

# **Autologous bone graft versus Demineralized Bone Matrix in internal fixation of ununited long bones.**

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**ABSTRACT: BACKGROUND:** Non-unions are severe complications in orthopaedic trauma care and occur in 10% of all fractures. The golden standard for the treatment of ununited fractures includes open reduction and internal fixation (ORIF) as well as augmentation with autologous-bone-grafting. However, there is morbidity associated with the bone-graft donor site and some patients offer limited quantity or quality of autologous-bone graft material. Since allogene bone-grafts are introduced on the market, this comparative study aims to evaluate healing characteristics of ununited bones treated with ORIF combined with either iliac-crest-autologous-bone-grafting (ICABG) or demineralized-bone-matrix (DBM). **METHODS AND RESULTS:** From 2000 to 2006 out of sixty-two consecutive patients with non-unions presenting at our Level I Trauma Center, twenty patients had ununited diaphyseal fractures of long bones and were treated by ORIF combined either by ICABG- (n = 10) or DBM-augmentation (n = 10). At the time of index-operation, patients of the DBM-group had a higher level of comorbidity (ASA-value: p = 0.014). Mean duration of follow-up was 56.6 months (ICABG-group) and 41.2 months (DBM-group). All patients were clinically and radiographically assessed and adverse effects related to bone grafting were documented. The results showed that two non-unions augmented with ICABG failed osseous healing (20%) whereas all non-unions grafted by DBM showed successful consolidation during the first year after the index operation (p = 0.146). No early complications were documented in both groups but two patients of the ICABG-group suffered long-term problems at the donor site (20%) (p = 0.146). Pain intensity were comparable in both groups (p = 0.326). However, patients treated with DBM were more satisfied with the surgical procedure (p = 0.031). **CONCLUSION:** With the use of DBM, the costs for augmentation of the non-union-site are more expensive compared to ICABG (calculated difference: 160 euro/case). Nevertheless, this study demonstrated that the application of DBM compared to ICABG led to an advanced outcome in the treatment of non-unions and simultaneously to a decreased quantity of adverse effects. Therefore we

conclude that DBM should be offered as an alternative to ICABG, in particular to patients with elevated comorbidity and those with limited availability or reduced quality of autologous-bone graft material.

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## **Plate fixation of ununited humeral shaft fractures: effect of type of bone graft on healing.**

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**BACKGROUND:** Delayed union or nonunion of a fracture of the humerus is an infrequent but debilitating complication. Open reduction and internal fixation combined with autologous bone-grafting can result in reliable healing of the fracture; however, there is morbidity associated with the bone-graft donor site. This study was designed to evaluate healing of ununited fractures of the humeral shaft treated by one surgeon at one institution with a strict and consistent surgical protocol but with the use of two different types of bone graft: autologous iliac crest bone graft and demineralized bone matrix. **METHODS:** A consecutive retrospective cohort series was analyzed. From 1992 to 1999, forty-five patients with an aseptic, atrophic delayed union or nonunion of a humeral shaft fracture were treated with open reduction and internal fixation with a plate and autologous iliac crest bone graft. The mean time from the fracture to the surgery was 14.0 months, and the mean duration of follow-up was 32.8 months. From 2000 to 2003, thirty-three patients with the same condition were treated with the same protocol with the exception that Demineralized Bone Matrix was used instead of autologous iliac crest bone graft. The mean time from the fracture to the surgery in that group was 22.6 months, and the mean duration of follow-up was 20.4 months. All patients in both groups were assessed clinically and radiographically. **RESULTS:** Osseous union was noted clinically and radiographically following the index surgery in 100% of the forty-five patients treated with autologous bone graft and 97% (thirty-two) of the thirty-three patients treated with Demineralized Bone Matrix. The mean time to union was 4.5 months in the group treated with autologous bone graft and 4.2 months in the group treated with Demineralized Bone Matrix. The overall functional

outcome did not differ between the groups; however, twenty (44%) of the autologous bone-graft recipients had donor site morbidity, including a prolonged pain in the majority and a superficial infection requiring irrigation and débridement in one patient. CONCLUSIONS: Healing of an ununited humeral shaft fracture can be achieved consistently with rigid plate fixation and lag-screw compression augmented with either autologous cancellous bone graft or commercially available Demineralized Bone Matrix. The harvest of the autologous bone graft is frequently associated with complications. LEVEL OF EVIDENCE: Therapeutic Level III. See Instructions to Authors for a complete description of levels of evidence.

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## **Safety and efficacy of use of Demineralised Bone Matrix in orthopaedic and trauma surgery.**

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Demineralised bone matrix (DBM) acts as an osteoconductive, and possibly as an osteoinductive, material. It is widely used in orthopaedic, neurosurgical, plastic and dental areas. More than 500,000 bone grafting procedures with DBM are performed annually in the US. It does not offer structural support, but it is well suited for filling bone defects and cavities. The osteoinductive nature of DBM is presumably attributed to the presence of matrix-associated bone morphogenetic proteins (BMPs) and growth factors, which are made available to the host environment by the demineralisation process. Clinical results have not been uniformly favourable; however, a variable clinical response is attributed partly to nonuniform processing methods found among numerous bone banks and commercial suppliers. DBMs remain reasonably safe and effective products. The ultimate safe bone-graft substitute, one that is osteoconductive, osteoinductive, osteogenic and mechanically strong, remains elusive

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## **Demineralized bone matrix and spinal arthrodesis.**

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Spinal fusion is a gold-standard treatment for many disorders of the spine with autogenous bone graft as the gold-standard source for augmenting fusion. However, the morbidity and limitations of autogenous bone grafting has motivated the search for bone graft alternatives. One such alternative is Demineralized Bone Matrix (DBM). The purpose of this paper is to describe and characterize the properties of DBM in addition to reviewing the results of its use in animal and human studies of spinal fusion. A thorough and critical review of the English-language literature was conducted. DBM is both osteoconductive and osteoinductive. Studies have produced variable results with respect to spinal fusion rates. Various studies have demonstrated inferior, equal, or enhanced fusion rates. Some of the differences in these studies include the animal models used, the manner in which DBM was prepared, and the carrier with which DBM was combined. These differences may account for the dissimilar results. DBM is able to function as a graft extender in the human species.

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## Efficacy of demineralized bone matrix paste for maxillary sinus augmentation: a histologic and clinical study in humans.

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### Abstract

**OBJECTIVES:** The aim of this study is to report the effect of paste type of Demineralized Bone Matrix (DBM) on augmentation of maxillary sinus using clinical parameters. **STUDY DESIGN:** Sinus augmentation with DBM was performed on 5 maxillary sinuses. This study included 5 patients, 4 men and 1 woman, aged from 41 to 67 years (mean age 55 years). After an average of 6 months' healing period, a core bone was obtained and stained for histologic analysis. **RESULTS:** All implants showed favorable osseointegration, and final restorations were completed without failure in all cases. Histologically, new bone formation was active around grafted bone and grafted bone was well integrated to the newly formed bone matrix. In histomorphometric analysis, vital bone volume was 25.2 +/- 11.9%. **CONCLUSION:** The DBM paste is clinically useful for the increase of bone volume in sinus augmentation, because of its favorable effect of new bone formation and easy handling.