	1.00	0.0667	83.1	16.9	0.25112
Infection	75	0	1	0.01	97.4	2.6	0.150
Perforation	75	.00	0.000	0.000	100		0.000
Failure	75	.00	0.000	0.000	100		0.000

Table 3. Descriptive analysis of complications of SL patients.

Complications	N	Min	Max	Mean	Score % of freq.		Std. Dev
					0	1	
Pain	77	.00	1.00	0.1688	83.1	16.9	0.37706
Infection	77	0	1	0.03	97.4	2.6	0.160
Perforation	77	.00	1.00	0.0909	90.9	9.1	0.28936
Failure	77	.00	1.00	0.0130	98.7	1.3	0.11396

Table 4. Pain comparison in both groups.

Complications	N	Mean	St. D	Z value	p-value
NSL Pain	75	0.0667	0.25112	-1.943	0.052
SL Pain	77	0.1688	0.37706		

Table 5. Infection comparison in both groups.

Complications	N	Mean	Std. Dev	Z value	p-value
NSL infection	75	0.01	0,0150	-0.558	0.577
SL infection	77	0.03	0.0160		

Table 6. Perforation of membrane comparison in both groups.

Complications	N	Mean	Std. Dev	Z value	p-value
NSL perforation	75	0.000	0.000	-2.665	0.008
SL perforation	77	0.0909	0.28936		

Table 7. Failure comparison in both groups.

Complications	N	Mean	Std. Dev	Z value	p-value
NSL Failure	75	0.000	0.000	-0.987	0.324
SL Failure	77	0.0130	0.11396		

* $p \leq 0.05$ is considered as statistically significant.

hand piece use where other facilities are not present. Dealing after perforation is dependent on the surgeon's judgment at once whether to continue the lifting or to only treat the perforation and close.

Although the past discussed complications are shown, we gained a good success rate in DSL cases same as in non-sinus lift patients, as p -value were not significant (0.324) (Table7).

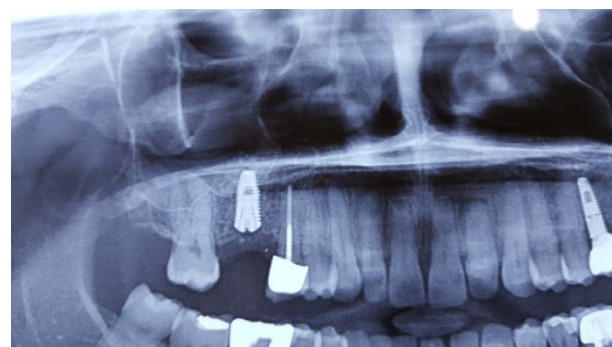


Fig. 3 Radiographical assessment post-operatively.

Radiographical assessment post-operatively is shown in Fig. 3. Accurate management of the complications can give good result without affecting success rate.

Discussion

Alveolar ridge resorption is the physiological sign which can be seen post-extraction for many causes especially in posterior maxilla with presence of antral pneumatization. Loss of bone height, width, and density can disturb the survival of fixture in posterior region which makes placing dental implants are some challenges.

Direct sinus augmentation as reported aid placement of dental implants in the posterior maxilla. Many literatures were reporting complications of maxillary lifting surgeries such as bleeding, infection, laceration of infraorbital nerve, wound dehiscence, and Schneider a membrane perforations.⁷

In this clinical retrospective study, we discuss the effect of complications that can be seen in augmented and non-augmented sinus floor with fixture placement in a follow-up period of about 5 years post-loading.

Pain as a complication shows no significant effect on survival rate of fixture in both groups as it can be associated

with any surgical procedure depending on pain threshold of patients, it simply can be controlled by low-dose analgesics.

Giampiero Cordioli¹² stated that his patients who underwent sinus augmentation with 27 fixtures simultaneously placed; none of the patients had post-operative complications not more than normal swelling and inflammation at the surgical sites.

Infection occurred in three cases, one in non-augmented area and two cases occurred in augmented area. These cases were controlled by use of antibiotics and mouth rinses to avoid extension of infection (sinusitis) that might lead to loss of fixture. This result is reconciled with a study done by Eric Oh.¹³ He stated that from total of 175 sinuses that were augmented, 115 patients sustained membrane perforation. Three cases persist with infection treated by antibiotics and mouth washes for 10 days.

