Repair of Chronic Osteochondral Defect at Weight Bearing Portion by the Combination Therapy with Articulated Joint Distraction and Injectable Mesenchymal Stem Cells

Yohei Harada, Tomoyuki Nakasa, Goki Kamei, Nobuo Adachi, Masataka Deie, Mitsuo Ochi.
Hiroshima University, Hiroshima, Japan.

Disclosures:

Introduction: There are several therapies for cartilage defect, but repair of large cartilage defect in weight bearing area is still challenging. Bone marrow stimulation procedure such as subchondral drilling or microfracture has been used for cartilage repair, but the repair tissue is fragile and will be damaged by overloading. To prevent from overloading, an articulated joint distraction therapy with subchondral drilling was reported. Distraction device can prevent cartilage in weight bearing area from overloading and allow joint motion after the bone marrow stimulation. On the other hand, there is another bone marrow stimulation therapy using cultured and injectable bone marrow mesenchymal stromal cells(MSCs), and some reports proved the effectiveness. So we hypothesize that the combination therapy with articulated joint distraction and MSCs injection is more effective against large osteochondral defects in weight bearing area.

Methods: Full-thickness osteochondral defect was created in weight bearing portion of medial femoral condyle of an adult Japanese white rabbit. At the same time, bone marrow was obtained from the iliac crest and MSCs were cultured. Four weeks later, the rabbits were divided into four groups with four knees in each group. In all groups, four equally spaced holes are drilled at the defect site. In group A, no additional procedure was performed. In group B, 200µL PBS with 1x10^6 MSCs was injected intra-articularly. In group C, knee joint was distracted 1.5 mm using distraction device. In group D, 200µL PBS with 1x10^6 MSCs was injected after the knee was distracted. The rabbits were sacrificed at four and eight weeks after the treatment and macroscopic and histological evaluation were assessed. To compare the morphologic changes, histological grading scale (Pineda score) was used. Kruskal-Wallis test and Mann-Whitney test was used for statistical analysis and a p-value <0.05 was considered to be statistically significant.

Results: At four weeks, there was no repair tissue in group A and partial repair tissue in group B and C, and almost full-thickness repair tissue in group D(Fig.1). Only the deep layer of the repair tissue in group D was stained with afranin O. At eight weeks, there was partial-thickness fibrous tissue in group A and B. In group C, full-thickness fibrous tissue was found in half of the joints. In group D, cartilage-like tissue stained with Safranin O was found(Fig.2). To compare the morphologic changes, histological grading scale (Pineda score) was used. At four weeks, Group C(9.75±0.83) and D(8.00±2.12) was significantly better than Group A(13.25±1.30). At eight weeks, Group D(6.50±1.80) was significantly better than Group A(11.8±1.79), B(11.5±1.66), C(10.3±0.83)(Fig.3).

Discussion: Intra-articularly injected MSCs led to the cartilage repair, but it didn’t grow to the level of the adjacent cartilage under weight bearing condition. An articulated joint distraction led to the cartilage repair to the level of the adjacent cartilage, but most of the repair tissue was fibrous. The combination with injectable MSCs and joint distraction led to the cartilage-like tissue to the level of the adjacent cartilage.

Significance: The combination therapy with articulated joint distraction and injectable MSCs is effective for repairing chronic osteochondral defect at weight bearing portion.

Acknowledgments:

References: (1)Kajiwara.R et.al. J Orthop Res. 2005
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