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Achieving Predictable Success with Minimal Morbidity: Analysis of the Indirect Sinus Lift Technique for Maxillary Dental Implant Placement

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ABSTRACT

Objective: To analyze the efficacy of indirect sinus lift procedure for maxillary dental implant placement.
Study Design: Prospective analytical study.
Place and Duration of Study: 28 Military Dental Centre/ Combined Military Hospital Rawalpindi Lahore, from May 2021 to April 2023.
Methodology: The study included 50 consecutive patients of 40 to 65 years of age presenting with missing upper maxillary molar teeth with maxillary sinus extension in the alveolar ridge and requiring maxillary dental implant placement. Indirect sinus lift and bone augmentation was carried out through the osteotomy site with concurrent dental implant placement in all patients.
Results: Out of 50 patients 49(98%) have successful osseointegration of dental implant at 4 months follow-up without any sinus complications. The mean procedure time was 25.00+5.00 minutes including osteotomy, bone graft and implant placement.
Conclusion: Elevating maxillary sinus floor presents a crucial step in achieving optimal bone volume for dental implant placement. Performed meticulously, indirect sinus lift technique is minimally invasive alternative to overcome the surgical complications and risks involved with direct open surgical approach.

Keywords: Indirect sinus lift, Maxillary implants, minimally invasive procedure, Osseointegration, Sinus lift.

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INTRODUCTION

Implant supported dental prosthesis is a promising modality of treatment in the field of dentistry and is an easy procedure when adequate bone density, width, and height is present [1], while in many cases dental implant placement is more complex because of inadequate bone and soft tissue. Dental implant placement in the region of the posterior maxilla is mostly troublesome due to the expansion of the maxillary sinus into the alveolar bone [1]. The maxillary sinuses are air-filled cavities that are present in the maxillary bone bilaterally and are significantly larger in adult patients with edentulous posterior maxilla due to pneumatization of sinus schneiderion membrane in the edentulous space as compared with patients with complete posterior dentition[2]. This extension of the sinus membrane prevents the placement of dental implants in the posterior region of maxillary alveolus due to inadequate bony support [2]. The quest for an adequate level of bone volume for implant placement in the posterior quadrants of maxilla often leads to a sinus lift procedure[3]. The sinus lift is a procedure in which graft material is placed inside the maxillary sinus cavity but external to the sinus membrane to augment alveolus[4] . Many surgical treatment modalities have been described for a vertically deficient, edentulous posterior maxilla. Two approaches were being used traditionally: direct sinus elevation in which a lateral window approach is used and indirect sinus elevation by using a crestal approach[2-5] . In the direct sinus elevation approach, incisions are placed palatal to the alveolar crest with a full-thickness mucoperiosteal flap elevation in order to expose the maxilla followed by the creation of a window 2 to 3 millimeters above the sinus floor with the use of either a surgical or diamond bur down to the maxillary sinus membrane. This cortical window is then carefully fractured inward and dissection of the sinus membrane is done to create required space for bone graft placement. The lateral maxillary wall becomes the roof for the subsequent graft material. This traditional direct approach despite its established success carries the inherent risk of sinus membrane perforation, extended surgical procedure time, and

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increased patient discomfort[6]. In response, the minimally invasive indirect sinus lift technique has emerged as a promising alternative aiming to elevate the sinus floor without directly exposing the delicate schneiderion membrane[7]. In this technique, after raising a full-thickness mucoperiosteal flap from the maxillary alveolus an osteotomy is made in the desired implant placement site with the consecutive increasing number of surgical drills and stoppers at 4 to 5 millimeter. Specially designed osteotomes are then used to push the sinus membrane upwards and bone graft material is placed through the osteotomy site. Although in some cases dental implant placement can precede simultaneously when 4 to 5 millimeters of alveolar bone height exist in many cases dental implant is placed 6 months later. This procedure is highly effective when just a few millimeters of bone augmentation is required in combination with concurrent dental implant placement[8].

This article delves into the efficacy of the indirect technique, meticulously analyzing 50 consecutive cases and highlighting its potential for achieving predictable success with minimal postoperative complications.

METHODOLOGY

This prospective analytical study was approved by ethical committee at 28 Military Dental Centre, CMH, Lahore Letter No.MDC/R02/21 , and was conducted from May 2021 to April 2023. This study included 50 patients selected on non-probability convenience basis. The sample size was calculated using OpenEpi version [3] sample size calculator, with prevalence of post-operative pain as 44.8%, a confidence level of 95% with margin of error as 5%, the sample size came out to be 46 which was increased for generalizability of results.[9] Thorough clinical and radiological assessment was done for all patients and patients who fulfilled inclusion criteria were selected.