Schneiderian membrane perforation has been reported as a serious complication occurring 10%–60% of the time during sinus augmentation.¹⁴ In this study, 7 patients had accidental perforation occurring from the total 77 cases. This can be attributed to many cause as anatomical variation, surgeon experts, use of round bur, and straight hand piece, sever resorbed bone, thin membrane wall.¹⁵ It shows a significant difference from non-augmented cases as it is impossible to be seen if the surgeon follow ideal and accurate steps in choosing fixture height. This result is not harmonized with Eric Oh in 2011. He demonstrates that perforation of the Schneiderian membrane does not cause negative long-term effects on sinus bone grafts and dental implants.¹³

While Lifshy stated that perforation might cause infection subsequently due to migration of graft particles to other sites related to presence of anatomical communications with other sinuses. For that, some studies report abandoning sinus lifting procedure in case of wide perforation.¹⁶ On the contrary is not an absolute indication for cancelling sinus lifting unless the membrane is largely destroyed.¹⁴

Giampiero Cordioli¹² stated that minor nasal bleeding occur in two perforation cases only from 27 patients.

Elvinas Juzikis highlighted that perforation is present in 19.5% (varies from 0% to 58.3%) of clinical cases. Surgeon skill, distinct anatomy of the sinus, tools used through the surgery, calm of the patient: all these factors can affect the complications occurrence intra-operatively (5).

In study done by Balaji,¹⁷ sinus augmentation is done during and after placement of dental implants, no significant complications were reported. These results were consistent with the findings of Graziani et al.,¹⁸ no complication were recorded. Milan Jurisic et al. and Diana and Rao estimated a high success rate implant placements on 61 and 11 patients, respectively.^{19,20}

Balaji¹⁷ conclude that result of sinus augmentation depends on surgeon's acumen and experience.

Presence of adequate quantity and quality bone is essential for lifelong success in implant surgeries. Both functional and esthetic support for edentulous area is a challenge in certain region where diminished bone is available. One of these

challenged sites is the posterior edentulous maxilla because of the presence of the maxillary sinus.²¹

Sunitha V. Raja²² concludes that a well-structured training program under an experienced mentor would be of great benefit to the novice implant dentist. Mark⁴ stated that the short-term (3 years) clinical success/survival of implants in sinus augmented sites is not different from that of implants placed in the non-grafted alveolar process.

It is well known that most implant failures occur 3–6 months after surgery, and they are usually unrelated the maxillary sinus infections.²³

Stefan Lundgren et al.²⁴ stated that in estimation of implant stability by resonance frequency analysis, bone formation was evident in all 10 patients after 12 months of loading. These results were confirmed in two other publications, which also obtained good bone in the maxillary sinus floor beneath the membrane without adding a graft material. In Hatano et al. study,²⁵ bone formation was evident and the average height of newly formed bone around the implants was 10 mm. As well as the study conducted by Thor et al.²⁶ showed an average of 5 mm residual bone at the floor of the maxillary sinus, new bone formation averaged 7 mm. The authors found that the greater the length of the implants, the more new bone that was formed.²⁶ This also equivalent with Giampiero Cordioli.¹² "All implants maintained stability at 12 months after loading."

Eric Oh,¹³ in his study, shows 99% success rate of implant integration in intact sinuses compared with 97% success rate in perforated sinuses

Gerry M. Raghoebar in his meta-analysis revealed annual implant loss of 0.43% (95% CI: 0.37%–0.49%) and overall complications were low (9), which corresponds with Claudio Stacchi in his systematic review 2018.²⁷

Gian Maria Ragucci in his systematic review concludes that survival rate 95.6%, after 52.7 months of follow-up, with epistaxis was the most frequent clinical complication without significant differences according to the level of penetration ($p = 0.301$).¹⁰

Conclusion

Maxillary sinus augmentation surgery, considered as one of the advanced type surgeries whether direct or indirect approach, needs careful accurate analysis, clinically and radiographically. Surgical tools and skill hands are substantial to avoid unexpected complications that can affect fixture survival.

Although serious complications are uncommon, dental implant placement is not free of complications, as complications may occur at any stage. The patient can be properly informed about which complications can be faced.

Conflict of Interest

None

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