Use of Bone Marrow–Derived Culture-Expanded Mesenchymal Stem Cells to Augment Healing of Chondral Defects Treated With Microfracture

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Intra-articular injection of autogenous bone marrow–derived stem cells provided long-term improvement in repair tissue firmness and aggrecan staining in cartilage defects. Authors' addresses: Gail Holmes Equine Orthopaedic Research Center, Colorado State University, 300 West Drake, Fort Collins, Colorado 80523-0912 (McIlwraith, Frisbie, Kisiday, Kawcak, Werpy); and Steadman Philippon Research Institute, 181 W. Meadow Drive, Suite 1000, Vail, Colorado 81657 (Rodkey, Steadman); e-mail: wayne.mcilwraith@colostate.edu. © 2010 AAEP.

1. Introduction

Previous reports evaluating the ability of bone marrow-derived stem cells (BMSCs) in repairing equine cartilage defects have failed to show long-term beneficial results when BMSCs were delivered to defects with a carrier.1 This study evaluated intra-articular injection of BMSCs to augment healing with microfracture compared with microfracture alone.

2. Materials and Methods

Ten horses (2.5–5 yr of age) had 1-cm² defects arthroscopically created on both medial femoral condyles. Defects were debrided to subchondral bone followed by microfracture. One month later, one randomly selected medial femorotibial joint in each horse received an intra-articular injection of 20 × 10⁶ BMSCS with hyaluronan (HA) or HA alone. Routine strenuous post-operative rehabilitation protocol was followed. Horses underwent musculoskeletal and radiographic examinations bimonthly and relook arthroscopy at 6 mo. Horses were euthanized 12 mo after induction of the defects, and study joints underwent magnetic resonance imaging (MRI) and gross, histologic, histomorphometric, immunohistochemical, and biochemical examinations. Horses were confined for 4 mo with hand walking starting at 2 wk and gradually being increased. At 4 mo, horses were subjected to a treadmill regimen of 2-min trot, 2-min gallop, 2-min trot 5 day/wk until completion of the study at 12 mo.

3. Results

Arthroscopic and gross evaluation confirmed a significant increase in repair tissue firmness and a trend for
better overall repair tissue quality (cumulative score of all arthroscopic and gross grading criteria) in BMSC-treated joints. Immunohistochemical analysis showed significantly greater levels of aggrecan in repair tissue associated with BMSC treatment. There were no other significant treatment effects.

4. Discussion
This study indicates that intra-articular BMSCs can enhance cartilage repair. Clinical use post-operatively when cartilage defects are present is expected to be potentially beneficial.

References