Implantation of hUCB-MSCs generates greater hyaline-type cartilage than microdrilling combined with high tibial osteotomy

Se-Han Jung[1], Min Jung[1], Kwangho Chung[1], Hyun-Soo Moon, Jusung Lee[2], SOHEUN LEE, Sung-Hwan Kim[3]
[1]Yonsei University College of Medicine, [2]Severance, [3]Gangnam Severance Hospital, Yonsei University Coll

INTRODUCTION:

Human umbilical cord blood-derived mesenchymal stem cells (hUCB-MSCs) offer several advantages among the various sources of cartilage repair; these include non-invasive cell collection, high expansion capacity, and hypo-immunogenicity, rendering them suitable as allogeneic off-the-shelf products. Furthermore, hUCB-MSCs theoretically overcome age-related concerns, such as the diminished reparative potential of autologous cells, which is particularly relevant in patients with osteoarthritis. Previous randomised clinical trials have demonstrated the effectiveness and safety of hUCB-MSC treatment for patients with conditions other than Kellgren–Lawrence (K–L) grade IV osteoarthritis and severe deformities. The indication for this treatment corresponds, to some extent, to that of HTO. Accordingly, hUCB-MSC implantation combined with HTO is being considered, demonstrating promising results. Marrow stimulation can effectively treat small and medium defects and supplement HTO procedures with improved cartilage regeneration outcomes. Microdrilling, a recently introduced next-generation marrow stimulation, allows deeper and more subchondral perforations using a drill with a smaller diameter. The clinical outcomes and the quality of repaired tissues are better for microdrilling than conventional microfracture using awls. The present study aimed to compare the outcomes of treating large MFC lesions in knee osteoarthritis using hUCB-MSC implantation or arthroscopic microdrilling as a supplementary cartilage regenerative procedure combined with HTO.

METHODS:

This 1-year prospective comparative study included 25 patients with large, near full-thickness cartilage defects (International Cartilage Repair Society grade ≥ IIIB) in the medial femoral condyles and varus malalignment. Defects were treated with hUCB-MSC implantation or arthroscopic microdrilling combined with HTO. The primary outcomes were pain visual analogue scale and International Knee Documentation Committee subjective scores at 12, 24, and 48 weeks. Secondary outcomes included arthroscopic, histological, and magnetic resonance imaging assessments at 1 year.

RESULTS: Fifteen and 10 patients were treated via hUCB-MSC implantation and microdrilling, respectively. Baseline demographics, limb alignment, and clinical outcomes did not significantly differ between the groups. Cartilage defects and total restored areas were significantly larger in the hUCB-MSC group (7.2±1.9 *vs.* 5.2±2.1 cm^2, P = 0.023; 4.5±1.4 *vs.* 3.0±1.6 cm^2, P=0.035). The proportion of moderate-to-strong positive type II collagen staining was significantly higher in the hUCB-MSC group compared to that in the microdrilled group (93.3% *vs.* 60%, respectively). Rigidity upon probing resembled that of normal cartilage tissue more in the hUCB-MSC group (86.7% *vs.* 50.0%, P=0.075). Histological findings revealed a higher proportion of hyaline cartilage in the group with implanted hUCB-MSC (P=0.041).

DISCUSSION AND CONCLUSION:

hUCB-MSC implantation showed comparable clinical outcomes to those of microdrilling as supplementary cartilage procedures combined with HTO in the short term, despite the significantly larger cartilage defect in the hUCB-MSC group. The repaired cartilage after hUCB-MSC implantation showed greater hyaline-type cartilage with rigidity than that after microdrilling.