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Comparison of Mesenchymal Stem Cells (Osteoprogenitors) Harvested from Proximal Humerus and Distal Femur During Arthroscopic Surgery

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Summary:
Arthroscopic bone marrow aspiration from the proximal humerus and distal femur is a reproducible technique and yields reliable amounts of mesenchymal stem cells.

Abstract:
Background:
Human MSCs derived from concentrated bone marrow aspirate are a promising biologic addition that may have practical use in the future of softtissue augmentation. Arthroscopic techniques for bone marrow aspiration without the need of an additional surgical site(e.g. iliac crest) and quick intraoperative centrifugation may facilitate its use in arthroscopic surgery. Purpose was to examine the relationships between age, gender and number of viable mesenchymal stem cells (MSCs) in concentrated bone marrow (BM) arthroscopically obtained from the proximal humerus and distal femur. Our hypothesis was that the number of MSCs obtained from concentrated BM, aspirated from the proximal humerus and distal femur, would remain consistent throughout the age-range of the population commonly undergoing surgery for rotator cuff or ACL.

Methods:
BM was aspirated from either the proximal humerus or distal femur during arthroscopic surgery in 84 patient (51.3 ±11.6yrs). MSCs were obtained from fractionated bone marrow following a 5-minute spin at 1500 rpm. Volume of BM and number of nucleated cells (NC) were calculated and samples were cultured for 6 days after which point the number of colonyforming units (CFU) was quantified and fluorescence-activated cell sorting (FACS) analysis was performed. Linear regression was used to explore relationships between the age, gender, volume of aspirated BM, and MSCs/ml.

Results:
Bone marrow aspirations yielded a mean quantity of 22.6±12.3 ml. After centrifugation 30.0±16.7 x 106 nucleated cells/ml of concentrated BM were harvested. The proximal humerus provided 38.7±52.6 x 106 and the distal femur 25.9±14.3 x 106. This resulted in overall 766.3±545.3 MSCs/ml of concentrated BM (proximal humerus: 883.9±577.6; distal femur: 551.3±408.1). There were no significant differences shown according to age, gender and donor sites.

Conclusion:
Arthroscopic bone marrow aspiration from the proximal humerus and distal femur is a reproducible technique and yields reliable amounts of MSCs. Additionally the evaluated intraoperative concentration method resulted in consistent amounts of MSCs in all clinically important age groups without a significant drop of the number of isolated MSCs.