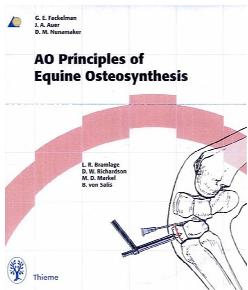


References for use of bone allograft in equine orthopedic applications



Independently published studies speak for themselves:



"Often the mechanical advantage contributed by a bone graft makes the difference between healing the fracture and premature breaking of the implants."

"A bone graft will act as a portable callus or bridge, and the structural strength of the graft can be expected to increase rapidly after the first 10 days."

"Most surgeons will not hesitate to use bone graft if there is a large defect, but many will neglect its use for ostensibly insignificant cracks or gaps. [...] (However,) paradoxically, small gaps are potentially more devastating than large ones since they will cause greater concentrations of stress in the plate."

"The use of axial compression in fracture fixation is only helpful if there is intact bone stock that will result in a stable situation under pressure."

Nunamaker DM

General techniques and biomechanics.

in: AO Principles of Equine Osteosynthesis. Bramlage LR, et al.; eds. AO Publishing, Davos Platz, pp. 11-24, 2000.

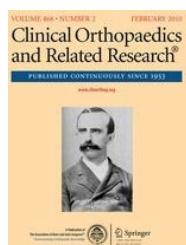
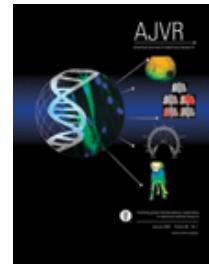
"The most compelling reason for the use of the substance (allogeneic bone) is the elimination of the need of a harvesting operation on a patient already undergoing extensive surgery for the restitution of skeletal integrity."

"The establishment of bone banks, eliminating the need for a 2nd surgical procedure, but providing dependable osteogenic material, presents a most attractive idea."

Fackelman GE, Rechenberg B, Fetter AW

Decalcified Bone Graft in the Horse.

American Journal of Veterinary Research. 42:943-948, 1981.



"Marrow and DBM stimulated defect healing. However, the combination of bone marrow with DBM produced a synergistic response in the defect, which was greater than the sum of either marrow or DBM alone."

Tiedman JJ, Connolly JF, Strates BS, Lippiello L

Treatment of nonunion by percutaneous injection of bone marrow and demineralized bone matrix. An experimental study in dogs.

Clin Orthop Relat Res. 268:294-302, 1991.

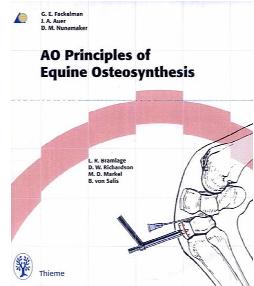
"The use of allogeneic grafting materials in the horse was inspired by the desire to eliminate the need for a second (harvesting) operation, thus saving time and avoiding potential complications."

"There is an initial phase in revascularization relative to autogenous material, but this appears to disappear with time and by 9 weeks postoperatively the two graft materials show about the same degree of repopulation of osteoblasts."

Auer JA, Fackelman GE

Allogeneic grafts and bone substitutes.

in: AO Principles of Equine Osteosynthesis. Bramlage LR, et al.; eds. AO Publishing, Davos Platz, pp. 333-350, 2000.



None of these studies were initiated or funded by VTS.

Please see back for additional references >>

Selected Additional References for Use of Bone Graft in Equine Orthopedic Applications

Equine Allograft Bone

"Capillary ingrowth on day 9 is followed by the start of bone formation on day 10."²

1. Cassotis NJ, Stick JA, Arnoczky SP. Use of full cortical allograft to repair a metatarsal fracture in a foal. *J Am Vet Med Assoc.* Nov 211(9):1155-1157, 1997.
2. Douglas J, Clarke A. Response to demineralized bone matrix implantation in foals and adult horses. *Am J Vet Res.* May 56(5):649-655, 1995.

Indications for Bone Grafting

"The results obtained with lag screw fixation and bone grafting in these horses would indicate that the racing careers of many horses with transverse sesamoid bone fractures can be salvaged by use of this technique."⁵

3. Zubrod CJ, Schneider RK. Arthrodesis techniques in horses. *Vet Clin Equine.* 25:691-711, 2005.
4. Jackman BR, Baxter GM. Treatment of a mandibular bone cyst by use of a corticocancellous bone graft in a horse. *J Am Vet Med Assoc.* Sep 201(6):892-894, 1992.
5. Henninger RW, Bramlage LR, Schneider RK, Gabel AA. Lag screw and cancellous bone grafting fixation of transverse proximal sesamoid bone fractures in horses: 25 cases (1983-1989) *JAVMA.* 199:606-612, 1991.

Bone Grafting and Stem Cells

"SCR-enriched (Selective Cell Retention) DBM-CC (demineralized bone and cancellous chips) was equivalent to autograft to repair critical-size defects."⁷

6. Taylor SE, Smith RK, Clegg PD. Mesenchymal stem cell therapy in equine musculoskeletal disease: scientific fact or clinical fiction? *Equine Vet J.* 39(2):172-180, 2007.
7. Brodke D, Pedrozo HA, Kapur TA, Attawia M, Kraus KH, Holy CE, Kadiyala S, Bruder SP. Bone grafts prepared with selective cell retention technology heal canine segmental defects as effectively as autograft. *J Orthop Res.* May 24(5):857-66., 2006.
8. Kraus KH, Kirker-Head C. Mesenchymal stem cells and bone regeneration. *Vet Surg.* 35:232-242, 2006.

Cost and Risk of Autograft Procurement

"Total mean ($\pm SD$) surgical time for harvesting bone [...] was 38 ± 6 minutes. [...] Mortality was 12.5%; one horse fractured the operated humerus during anesthetic recovery."⁹

9. Harriss FK, Galuppo LD, Decock HE, McDuffee LA, Macdonald MH. Evaluation of a technique for collection of cancellous bone graft from the proximal humerus in horses. *Vet Surg.* May-Jun 33(3):293-300, 2004.

Conflicting Results to Date and the Significance of Good Tissue Banking Practices

"Particles of 2 to 4 mm DBM should not be used as an aid to fracture repair because particles of this size interfere with normal mineralization."¹⁰

"Matrix particle sizes of 2.0 mm³ to 4.0 mm³ and 5.0 mm³ to 10.0 mm³ were associated with osteoinductive activity."¹¹

"There were no significant differences in osteoinductivity potential among the DBM in the 350 to 550 microns, 250 to 350 microns, and 710 to 850 microns bone particles size groups."¹²

"Properly demineralized bone is maximally osteoinductive. [...] Over-demineralization may reduce or virtually eliminate these (remineralization) foci."¹²

10. Kawcak CE, Trotter GW, Powers BE, Park RD, Turner AS. Comparison of bone healing by demineralized bone matrix and autogenous cancellous bone in horses. *Vet Surg.* 29:218-226, 2000.
11. Vail TB, Trotter GW, Powers BE. Equine demineralized bone matrix: relationship between particle size and osteoinduction. *Vet Surg.* Sep-Oct 23(5):386-95, 1994.
12. Zhang M, Powers RM Jr, Wolfinbarger L Jr. Effect(s) of the demineralization process on the osteoinductivity of demineralized bone matrix. *J Periodontol.* Nov 68(11):1085-92, 1997.

Basic Bone Healing Biology

13. Bassett CAL. Clinical implications of cell function in bone grafting. *Clin Orthop Relat Res.* Sep 87:49-59, 1972.