Cell magnetic targeting system for repair of severe chronic osteochondral defect in a rabbit model

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Abstract:

The aim of this study was to investigate a cell delivery system for repair of severe chronic osteochondral defects using magnetically labeled mesenchymal stem cells (m-MSCs), with the aid of an external magnetic device, through the accumulation of a small number of m-MSCs into a desired area and to detect the suitable number of autologous m-MSCs needed for repair of the defect. Twenty-six male Japanese white rabbits aged 6 months were used. An osteochondral defect was created bilaterally at the weight-bearing surface of the medial femoral condyle of the rabbits knees (3 mm diameter; 4 mm depth). At 4 weeks after creation of the defect, autogenic transplantation of the m-MSCs into the defect area was performed, followed by 10-min exposure to an external magnetic device, where animals were divided into four groups: high (1 × 106 m-MSCs), medium (2 × 105 m-MSCs), low (4 × 104 m-MSCs), and control (PBS injection). At 4 and 12 weeks posttransplantation of m-MSCs, repaired tissue was assessed histologically using the Fortier score with toluidine blue staining. Transplantation of a low number of m-MSCs was not enough to improve osteogenesis and chondrogenesis, but the medium and high groups improved repair of the chronic defect with chondrogenic tissues and showed histologically significantly better results than the control and low groups. The use of a magnetic targeting system for delivering m-MSCs has the potential to overcome the clinical hurdles for repair of the severe chronic osteochondral defect. Furthermore, this system is predicted to produce good clinical outcomes for humans, not only to repair osteochondral defects but also to repair a variety of damaged tissues.

Keywords:

Cell delivery system; Clinical relevance; External magnetic device; Magnetically labeled mesenchymal stem cells (m-MSCs); Osteochondral repair

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