Inclusion Criteria: Healthy patients aged 40 to 65 years, having good oral hygiene, posterior maxillary bone height of 2 to 7 mm and patients willing to undergo indirect sinus lift procedure along with dental implant placement were included.

Exclusion Criteria: Patients presented with any systemic disease, history of radiotherapy in the maxillofacial region, patients on bisphosphonate therapy and patients having periodontal inflammatory or maxillary sinus disease were excluded.

All procedures were performed by a single individual experienced in Oral and Maxillofacial surgery. The procedures were performed under local anaesthesia in all patients as ambulatory care. Surgical technique involved following steps.[1] A mid-crest incision was made with number 15 blade and a full thickness mucoperiosteal flap was elevated in order to expose the edentulous alveolar ridge.[2] Osteotomy was made by osteotomy drills of consecutively increasing diameter.[3] The sinus floor was gently displaced upwards using custom made osteotomes,Picture -1 specially designed for sinus floor elevation and bone grafting without directly exposing the schneiderian membrane.[4] A mixture of autogenous bone chips obtained from osteotomy site with osteotomy drills and hydroxyapitite bone graft substitute Mega-Oss was pushed through the osteotomy site into the sinus beneath the sinus membrane. Care was taken not to elevate the membrane for more than 4 to 5 mm to avoid perforation.[5] The adequacy of bone graft and integrity of sinus membrane was assessed by a peri-apical radiograph before placement of implant. The formation of a well balanced parabolic shape radioopacity above the osteotomy site was considered as adequate bone graft and non perforation of the sinus membrane.[6] In all the cases dental implant Any One by Megagen was placed simultaneously with sinus lift procedure Picture[2-7] The flap was then sutured closed with the help of 3-0 Polyglycolic Acid Suture, and patient was provided with postoperative instructions. Data of all patients was collected for demographics, preoperative alveolar bone height, surgical procedure time, per operative sinus membrane perforation, postoperative pain at surgical site and osteointegration of dental implant after 4 months.

Data was analyzed on Statistical Package for Social Sciences version 24, frequencies and percentages were calculated for qualitative variables while mean and standard deviation was calculated for quantitative variables like procedure time.

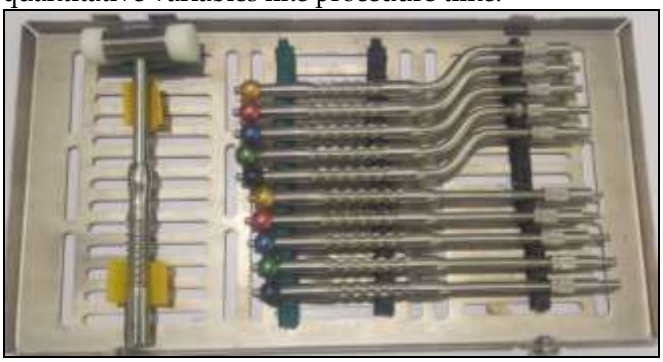

Figure-1 Specially designed indirect sinus lift kit

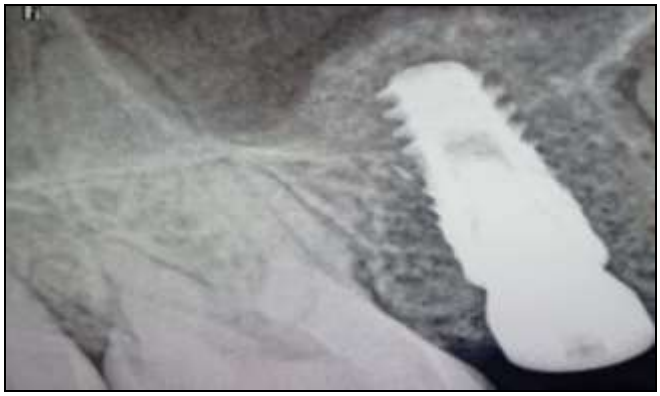

Figure-2 Sinus lift indirect with bone graft and dental implant

RESULTS

In this study of 50 patients, 19 individuals 38% were males whereas 31 respondents 62% were females. The mean age of study population was 40.00+10.00 years. The mean posterior maxillary bone height as measured on pre-operative radiographs from floor of maxillary sinus to alveolar crest was 4.00+2.00 millimeters. Total surgical procedure time was 20.00+5.00 minutes. Table- I explains postoperative pain as measured on the visual analogue scale on 1st and 3rd postoperative day while Table- II explains osteointegration at four months follow up. No sinus membrane perforation was encountered during surgical procedure in any patient.

