Alloplastic vs Autologous Bone Grafts for Mandibular Reconstruction: A Meta-analysis

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♦ Introduction

Mandibular reconstruction following tumor resection, trauma, or congenital defects presents a significant clinical challenge requiring restoration of both form and function. Surgical options include autologous bone grafts (harvested from the patient's own body fibula, iliac crest, scapula) and alloplastic grafts (synthetic materials such as titanium mesh with bone substitutes).

While both graft types are utilized in clinical practice, comparative effectiveness data remains limited and conflicting. Autologous grafts are considered the gold standard such as fibula free flap but require donor site surgery, while alloplastic grafts offer potential advantages of reduced operative time and no donor site morbidity.

Question

How do autologous bone grafts compare to alloplastic bone grafts in terms of effectiveness and safety for mandibular reconstruction?

Hypothesis

The study hypothesized that autologous bone grafts would demonstrate higher success rates than alloplastic grafts due to superior biocompatibility and bone integration capacity.

♦ Methods

Study Design

Systematic review and meta-analysis conducted in accordance with PRISMA guidelines.

Data Sources and Search Strategy

A systematic search was performed in PubMed and Medline (Ovid) for studies published between January 2005 and September 2025. Search terms included combinations of “mandibular reconstruction,” “bone graft,” “autologous,” “alloplastic,” “success rate,” and “complication.”

Study Selection

After removal of duplicates (**n = 228**), **1,821** records were screened. **25** full-text reports were sought for retrieval, of which **4** were not obtained. **21** studies were assessed for eligibility, and **9** met all inclusion criteria and were included in the final analysis. Excluded studies lacked sufficient quantitative data (n = 8), outcome data (n = 2), were non-primary research (n = 1), or had insufficient sample size (n = 1).

Outcomes Measured

Graft success rate: defined as maintained reconstruction without failure requiring revision.

♦ Results

Study Selection

A total of 9 studies met inclusion criteria, encompassing 489 participants. Of these, 6 studies (n = 426) evaluated autologous grafts and 3 studies (n = 63) evaluated alloplastic grafts.

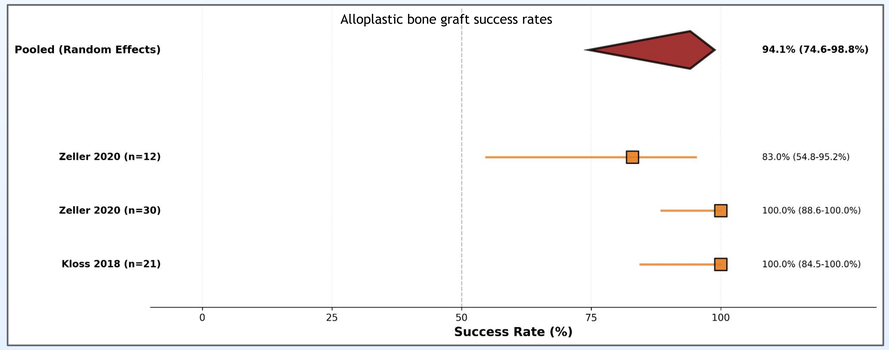

Figure 1. Forest plot of alloplastic bone graft success rates in mandibular reconstruction. Individual study success rates with 95% confidence intervals (squares and horizontal lines) and pooled random-effects estimate (diamond) showing 94.1% overall success across 3 studies (n=63).

