



The Impact of Open and Closed Sinus Lift Procedures on Osseo Integration of Delayed and Immediately Placed Dental Implants: A Retrospective Study

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Received: July 20, 2020; Published: August 19, 2020

Abstract

Introduction: Success of dental implants is attributed to several factors, including adequate bone quality and quantity. Sinus lift procedures can provide sufficient bone to accommodate dental implants in an atrophic maxilla, aiding in successful Osseo integration.

Aim: The aim of this study was to 1) evaluate the credibility of sinus lift procedures, 2) compare the success of dental implants placed after a closed vs. open sinus lift procedure and 3) the success of immediate vs. delayed placement of dental implants.

Materials and Methods: A retrospective study was carried out at Islamic International Dental College and Hospital and Park Road practice, Islamabad, Pakistan. The sample size of this research comprised of a total of 58 implants in 35 consecutive patients. Bilateral or unilateral Sinus lift procedures were carried out using an open or closed technique, with delayed or immediately placed implants. Osseo integration outcome (success or failure) was evaluated in all the cases.

Results: 93% of the Sinus lift procedures were successful; yielding a high success rate of 95.2% Osseo integrated dental Implants, regardless of the techniques used in the 93 sinus lift procedures. In some cases, the sinus membrane was perforated which was either sutured or covered with a membrane barrier, depending on the size of the defect.

Conclusion: The result of our research further authenticates the previously documented studies and proves that Sinus lift is a highly dependable technique and guarantees higher rate of success in both delayed or immediately placed dental implants.

Keywords: *Closed Sinus Lift; Osseo Integration; Dental Implants*

Introduction

Dental implants have revolutionized the world of dentistry in the recent decades. Patients suffering from tooth loss have relied on the exponentially progressing techniques and variety of dental implants. Dental implants can aid in restoring form, functionality and aesthetics to the patients [1]. An important factor affecting the success of Dental implant is the quantity and quality of bone that is essential for Osseo integration to take place. Reduced bone levels may not be sufficient to accommodate the length of dental implant, resulting in decreased support and stability. Due to a long span of edentulous phase, the crestal bone reduces in width and height. In addition to that, the maxillary sinus may pneumatize, expanding more towards the floor than laterally. Both these processes of bone remodeling and pneumatization result in an overall reduction in the bone volume.

Sinus lift procedure, introduced in 1974 by Dr. Hilt Tatum Jr, helps overcome the problem associated with reduced bone levels and enhance the support required for Osseo integration of dental implants. The aim of this procedure to lift the sinus membrane and increase the thickness of the maxillary sinus floor by adding a grafting material onto which the dental implant can be placed [2]. Bone graft materials used in the sinus augmentation procedure facilitate bone formation by forming a scaffold over which osteogenesis takes place [3]. The graft materials exhibit biocompatibility which ensures the graft does not initiate foreign body reactions. Moreover, graft materials are also bioresorbable which aids in remodeling of the existing bone, as well as infiltration of new bone. The graft materials can be categorized as autogenic (using bone

from the patient's own body, for example the maxillary tuberosity or ileac crest) [4-6], allograft (from a human cadaver, freeze dried bone) [7], xenograft (bovine), or alloplastic hydroxyapatite/collagen matrix graft material. The end result of grafting the floor of the maxillary sinus is to acquire adequate bone height and volume, with enhanced support and stability for implants.

The Sinus Lift procedure is rapidly evolving, offering more reliable modifications in the techniques. The maxillary sinus augmentation can be done using a traditional Lateral window technique in cases where available ridge height is ≤ 4 mm (also called an open sinus lift procedure), whereby a window is cut into the lateral wall of the Sinus, making a trap door of the bone, separating the sinus membrane from the bone and introducing the graft in between. The wound is closed and sufficient time is allocated for bone healing to take place. Another less invasive technique is the osteotome technique (Closed sinus lift procedure), whereby a socket is made in the bone, with a 1 - 2 mm space between the sinus wall. Lifting the floor is done by tapping through the socket using osteotomes [8]. This technique is less invasive than the lateral window technique and is used when the available bone height is $> 6 - 7$ mm [9]. Another technique, namely the hydraulic Sinus Condensing technique is developed with the benefit of much shorter recovery time. After the incision into the gingiva, an osteotomy is done on the lateral aspect of the maxillary ridge, up to 1 mm distance from the sinus floor. Hydraulic pressure is introduced which dislodges and separates the sinus membrane from the underlying bone. This aids in lifting the sinus floor and making sufficient space for the grafting material to be packed. In certain instances, where there is moderate bone height to support dental implants, sinus membrane can be elevated and implants placed without the use of graft material in place [10].