Table-I: Post-operative pain measured using VAS (n=50)

Severity of pain	1st Post-Operative Day n= 50		3rd Post-Operative Day n= 50	
Mild	Present	22(44%)	Present	12(24%)
	Absent	18(36%)	Absent	37(74%)
Moderate	Present	10(20%)	Present	1(2%)
	Absent	40(80%)	Absent	49(98%)
Sever	Present	0(0%)	Present	0(0%)
	Absent	50(100%)	Absent	50(100%)

important goal in dental implant placement is to maintain a close bone to implant connection[10]. Anatomic variation in different areas of jaw widely affects the osteointigeration and prognosis of dental implant. In the immediate time period after maxillary posterior teeth extraction initial decrease in width is by resorption of buccal bone and this resorption of the maxillary alveolar ridge together with maxillary sinus pneumatization presents a significant challenge to the prosthetic reconstruction of the dentition. The success of implant therapy is directly related to the available quality and quantity of the bone in the maxilla or mandible[11]. Implant placement in the posterior maxillary alveolus is still a concern due to the bone morphology and closeness to the maxillary sinus, and this prevents placement of dental implant because of insufficient bony support. In such a condition it becomes crucial to modify or lift sinus lining for placing the implants[12]. Many advance surgical techniques in the recent years have evolved which make it possible now for implant placement even in compromised situations[13].

Autogenous bone graft is the gold standard. Bone can be harvested from either intraoral sites like chin and ramus of mandible or from distant donor site like iliac crest.Both procedures needs a second surgical site hence increases donor site morbidity and time of the procedure. In contrast hydroxyapitite bone graft is viable alternative that prevents a second surgical site and decreases overall surgical time. The high success rate of indirect sinus lift procedure observed in this study is particularly noteworthy compared to previously reported outcomes for the indirect sinus lift technique, which range from 88% to 95%[14] . This discrepancy might be attributed to several factors, including the surgeon's experience, meticulous protocol adherence, and careful patient selection. The

Table-II: Osseointegration of dental implant at 4 months follow-up (n=50)

	Clinical Parameters n= 50			Radiological Parameters n= 50		
Osseointegration at four months Follow-up	Pain	Yes	No	Marginal bone loss	Yes	No
		0(0%)	50(100%)		1(2%)	49 (98%)
	Inflammation	Yes	No	Lateral and/or apical radiolucency	Yes	No
		1(2%)	49(98%)		0(0%)	50(100%)

DISCUSSION

Dental implant placement in partially or completely edentulous patient has given dental profession and patient and extremely predictable and effective means of tooth replacement. The most operator's experience in precise bone fracturing and minimizing tissue trauma plays a crucial role in achieving optimal outcomes. Additionally, the standardized technique minimizes room for error and secures consistency throughout the procedure. Furthermore, careful patient selection based on sinus

health and oral hygiene likely contributed to favorable healing and reduced risk of complications [15-16] .

The advantages of the indirect sinus are numerous. Its minimally invasive nature translates to reduce tissue dissection, faster healing, and less discomfort for patients compared to the direct approach [17].This technique also minimizes the potential for membrane perforation, a significant complication associated with the direct approach that can compromise implant success and necessitate additional procedures[18-19] . Furthermore, the indirect technique requires less technical expertise compared to the direct approach, making it potentially more accessible for a wider range of oral and maxillofacial surgeons.

CONCLUSION

Indirect sinus lift procedure for posterior maxillary dental implant placement provides conservative surgical access and localized maxillary sinus augmentation with comparatively less degree of postoperative morbidity. Early loading of the implant is possible with this technique as compared to the conventional direct sinus lift procedure. The application of the clinician's knowledge with good patient evaluation thereby exploring all the solutions and choosing the suitable treatment modality forms the basis of successful implant placement.

While this study presents promising results, long-term implant survival data is essential for a definitive assessment of the technique's success beyond the 4 months follow-up reported here.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

SUK & AB: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

AAK: & MI: Data acquisition, data analysis, approval of the final version to be published.

SIK & IK: Critical review, concept, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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