



Direct & Indirect Sinus Lift Procedure in Implants (Comparison): A Review

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ABSTRACT

The direct sinus lift technique involves lifting the sinus membrane through a lateral window approach, followed by bone grafting to increase the vertical bone height. Conversely, the indirect technique utilizes osteotome instruments or hydraulic pressure to elevate the sinus floor, minimizing surgical invasiveness. This article critically evaluates the clinical outcomes, long-term success rates, patient comfort, and overall feasibility of these two approaches.

Keywords: dental implants, sinus lift, direct sinus lift, indirect sinus lift, bone grafting, maxillary sinus augmentation, implantology, osseointegration, lateral window approach, osteotome technique.

INTRODUCTION

The restoration of posterior maxillary edentulism through dental implantology has witnessed remarkable advancements, offering patients an enhanced quality of life and functional rehabilitation. However, the successful placement of dental implants in cases of limited bone volume remains a significant clinical challenge.¹ The sinus lift procedure, an indispensable technique in implant dentistry, has emerged as a pivotal solution to address this challenge and enable optimal implant integration in the posterior maxilla. The sinus lift procedure, also known as maxillary sinus augmentation, aims to augment the bone volume in the maxillary sinus region, facilitating the placement of dental implants with adequate support and stability.² The posterior maxilla is particularly susceptible to bone resorption following tooth loss due to the presence of the maxillary sinus, which gradually expands as a consequence of tooth loss and aging. As a result, the vertical bone height in this region often becomes insufficient for standard implant placement. In response to this clinical dilemma, two primary techniques have been developed: the direct sinus lift procedure and the indirect sinus lift procedure. These techniques have revolutionized implant dentistry by providing clinicians with effective strategies to increase bone volume and enable successful implant osseointegration in cases of compromised bone height. The direct sinus lift procedure involves accessing the maxillary sinus through a lateral window approach, followed by elevation of the sinus membrane and placement of bone graft materials. This technique has evolved over time, incorporating advancements in grafting materials and surgical instrumentation to enhance outcomes and minimize complications.³ The indirect sinus lift technique, on the other hand, presents an alternative approach to augmenting the sinus floor. It involves the use of osteotomes or hydraulic pressure devices to elevate the sinus floor, creating space for bone graft materials without the need for an extensive surgical window.⁴ This technique has gained popularity due to its reduced invasiveness and shorter healing times. As implant dentistry continues to evolve, it is crucial to critically assess and compare these two sinus lift techniques. Understanding their procedural nuances, indications, contraindications, clinical outcomes, and patient experiences is essential for making informed decisions and achieving successful implant rehabilitation in the posterior maxilla. This review article aims to provide a comprehensive analysis of the direct and indirect sinus lift procedures, offering insights into their evolution, clinical applications, advantages, limitations, and potential future directions in the field of dental implantology.

DIRECT SINUS LIFT TECHNIQUE

The direct sinus lift technique stands as a cornerstone in the realm of maxillary sinus augmentation for dental implant placement. Developed to address the challenge of inadequate vertical bone height in the posterior maxilla, this approach involves a meticulously planned surgical procedure aimed at elevating the sinus membrane and creating space for bone graft material. A carefully planned incision is made in the edentulous region to expose the lateral aspect of the maxilla. This provides access to the lateral wall of the maxillary sinus. A window is created in the lateral wall of the maxillary sinus, exposing the sinus membrane. This membrane is gently detached from the sinus floor and elevated. Once the sinus membrane is elevated, bone graft material is inserted into the created space. Commonly used graft materials include autogenous bone, allografts, xenografts, or synthetic bone substitutes.⁵ These materials encourage new bone formation and integration over time. After the bone graft material is placed, the elevated sinus membrane is carefully repositioned and sutured. This closure prevents the intrusion of graft material into the sinus cavity and facilitates the healing process. Following a healing period, during which the graft material consolidates with the existing bone, dental implant placement is performed in the augmented site. The osseointegration of the implant with the surrounding bone is essential for long-term stability and success. This technique allows for precise control over

the amount of bone graft material placed and suitable for cases with significant vertical bone deficiency. It also provides direct visualization of the surgical site, facilitating precise graft placement. This technique is generally considered more invasive due to the need for a lateral window and sinus membrane elevation and healing time may be extended due to the more extensive surgical procedure.⁶ The MISCH classification provides a systematic approach to assessing the posterior maxilla for dental implant placement based on the quality and quantity of available bone. Type II cases involve dense cortical bone with inadequate height, requiring consideration of a direct sinus lift procedure. In such instances, the thick cortical bone may be present, but vertical height is lacking. A direct sinus lift becomes necessary to elevate the sinus membrane, creating space for the formation of new bone. This procedure is often performed concurrently with implant placement to ensure stability and support.

