



## Case Series

## Comparative clinical outcomes of Xenograft, Alloplast, and Allograft materials in direct sinus lift procedures: A case series

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### Abstract

This case series evaluates and compares the clinical outcomes of three different graft materials including xenograft, alloplast, and allograft, used in direct sinus lift procedures for posterior maxillary augmentation. Three patients presenting with severely resorbed posterior maxilla and inadequate residual bone height underwent lateral window sinus lift surgery using one of the three graft types. Post-operative assessment over a six-month healing period included radiographic evaluation of bone height gain and clinical stability at the implant placement stage. All graft types supported satisfactory bone regeneration, with xenograft achieving the highest bone height gain and volume stability, followed by alloplast and allograft. These results align with published evidence favoring xenografts for their osteoconductive properties and long-term stability, while also confirming the suitability of alloplasts and allografts in selected cases. Careful case selection, surgical precision, and compliance with post-operative care protocols were critical to achieving favorable outcomes.

**Keywords:** Direct sinus lift, Xenograft, Alloplast, Allograft

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### 1. Introduction

Rehabilitation of the posterior maxilla with dental implants often presents clinical challenges due to limited vertical bone height resulting from alveolar bone resorption and maxillary sinus pneumatization.<sup>1</sup> When residual bone height is insufficient to ensure primary implant stability, sinus augmentation procedures become essential to facilitate implant placement and long-term success.<sup>2</sup> The direct (lateral window) sinus lift technique is a widely accepted and predictable surgical approach for vertical bone augmentation in such cases, particularly when residual bone height is less than 5 mm.<sup>3</sup>

The choice of graft material plays a critical role in the success of sinus augmentation procedures. Various grafts, including autografts, allografts, xenografts, and alloplasts, have been employed, each with distinct biological properties

and clinical performance.<sup>4</sup> While autogenous bone remains the gold standard due to its osteogenic potential, it is often associated with donor site morbidity.<sup>5</sup> Alternatives such as bone bank allografts, xenografts, and synthetic alloplastic materials offer favourable outcomes with reduced surgical burden.

This case series presents three clinical scenarios where the direct sinus lift technique was employed using different bone graft materials including NovaBone Putty (alloplast), bone bank allograft particulates, and A-Oss xenograft granules, to augment the posterior maxilla and enable future implant placement. The aim is to highlight surgical outcomes and vertical bone gain associated with each graft type.

### 2. Case Series

Three systemically healthy adult patients, two males (aged 48 and 55 years) and one female (aged 52 years), reported with

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missing maxillary first molars requiring implant-supported rehabilitation. One case involved the upper right first molar (tooth 16), and two cases involved the upper left first molar (tooth 26). Clinical examination revealed adequate alveolar ridge width in all patients but insufficient vertical bone height due to maxillary sinus pneumatization, making direct sinus lift procedures necessary prior to implant placement.