Placement of dental implants can also be classified as immediate or delayed. In a closed sinus lift, dental implants can be placed simultaneously in the socket drilled during the osteotomy (1-stage procedure). In an open sinus lift procedure, if the bone height is less than 4 mm, implant placement is delayed till bone healing is complete (2-stage procedure). While, if more than 4 mm bone augmentation is required, simultaneous implant placement can be carried out [2]. Usually, where adequate bone height (≥ 6 to 7 mm) is present, simultaneous implant placement in a one stage procedure is advocated [11].

The rapid evolution and increasing reliability of the technique makes it a field open to constant research. There have been no studies conducted in Pakistan that evaluate the credibility of sinus lift procedures and their impact on OI following immediate or delayed implant placement. This study will facilitate the surgeons in their decision making regarding the need of SL procedure prior to implant placement.

Materials and Methods

In this retrospective study at Islamic International Dental College and Hospital and Park Road practice, Islamabad, Pakistan, records of 83 patients were evaluated for the success of dental implant placed after a sinus lift procedure, either with an open or closed sinus lift technique or with an immediately or delayed implant placement. Out of the 83 patients, 50 were males and 43 were female patients, with the mean age of 47.97. A total of 93 Sinus lift procedures were carried out, amongst which 15 were bilateral and 78 were unilateral sinus lift procedures.

An inclusion criteria was set to incorporate healthy patients, with insufficient bone height (< 4 mm for open sinus lift and 6 - 7 mm for closed sinus lift), missing teeth in the maxillary posterior quadrant.

The exclusion criteria consisted of patients with severe uncontrolled metabolic disease such as diabetes, ongoing or history of radiotherapy after head and neck cancers, suffering from osteoporosis or taking bisphosphonates, mentally handicapped patients, lastly those with poor oral hygiene and periodontitis.

Before the procedure, a thorough history was taken from the patient and a Dental Panoramic tomogram advised. Prior the commencement of the procedure, antibiotics (Capsule Augmentin 2g, one hour prior to the procedure) were administered as prophylaxis. The procedure was carried out under local infiltration anesthesia (2% lidocaine with 100,000 epinephrine) and in some cases, oral and IV sedation was utilized to make the procedure more comfortable for the patients. Depending upon the type of sinus lift procedure, access was gained via the buccal sulcus (forming a lateral window in an open sinus lift procedure) or through the osteotomy socket (in a close sinus lift procedure). During the osteotomy, con-

tinuous saline irrigation was carried out to prevent bone necrosis. After exposing the sinus membrane and detaching it from the underlying bone, the graft material was placed and secured by suturing the wound closed. The graft material used was 1 - 2 cc of allograft (FDB), alloplastic material or a combination of both, depending upon the amount of lift required.

The implants were then placed in the prepared site. Sutures (interrupted) were removed 7 - 10 days after the surgery. Prescription of post-operative antibiotics (Capsule 1g Augmentin, twice daily for 5 days after procedure) and analgesia (Tablet Ansaid 100 mg, twice daily and Tablet Panadol, 3 times daily), along with Enziclor mouthwash rinses twice daily over a period of two weeks.

Patients were advised to follow standard postoperative instructions, which included ice-pack, soft high nutrient diet for two weeks and to avoid sneezing, blowing their nose, or other actions that could result in an increase in intranasal pressure.

The delayed implants were placed 6 months after the sinus lift procedure and loaded 2 months after successful Osseo integration. Intraoral periapical radiographs were taken during and 1 month after the sinus lift procedure. Dental panoramic tomogram was advised 6 months after the sinus lift and implant placement.

The implant was considered to be successful in the absence of any signs and symptoms of infection (pain, discomfort, swelling, implant mobility, radiographic radiolucency or bone loss of the graft or around the implant. The presence of the above mentioned features was considered a failure. Failure of sinus lift procedures consisted of instability or necrosis of bone graft.

Results

Amongst the 93 sinus lift procedures, 56 were open sinus lift procedures/the lateral window technique and 37 were closed sinus lift procedures/crestal osteotomy technique. Out of a total of 125 dental implants, 33 were placed in a 1 stage procedure (immediate implant placement) while 92 were placed in a 2 stage procedure (delayed implant placement and loading).

Failure of Sinus lift procedure and Implant loss was observed during the study period. 93% of the sinus lift procedures were suc-

cessful, whereas 7% failed. Relatively small membrane tears (5 to 10 mm) were observed in 21% of the sinuses (Table 1). For the sinus lift procedures, there was no significant difference between the open and closed sinus lift procedure techniques ($p = 0.699$).