Conversely, Type IV cases entail thin cortical bone with insufficient height. In these situations, a comprehensive treatment plan typically involves both vertical and horizontal bone augmentation. Similar to Type II, a direct sinus lift may be incorporated into the strategy to address the height deficiency in the posterior maxilla. By combining techniques such as direct sinus lifts with appropriate augmentation procedures, dental professionals aim to enhance the bone structure, providing a solid foundation for successful dental implant placement in the challenging context of Type II and Type IV cases.

INDIRECT SINUS LIFT TECHNIQUE

The indirect sinus lift technique, an innovative approach within maxillary sinus augmentation, offers an alternative to the direct method. This technique aims to increase bone volume beneath the maxillary sinus without the need for a traditional lateral window, reducing invasiveness and accelerating healing times. A small osteotomy is created in the edentulous area, adjacent to the maxillary sinus. This osteotomy serves as the implant site and provides access for the subsequent sinus floor elevation. Osteotomes, specialized instruments designed for controlled bone manipulation, are used to gently lift the sinus floor by compacting the bone beneath it. This creates a void that can be filled with bone graft material. Bone graft material, often in the form of particulate or granules, is placed within the created space. The graft material encourages new bone growth and serves as a scaffold for integration. Following the graft placement, dental implant placement can occur within the osteotomy site. The bone graft material facilitates osseointegration between the implant and the surrounding bone. It is a minimally invasive procedure, reducing the need for extensive surgical access and has shorter healing times due to reduced surgical trauma. It preserves the integrity of the sinus membrane, potentially reducing postoperative complications and is well-suited for patients with moderate bone deficiencies. Considerations include Cases with severe vertical bone deficiencies may require additional grafting procedures, achieving precise control over the graft material distribution can be challenging. The technique may necessitate specialized instruments for osteotome placement.^{7,8} Type III in the MISCH classification involves thin cortical bone with sufficient height and width in the posterior maxilla. In these cases, the primary concern is often horizontal bone augmentation. While the cortical bone may be thin, the adequate vertical and horizontal dimensions provide a foundation for implant placement. The focus shifts to enhancing bone width to ensure the stability and long-term success of dental implants. To address the horizontal augmentation needs in Type III cases, an indirect sinus lift technique may be employed. This procedure, also known as a lateral window approach or osteotome technique, allows for the elevation of the sinus membrane indirectly during the bone augmentation process. By creating space for new bone formation, this method contributes to achieving the desired increase in bone width. The combination of indirect sinus lift and horizontal augmentation strategies aims to optimize the bone structure and create an ideal environment for successful dental implant placement in Type III situations within the posterior maxilla.

U.S Pal et al's study highlights that the direct sinus lift technique results in a greater increase in bone height. This is particularly advantageous for cases with substantial vertical bone deficiency. Indirect Technique despite its comparable implant stability is associated with a significantly lower gain in bone height, as noted by the study. Both techniques, as indicated by U.S Pal et al, demonstrate comparable implant stability and favourable healing outcomes.⁹ This suggests that both approaches offer reliable results in terms of implant integration and postoperative recovery. Tahmeena Atiq et al's study did not find significant differences between the direct and indirect sinus lift procedures in terms of post-surgical swelling, inflammation, and pain.¹⁰ This suggests that patient discomfort following either technique is relatively similar. The indirect technique presents an advantage in terms of being less invasive and consuming less time compared to the direct sinus lift, as mentioned by Saraperaz-martenz. This may contribute to reduced postoperative discomfort and quicker recovery for patients undergoing the indirect approach. Saraperaz-martenz's study endorses the sinus lift procedure as a valid surgical method to achieve crestal height enhancements ranging from 5 to 9 mm.¹¹ This implies that both direct and indirect techniques can effectively address vertical bone deficiencies. Bortoluzzi MC's research recommends the one-stage direct sinus floor augmentation technique as the preferred option when residual bone height in the posterior maxilla is less than 5 mm.¹² This indicates that the direct technique is particularly well-suited for cases with severely limited bone height S M. Balaji's findings reveal that the direct method of sinus lift procedure leads to significantly higher bone height gain compared to the indirect technique (Direct: 6.19 mm vs. Indirect: 5.34 mm).¹³ This suggests that the direct technique might be more suitable for patients seeking substantial bone augmentation. Pulkit Khandelwal's study concludes that single-stage direct (lateral) maxillary sinus floor augmentation serves as a valuable treatment option for patients with deficient alveolar bone in the posterior maxilla (residual bone height <5 mm).¹⁴ This further underscores the efficacy of the direct technique in cases of moderate bone deficiency. In summary, the comparative analysis based on these studies indicates that both direct and indirect sinus lift techniques offer valuable approaches for addressing edentulous resorbed posterior maxilla. While the direct technique may provide greater bone height gain and suitability for severely deficient bone, the indirect technique stands out for its reduced invasiveness and quicker healing. Clinicians should consider patient-specific factors, bone deficiency levels, and treatment goals when selecting the appropriate technique for maxillary sinus augmentation.