### 2.1. Preoperative assessment

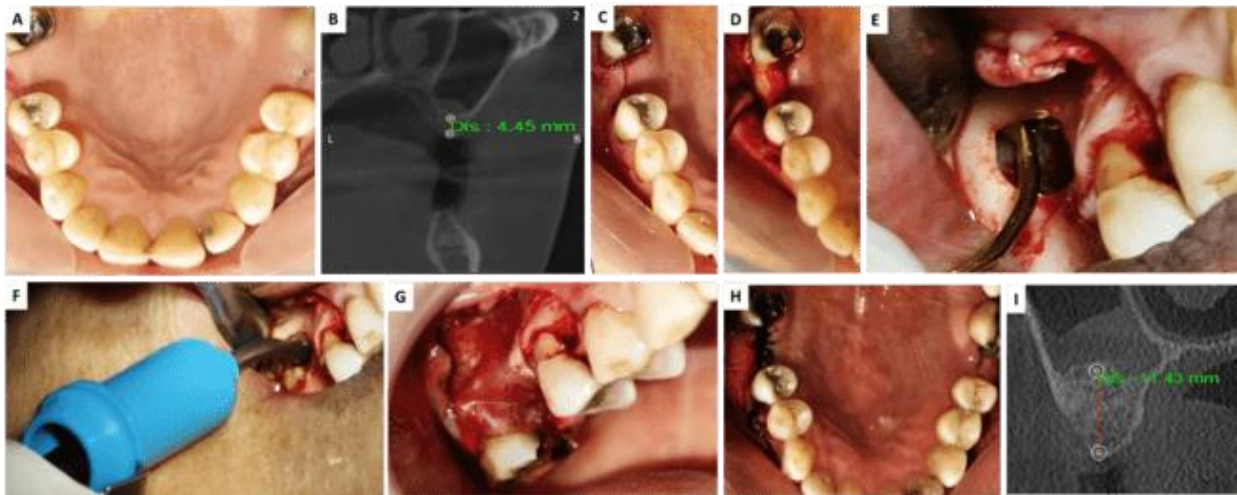
All patients underwent thorough clinical evaluation and cone beam computed tomography (CBCT) imaging to assess the residual bone height and the anatomy of the maxillary sinus. The preoperative bone heights were as follows: 4 mm in Case 1 (tooth 16), 3 mm in Case 2 (tooth 26), and 2.9 mm in Case 3 (tooth 26). None of the patients exhibited signs of acute or chronic sinus pathology. Based on these findings, a lateral

window (direct) sinus lift approach was planned to facilitate vertical bone augmentation.

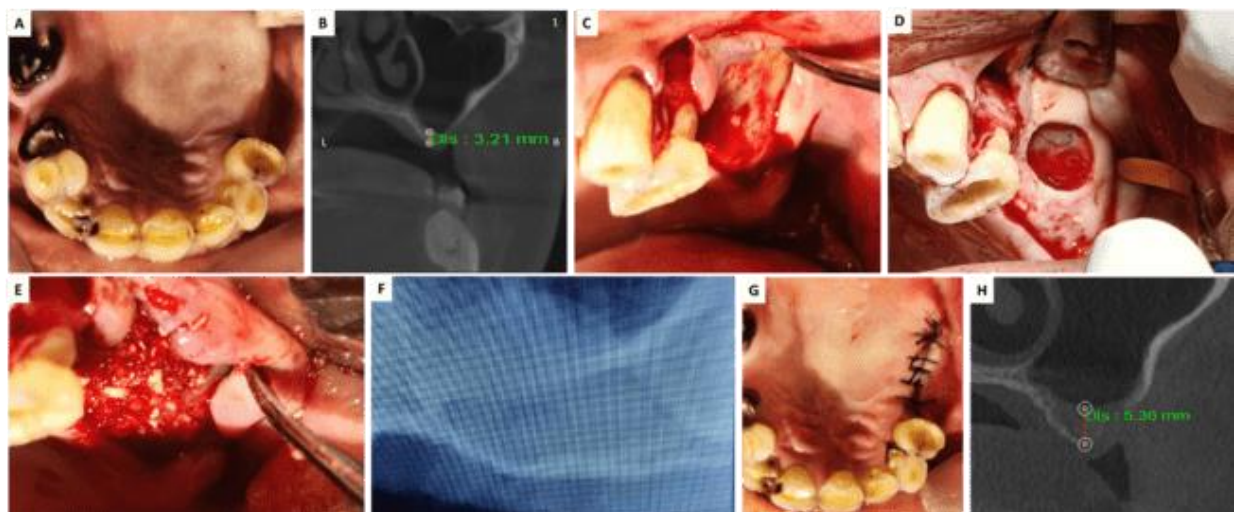
### 2.2. Medication protocol

All patients received a standardized preoperative and postoperative medication regimen. This included:

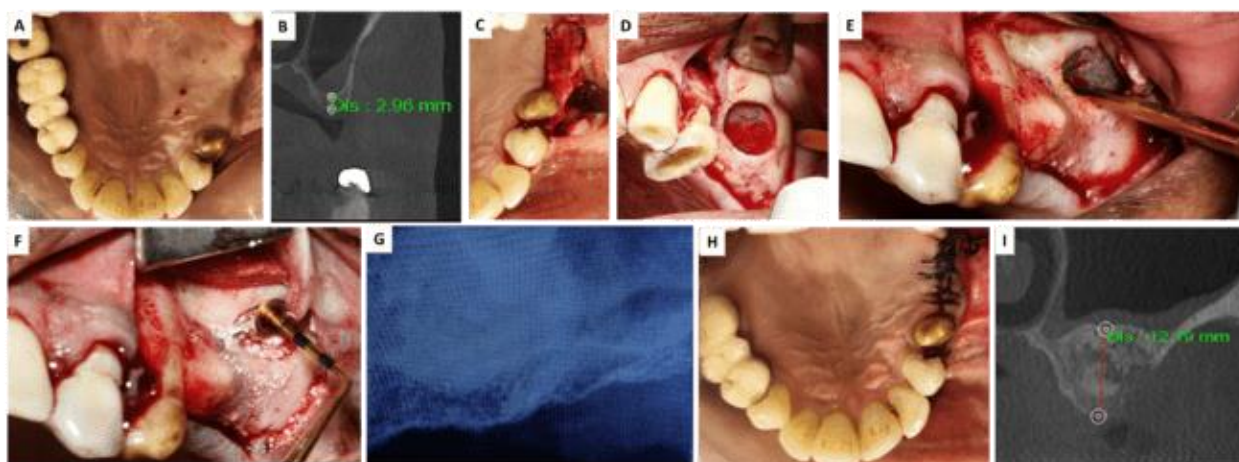
1. Antibiotics: Amoxicillin 500 mg three times daily starting one day before surgery and continuing for five days postoperatively (or clindamycin 300 mg in case of penicillin allergy).
2. Analgesics: Ibuprofen 400 mg was prescribed as needed for pain management.
3. Nasal Decongestants: Patients were instructed to use a decongestant spray to minimize intra-sinus pressure and reduce post-operative complications such as congestion or sinusitis.



**Figure 1:** Case I – A: Pre-operative intraoral photograph; B: CBCT assessment; C: Mucoperiosteal incision; D: Flap Reflection; E: Lateral window opening; F: Sinus Lift; G: Placement of Novabone graft; H: Placement of GTR membrane; I: Suturing; J: Post-operative CBCT assessment after 6 months



**Figure 2:** Case II – A: Pre-operative intraoral photograph; B: CBCT assessment; C: Flap Reflection; D: Lateral window opening; E: Sinus Lift and placement of allograft; F: Post-operative confirmatory radiograph; G: Suturing; H: Post-operative CBCT assessment after 6 months



**Figure 3:** Case III – **A:** Pre-operative intraoral photograph; **B:** CBCT assessment; **C:** Flap Reflection; **D:** Lateral window opening; **E:** Sinus Lift and placement of xenograft; **F:** Post-operative confirmatory radiograph; **G:** Suturing; **H:** Post-operative CBCT assessment after 6 months

### 2.3. Surgical procedure

All procedures were performed under local anesthesia using 2% lidocaine with 1:80,000 epinephrine. A mid-crestal incision was made along the edentulous ridge, accompanied by one or two vertical releasing incisions. A full-thickness mucoperiosteal flap was elevated to expose the lateral wall of the maxillary sinus. Using either a round surgical bur or a piezoelectric surgical unit, a lateral bony window was outlined and carefully removed. The Schneiderian membrane was then gently elevated with sinus lift elevators, ensuring membrane integrity in all cases.

Each case utilized a different graft material:

1. Case 1: NovaBone Putty (a moldable, bioactive synthetic alloplast) was incrementally packed into the sinus cavity.
2. Case 2: Freeze-dried corticocancellous bone bank allograft particulates were used as the graft material.
3. Case 3: A-Oss xenograft granules, derived from bovine origin, were packed to fill the subantral space.

After graft placement, a resorbable collagen membrane was positioned over the lateral window in all three cases to contain the graft material and support tissue healing. The surgical flaps were repositioned and sutured with 3-0 non-resorbable silk sutures using a tension-free technique to achieve primary closure. The cases I, II, and III are collectively depicted in **Figure 1, 2, and 3** respectively.

### 2.4. Postoperative Care and Follow-up

All patients were given detailed post-operative instructions, including sinus precautions such as avoiding nose blowing, sneezing with the mouth closed, using straws, and heavy lifting for at least two weeks. They were reviewed at 1 week, 1 month, 3 months, and 6 months post-operatively. Healing was uneventful in all cases, with no signs of sinus infection, graft exposure, or membrane perforation.

At the 6-month follow-up:

1. Case 1 showed a bone gain from 4 mm to 11 mm.
2. Case 2 achieved a bone gain from 3 mm to 5.36 mm.

3. Case 3 demonstrated a significant increase from 2.9 mm to 12.19 mm.

These outcomes confirmed successful graft consolidation and provided adequate bone volume for subsequent implant placement in each case.

### 3. Discussion

Maxillary sinus floor augmentation remains a pivotal procedure in implant rehabilitation for posterior maxillae with limited bone height.<sup>6</sup> Direct (lateral window) sinus lift is often employed in cases where the residual bone height is below 5 mm, a threshold commonly accepted for choosing this approach.<sup>7</sup> In the present case series, all three patients had  $\leq 4$  mm of residual bone, justifying the use of the direct technique based on standard inclusion criteria.

The graft materials used in our cases were selected in accordance with patient-specific factors, including systemic health, bone architecture, and economic considerations. Our findings showed that xenograft resulted in the highest bone gain (9.29 mm), followed by alloplast (7 mm), and allograft (2.36 mm). These outcomes align with the broader literature. Canellas et al. conducted a network meta-analysis and reported that xenografts, especially Osteoplant Osteoxenon®, produced significantly more newly formed bone at 6 months than other materials, and Bio-Oss® combined with BMAC outperformed Bio-Oss® alone, whereas additives like L-PRF or Emdogain® had limited additional benefit.<sup>8</sup>

Xenografts maintain volume due to their slow resorption and provide a sturdy osteoconductive scaffold.<sup>9</sup> Kempraj et al. also showed superior bone density and formation with Bio-Oss compared to PRF alone, using CBCT as an evaluative tool.<sup>10</sup> NovaBone demonstrated moderate bone regeneration, likely owing to its surface reactivity and osteoconductive properties.<sup>11</sup> Meanwhile, the allograft case showed the least gain, consistent with Jodia et al., who

reported that allografts may show slower integration and less predictable outcomes in maxillary sinus lift surgeries.<sup>12</sup>

It is important to note that patient selection is key for successful outcomes. Properly selected patients, those without active sinus pathology, with good systemic and oral health, and willing to adhere to post-operative protocols, typically exhibit better regenerative outcomes.<sup>13</sup> Moreover, adherence to strict post-operative care protocols, including sinus precautions, antibiotics, chlorhexidine rinses, and decongestants, likely contributed to the favorable healing seen across cases.<sup>14</sup>

Despite its advantages, direct sinus lift has inherent limitations, wherein it is more invasive, technically demanding, and associated with risks like Schneiderian membrane perforation and longer healing durations.<sup>15</sup> Hence, the choice of graft should balance biological potential with patient and anatomical factors.

#### 4. Conclusion

This case series highlights the clinical effectiveness of xenograft, alloplast, and allograft, used in direct sinus lift procedures for posterior maxillary augmentation. All three grafts facilitated satisfactory bone regeneration, with the xenograft demonstrating the greatest bone height gain and volume stability, followed by the alloplast and allograft. These findings underscore the importance of careful graft selection based on defect characteristics, patient systemic status, and long-term prosthetic requirements. Direct sinus lift remains a reliable technique when residual bone height is insufficient, provided that appropriate case selection, meticulous surgical execution, and stringent post-operative care are ensured to optimize outcomes.

#### 5. Source of Funding

None.

#### 6. Conflict of Interest

None.

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