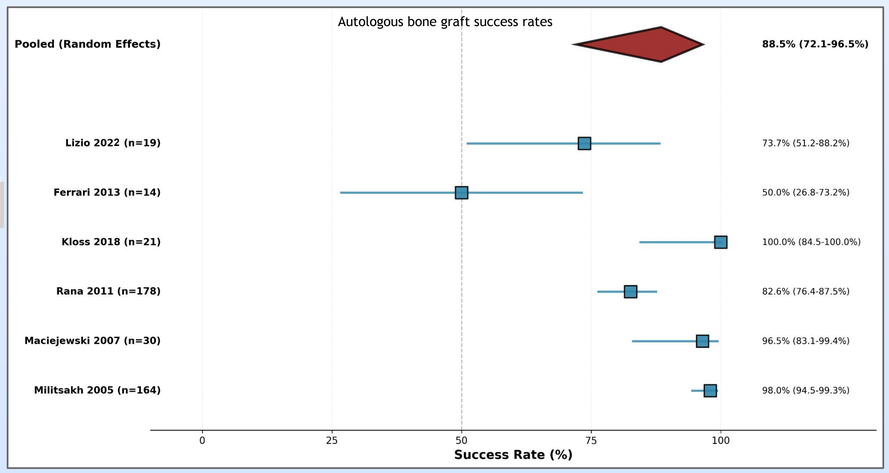

Figure 2. Forest plot of autologous bone graft success rates in mandibular reconstruction. Individual study success rates with 95% confidence intervals (squares and horizontal lines) and pooled random-effects estimate (diamond) showing 88.5% overall success across 6 studies (n=426).

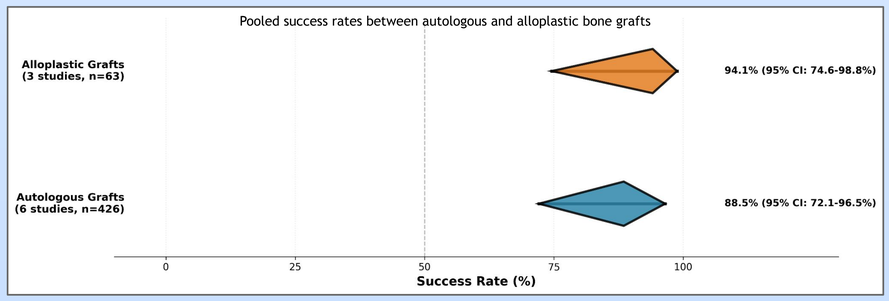

Figure 3. Comparison of pooled success rates between autologous (blue diamond) and alloplastic (orange diamond) bone grafts. Diamond shapes represent pooled random-effects estimates with 95% confidence intervals. Overlapping confidence intervals indicate no statistically significant difference between graft types.

♦ Results Cont.

Autologous Bone Grafts

Autologous reconstructions demonstrated a pooled success rate of 88.5% (95% CI: 72.1–96.5%). Reported success rates ranged widely from 50.0% to 100%. The fibula free flap was the most frequently used donor site, followed by iliac crest and scapular grafts.

Alloplastic Grafts

Alloplastic approaches achieved a pooled success rate of 94.1% (95% CI: 74.6–98.8%) across 3 studies. Individual study results were more consistent, ranging from 83% to 100%. Reported materials included titanium mesh with bone substitute and custom alloplastic implants.

Comparative Analysis

The difference in pooled success rates was 5.6% favoring alloplastic grafts, overlapping 95% confidence intervals indicate no statistically significant difference

♦ Discussion

Interpretation of Results

Both autologous and alloplastic bone grafts achieved high success rates in mandibular reconstruction. While alloplastic grafts showed a slightly higher pooled success rate (94.1% vs. 88.5%), overlapping confidence intervals indicate no significant difference. This finding contrasts with the initial hypothesis favoring autologous grafts.

Comparison to Literature

The fibula free flap remains the most reliable autologous option, with success rates of 90–98% in large series. Recent reviews highlight that modern alloplastic materials, such as titanium mesh and custom implants, perform comparably when appropriately selected.
Autologous grafts risk donor site morbidity, whereas alloplastic grafts may show higher exposure or infection rates highlighting the differing complication profiles. Findings support individualized graft selection that is based on patient and defect factors.

Strengths and Limitations

This study used a comprehensive, PRISMA-guided search, strict inclusion criteria, and clear outcome definitions. Limitations include the small number of alloplastic studies and lack of randomized trials, which limits direct comparison.

Future Directions

Further high quality randomized control trials with standardized outcomes are needed to have a better understanding of graft selection.

♦ Conclusion

Both autologous and alloplastic grafts achieve high success rates (88.5% and 94.1%) in mandibular reconstruction, showing comparable effectiveness. Both autologous and alloplastic grafts provide reliable outcomes in mandibular reconstruction; graft choice should be driven by patient factors and surgical context rather than graft type alone.

References: