



OsteoAuger™ Bone Graft Harvesting System Scientific Update

Autograft bone, considered the “gold standard” of bone repair,¹ provides all 3 components of the healing triad: osteogenesis, osteoconduction, and osteoinduction.² Autologous bone naturally contains a patient’s own viable cells, providing a bone graft with cell, signal, and scaffold that can be placed at the site of a fracture or fusion, enhancing bone healing and remodeling.³ The OsteoAuger™ bone graft harvesting system allows surgeons to obtain morselized autograft bone from several potential harvest sites, including the calcaneus, distal and proximal tibia, iliac crest, and distal radius.

Basics of Autograft Bone

Schmidt AH

[Autologous bone graft: is it still the gold standard?](#) *Injury*. 2021;52 Suppl 2:S18-S22. doi:10.1016/j.injury.2021.01.043

- Review of fracture healing, bone graft properties, and the advantages and disadvantages associated with autograft bone.
- An ideal bone substitute must be biocompatible, bioresorbable, osteoconductive, and osteoinductive.
- Pros of autogenous bone include histocompatibility, structural support, and no risk of disease transmission.
- Cons of autogenous bone include limited supply, increase in magnitude of surgery due to increased time, blood loss, potential need for general anesthesia, and donor site morbidity.

Takeaway

Autogenous bone remains the gold standard of bone repair, with greater union rates associated with autograft bone.

Pape HC,
Evans A,
Kobbe P

[Autologous bone graft: properties and techniques.](#) *J Orthop Trauma*. 2010;24 Suppl 1:S36-S40. doi:10.1097/BOT.0b013e3181cec4a1

- Review of the biologic and mechanical properties of autograft bone, what distinguishes different types of autogenous bone grafts, and how autograft bone compares with other bone graft substitutes.
- Autograft bone contains osteogenetic, osteoinductive, and osteoconductive properties. Osteogenic properties arise from precursor cells and osteoblasts within the autogenous bone. Osteoinductive properties of autograft depend heavily on the availability of growth factors, such as bone morphogenetic proteins. Osteoconductive properties vary by autograft type (ie, cortical, tricortical, or cancellous).
- Cancellous bone contains greater cellular diversity and activity, while cortical bone has enhanced mechanical properties.
- Compared to allograft bone grafts and synthetic bone grafts, autograft bone continues to be more cost-effective and more effective in stimulating bone formation.

Takeaway

Autograft bone continues to be superior for use in bone defects or nonunions. When deciding what type of autogenous bone graft to use, consider whether the operative site needs metabolic activity or structure.



Khan SN,
Cammisa FP Jr,
Sandhu HS,
Diwan AD,
Girardi FP,
Lane JM

[The biology of bone grafting.](#) *J Am Acad Orthop Surg.* 2005;13(1):77-86.
doi:10.5435/00124635-200501000-00010

- Review of different bone grafting options, including autograft and allograft, and the impairment of bone healing.
- Autograft cancellous bone provides a large surface area that is covered by inactive and active osteoblasts, making it very osteogenic, easily revascularized, and rapidly incorporated at the host site.
- Neovascularization occurs within the graft as early as 2 days post-implantation.
- Remodeling of autogenous cancellous bone can take several months.
- Impairments to bone graft healing include smoking (inhibits cellular proliferation and causes vasoconstriction), systemic steroid use (inhibits differentiation of progenitor cells), nonsteroidal anti-inflammatory drugs (inhibit prostaglandin formation, which diminishes blood flow), and malnutrition (may lead to calcium and phosphorus deficiencies).

Takeaway

There are multiple factors that affect the incorporation of bone graft, including the type of bone graft used, the site of implantation, the vascularity of the graft and the host-graft interface, the immunogenetics between the donor and the host, preservation techniques, local and systemic factors, and the mechanical properties that are dependent on the size, shape, and type of graft implanted.

Clinical Applications

[Autogenous iliac crest bone grafting for the treatment of fracture nonunion is equally effective in elderly and nonelderly patients.](#) *J Am Acad Orthop Surg.* 2019;27(18):696-703.
doi:10.5435/JAAOS-D-18-00322

- Study involving 242 patients who underwent operative repair of a long bone fracture nonunion and received autogenous iliac crest bone graft and who were followed over a 13-year period.
- Union was achieved at a mean of 7.1 months for patients requiring a single autogenous bone grafting procedure.
- There was no difference in rates of healing between elderly and nonelderly cohorts.

Takeaway

The use of autogenous iliac bone graft for nonunion repairs appears to be as effective in elderly patients as it is in younger patients.

[Autologous bone graft in the treatment of post-traumatic bone defects: a systematic review and meta-analysis.](#) *BMC Musculoskelet Disord.* 2016;17(1):465. doi:10.1186/s12891-016-1312-4

- Meta-analysis of 34 studies selected to determine the bone union rate of bone defects treated with different autogenous bone graft techniques.
- Summary pooled union rate was 91% for the 34 selected studies.
- Based on the selected studies, there was no direct relation between bone defect size and bone union rate when autologous bone graft techniques were applied.

Takeaway

Autograft bone is an effective graft for bone defects, with bone defect size not impacting the rate of bone union.

Carlock KD,
Hildebrandt KR,
Konda SR,
Egol KA

Azi ML,
Aprato A,
Santi I,
Kfuri M Jr,
Masse A,
Joeris A



[Autologous bone graft in foot and ankle surgery.](#) *Foot Ankle Clin.* 2016;21(4):825-837. doi:10.1016/j.fcl.2016.07.007

- Review of autologous bone grafting in foot and ankle surgery that looked at multiple harvest sites, including the iliac crest, proximal tibia, distal tibia, calcaneus, and long-bone medullary cavity.
- Cancellous autograft is the most commonly used autograft in foot and ankle surgery due to its high surface area and osteogenic nature.
- The anterior iliac crest contains a large volume of cancellous bone and is a reliable source of corticocancellous structural graft.
- Proximal and distal tibia autogenous bone is reported to have sufficient harvest quantity, with very low donor site morbidity.
- Calcaneus autograft harvests are useful for midfoot and forefoot fusions and fracture repairs. A technique by Biddinger and colleagues reported three 8 mm trephine cores harvested from the calcaneus with minimal morbidity.

Takeaway

There are multiple harvest sites available for foot and ankle surgeons. The use of autogenous bone and where it should be harvested from depends on the need for autograft bone, the amount of autograft bone needed, whether a structural graft is necessary, and whether there is a need for the enhanced biology associated with iliac crest grafts.

[Autograft, allograft, and bone graft substitutes: clinical evidence and indications for use in the setting of orthopaedic trauma surgery.](#) *J Orthop Trauma.* 2019;33(4):203-213. doi:10.1097/BOT.0000000000001420

- Review of the properties of autograft, allograft, and bone graft substitutes that presents clinical evidence to better support their indications for use in trauma surgery.
- Autograft bone has the lowest risk of immunological rejection and has strong osteoconductive, osteoinductive, and osteogenic properties.
- Allograft bone alleviates the issue of donor site morbidity, is relatively abundant, and has ready-to-use characteristics.
- Bone graft substitutes, including calcium phosphate and calcium sulfate synthetic products, provide structural support and have abundant availability.

Takeaway

The type of bone graft needed is dependent on the patient and pathology. Autograft bone is regarded as the gold standard in fractures, delayed unions, and nonunions. Autograft bone can offer stronger structural support, as it is not subject to the storage and sterilization techniques seen with allograft options. Autograft bone also contains all 3 components of the healing triad, while synthetic bone graft substitutes (ie, calcium phosphate and calcium sulfate) only contain osteoconductive properties.

Outcomes and complication rates of different bone grafting modalities in long bone fracture nonunions: a retrospective cohort study in 182 patients. *J Orthop Surg Res.* 2013;8:33. doi:10.1186/1749-799X-8-3

- A retrospective cohort study of patients between the ages of 18 and 85 with long bone fracture nonunions performed at two level 1 trauma centers looking at the equivalency of autograft bone to allograft, allograft and autograft combined, and recombinant human bone morphogenetic protein-2 (rhBMP-2).
- The autograft group had a significantly shorter average time to union compared to the allograft group. No statistically significant differences were found between the autograft, allograft / autograft, and rhBMP-2 groups.
- The autograft group had significantly lower incidence of surgical revision rates compared to the allograft, allograft / autograft, and rhBMP-2 groups.

Takeaway

Autograft bone remains the gold standard for bone grafting of nonunions due to its shorter time to union, decreased need for revision surgery and revision bone grafting, and its low postoperative infection rates.

References

1. Schmidt AH. Autologous bone graft: is it still the gold standard?. *Injury.* 2021;52 Suppl 2:S18-S22. doi:10.1016/j.injury.2021.01.043
2. Pape HC, Evans A, Kobbe P. Autologous bone graft: properties and techniques. *J Orthop Trauma.* 2010;24 Suppl 1:S36-S40. doi:10.1097/BOT.0b013e3181cec4a1
3. Baldwin P, Li DJ, Auston DA, Mir HS, Yoon RS, Koval KJ. Autograft, allograft, and bone graft substitutes: clinical evidence and indications for use in the setting of orthopaedic trauma surgery. *J Orthop Trauma.* 2019;33(4):203-213. doi:10.1097/BOT.0000000000001420