Skeletal Stem Cell Characteristics in Iliac Crest Bone Graft and Clinical Implications in Fracture Non-Union Repair

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BACKGROUND

- Autogenous bone grafting is an essential tool in the treatment of fracture non-unions
- Bone graft contains skeletal stem cells (SSC's) that differentiate into osteoblasts, an important step in fracture healing
- Relationship between the SSC composition of bone graft and clinical healing in fracture is non-union not fully understood

OBJECTIVES

- To determine if there is a relationship between patient characteristics and SSC composition in iliac crest bone graft
- To understand the clinical significance of SSC composition in the healing of fracture non-unions

METHODS

Human skeletal stem cell preparation:

- Bone marrow was aspirated from iliac crest from subjects undergoing repair of fracture non-unions
- Cells were prepared for flow cytometry analysis by staining for CD45⁻ CD271⁺ cells. These markers have been used in previous studies for the identification of SSC

Radiographic analysis:

- Subjects were prospectively followed with serial radiographs to monitor fracture healing
- Radiographs were read by two independent observers, and time to union was determined by presence of bridging callus formation

Statistical analysis:

- Data are expressed as means $\pm$ SEM and analyzed by unpaired, two-tailed Student's t-test

RESULTS

	Male	Female	Overall	p
#	18	15	33	
Age	44.72 $\pm$ 14.98	59.27 $\pm$ 19.96	51.33	0.039
BMI	30.81 $\pm$ 5.60	28.37 $\pm$ 6.31	29.7	0.248
%SSC	0.162 $\pm$ 0.113	0.120 $\pm$ 0.083	0.145	0.211
Time to union (months)	5.37 $\pm$ 2.73	5.73 $\pm$ 2.94	5.52	0.750

Table 1: Demographics data. No significant difference in BMI, percentage of SSCs, or time to radiographic union between males and females.

Figure 1: Skeletal stem cell composition affected by patient age. There was a negative correlation between age and percentage of CD271⁺ SSC in bone graft (A), although this did not reach significance (p=0.0746). Subjects younger than 50 years old had a significantly higher percentage of SSCs in their bone marrow compared to those older than 50 years old (B) (p=0.0497). Obese patients with a BMI greater than 30 had lower %SSC in their bone graft, although this did not reach significance (p=0.0633)

RESULTS

Figure 2: Radiographic union following non-union repair. X-rays taken at various time-points to monitor healing. This patient had X-rays at 1 (A), 3 (B), and 6 (C) months post-op and achieved union at 6 months.

Figure 3: Time to union associated with %SSC of bone graft. Patients who united by 6 months had a greater percentage of SSCs in their graft than those who took 6 months or longer to heal (p=0.0495).

CONCLUSIONS

- There is a lower percentage of stem cells in bone graft in older patients than in younger patients
- Skeletal stem cell frequency in bone graft may be a predictor for time to union following non-union repair with autogenous bone graft