

## **Bone Marrow Aspirate Concentrate with Cancellous Allograft Versus Iliac Crest Bone Graft in the Treatment of Long Bone Nonunions**

*Kenneth Lin, MD; James VandenBerg, BS, MS; Sara M. Putnam; Christopher D. Parks; Amanda Spraggs-Hughes, BA<sup>1</sup>; Christopher M. McAndrew, MD, MS<sup>1</sup>; William M. Ricci, MD<sup>1</sup>; Michael J. Gardner, MD<sup>2</sup>*

<sup>1</sup>Washington University in Saint Louis, Saint Louis, Missouri, USA

<sup>2</sup>Stanford University, Redwood City, California, USA

**Purpose:** Fracture nonunion results in substantial disability. Iliac crest bone autograft (ICBG) has been considered the standard; however, ICBG provides limited quantities and can be associated with donor site morbidity. Given these limitations, bone marrow aspirate concentrate (BMAC) may be a viable alternative. The primary aim of this study was to evaluate the efficacy of BMAC in achieving nonunion healing compared to ICBG.

**Methods:** A retrospective matched cohort study was performed on 51 patients. 26 patients with nonunions with defects >2 mm were treated with open repair and BMAC grafting. These patients were matched by age and defect size to 25 patients treated with open repair and ICBG. Treatment success was defined as union, and treatment failure as either requiring revision surgery or progressing to persistent nonunion. Bivariate statistical analysis was performed using Student t tests or Mann-Whitney U tests for continuous variables, and chi-square tests or Fisher's exact tests for categorical variables where appropriate. A time-to-event analysis was done, using the cumulative incidence function, comparing the time to treatment success (bony union) between the 2 groups.

**Results:** Successful union occurred in 78% of the ICBG cohort, and in 75% of the BMAC cohort ( $P = 0.8$ ). The median time to union among treatment successes was 3.5 and 5.7 months for BMAC and ICBG, respectively ( $P = 0.023$ ). In a time-to-event analysis, treatment with BMAC was not a statistically significant factor. Infection was the only risk factor of statistical significance for failure. Open fracture, vascular injury, the need for soft-tissue coverage, and defect size did not influence the chance of failure.

**Conclusion:** Both ICBG and BMAC demonstrated comparable union rates in the treatment of nonunions. In this study, use of BMAC was associated with a faster time to union when compared to ICBG. While the time-to-event analysis for time to final union was not statistically significant, the difference in time to union between the 2 cohorts may be clinically significant and may result in an earlier return to activity in the BMAC group, although further study is necessary in this regard. The comparable success rate, quicker time to union, and minimal donor site morbidity associated with BMAC supports the use of BMAC in the treatment of long bone nonunions.