	Success		Total
	Successful	Failed	
Open Sinus Lift procedures (%)	51 59.3%	5 71.4%	56 60.2%
Closed Sinus Lift procedures (%)	35 40.7%	2 28.6%	37 39.8%
Total (%)	86 100%	7 100%	93 100%

Table 1: Sinus lift procedure techniques and success rate.

119 implants were successfully Osseo integrated, yielding a 93% success rate. 6 cases presented with difficulty in achieving initial stabilization. These failed implants were a direct result of failed sinus lift procedures. There was no statistically significant difference between 1 stage (immediate implant placement) or 2 stage (delayed implant placement) procedure ($p = 0.654$). Post-operative radiographs were done at follow up visits of 1 month, 6 months and 1 year. All patients with successful sinus lift procedures and dental implants received a fixed implant-supported prosthesis.

	Success		Total
	Successful	Failed	
Immediate Implant placement (%)	31 93.9%	2 6.1%	33 100%
Delayed Implant placement (%)	88 95.7%	4 4.3%	92 100%
Total number of Implants (%)	119 95.2%	6 4.8%	125 100%

Table 2: Successful dental implants placed with 1 stage and 2 stage procedures.

Discussion

In patients facing tooth loss, inadequate volume of bone as a result of remodeling of the alveolar ridge and pneumatization of maxillary sinus prevents successful Osseo integration of implants.

Sinus lift and bone augmentation have proven to facilitate the success of prosthesis. In our retrospective study, the 95.2% success of 125 implants placed in sinus lifted maxillae establishes that with the correct technique used, implant success is foreseeable [12].

A clinical investigation carried out over a span of 5 years by Hurzeler MB., *et al.* involved 151 implant prosthesis placed post sinus lift procedure. The result of this study predicted the sinus lift procedure as a highly credible technique for reconstruction of maxilla in cases where the bone amount was severely deficient. This further verifies the results of our study in favor of reliability of sinus augmentation procedure [13]. If sinus lift is not employed, the implant have to be short and hence wide to be accommodated by the residual bone (< 6 mm diameter).

Tormos M., *et al.* conducted a retrospective study evaluating the success of delayed and simultaneously placed 45 implants (23 delayed, 22 immediate) in augmented maxilla, with a 100% success rate [14].

Del Fabro M., *et al.* also evaluated the survival rates of dental implants in sinus lifted maxillae in a literature review that included 59 articles. According to the study, delayed and immediate implant placement had similar outcomes [15]. Both these studies coincide with the result of our study in which all 26 delayed and 32 immediate implants were successful.

Felice P., *et al.* compared the 1 stage vs. 2 stage sinus lift procedure, affirming the results of our study that there is no significant difference between the two procedures, although the study also suggests that the 1 stage procedure may impose a comparatively greater chance of implant failure in severely atrophic maxilla [16].

While substantial amount of literature has been documented to verify and support the results and claims of our study, there are also studies that have reported otherwise.

Seong WJ., *et al.* studied the prevalence of implant survival associated with sinus lifted maxilla in a retrospective study and sug-

gested that sinus augmentation may be a factor leading to implant failure. These results challenge our study and the employment of sinus lift as a technique [17]. A prospective controlled study by Nendir R., *et al.* contradicts with our study by stating that implants may be successful in a sinus lifted maxilla with or without the graft material in place [18].

In order to substantiate our results and eliminate false positive outcomes, there are always parameters, constants and variables that can be included or altered. Therefore, the results of a single study should be considered preliminary. The sterility of results can be obtained by altering various factors. A bigger sample size can validate the conclusions drawn in the existing study. Ideally CBCT should be used pre-operatively to prevent and assess for membrane tears (as septae are better visible than in a DPT). Furthermore, different graft materials should be used to explain the results of contradicting studies in our favor [19].

Conclusion

Sinus lift is a highly dependable technique and guarantees higher rate of success in both delayed or immediately placed dental implants.

Contributions

Dr. Anum Khan: conception, design, acquisition of data, initial drafting and final review of the manuscript. Dr. Kamran Khan was the Surgeon carrying out the Sinus lift procedures and Implant placement, responsible for data collection and final drafting. Dr. Kiran Khan, Dr. Rida Iqbal and Dr. Fareeha Khan: Data collection, referencing, review and final approval of manuscript.

Conflict of Interest

None.

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Volume 3 Issue 9 September 2020

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