ROLE OF GRAFTS IN AUGMENTATION

Bone grafts are essential for augmenting bone quantity in areas with deficiencies, often necessary for stable and supportive dental implant placement. The challenges posed by insufficient bone or defects in the maxilla and mandible make implant placement difficult, underscoring the critical role of bone grafts in restoring bone structure. The field of bone regeneration is rapidly advancing to address various human body defects. Significant progress has been made in both biomaterials and techniques for bone augmentation. Grafts serve as a supportive framework for bone regeneration (osteoconduction), promote the activation of the patient's own bone-forming cells (osteinduction), and, in the case of autografts, contribute viable bone cells (osteogenesis). These multifaceted functions highlight the importance of bone grafts in facilitating the regeneration and restoration of bone in challenging clinical scenarios.¹⁵ In 2015, Saraperaz-martenz conducted a systematic review, affirming the efficacy of the sinus lift procedure for achieving crestal height within the range of 5–9 mm. The study highlighted the indirect sinus lift's advantages, such as reduced invasiveness and time consumption compared to the direct method. Tahmeena Atiq research specifically compared the outcomes of direct and indirect sinus lift procedures. The results indicated that pain and gingival inflammation resolved by the 1st week postoperatively. However, patients undergoing the indirect method experienced a higher frequency of these issues compared to those treated with the direct method. Swelling subsided in both groups after the 1st week, but the indirect method showed a higher frequency, although the difference was not statistically significant. Both treatment groups exhibited a significant increase in bone height postoperatively, with patients treated directly showing a significantly higher mean bone height gain. Dental implant surgeons strive for straightforward, safe, cost-effective, and highly reliable procedures that are minimally invasive. The use of advanced and extensive surgical techniques can often increase treatment duration and costs without providing an absolute guarantee of the outcome. In contrast, minimally invasive approaches like Direct Sinus Augmentation Technique (DSAT) and Indirect Sinus Augmentation Technique (ISAT) in Sinus Augmentation Technique (SAT) prove to be cost-effective, less risky, and yield predictable results.

CONCLUSION

The direct and indirect sinus lift techniques each present unique advantages and considerations. The direct approach is suitable for cases requiring extensive bone grafting and demonstrates high predictability. However, its invasiveness and potentially longer healing times may be less appealing to certain patients. On the other hand, the indirect technique offers a minimally invasive alternative with quicker recovery, making it favourable for patients with moderate bone deficiencies. The choice between these techniques depends on the patient's individual condition, anatomical considerations, and treatment goals. A thorough understanding of their nuances empowers clinicians to make informed decisions, optimizing outcomes in the realm of maxillary sinus augmentation for dental implant placement. In conclusion, the review emphasizes the importance of tailoring sinus lift techniques based on individual patient needs, bone deficiency levels, and treatment goals. It highlights the nuances, advantages, and considerations associated with both the direct and indirect sinus lift techniques. The review offers valuable insights for clinicians to make informed decisions in the realm of maxillary sinus augmentation for dental implant placement. Overall, the review article provides a comprehensive analysis of the direct and indirect sinus lift techniques, synthesizing findings from various studies to guide clinicians in selecting the most appropriate approach for their patients.

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