MRI evaluation of cartilage damage in knee before and after intraarticular treatment with stem cells

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Background. Osteoarthritis (OA) is a leading cause of pain and disability across the world. It leads to cartilage damage associated with subchondral bone changes and synovial inflammation, causing pain and disability. Regenerative medicine has been receiving increased interest because of its potential for altering the progression of OA by repairing cartilage lesions. Bone marrow-derived mesenchymal stem cells (BMSC) are a promising tool for cartilage regeneration in arthritic joints. Magnetic resonance imaging (MRI) is the leading non-invasive imaging modality used for assessing engineered cartilage.

Aim. The purpose of this study was to evaluate the ability of MRI in detecting articular cartilage lesions before and after BMSC transplantation in knee joint for patients with chronic OA. Study tasks: retrospective analysis of MRI images of knee joint to evaluate cartilagine changes before and after BMSC treatment, as well analysis of BMSCs effect for accompanying features - bone marrow edema, synovial tissue changes and effect on effusion in knee joint.

Materials and methods. Retrospective study included 23 patients (11 females and 12 males, mean age 58 years; range 21 - 73 years). The inclusion criterion was Kellgren-Lawrence (KL) grade 2 or 3 radiographic changes. 7 patients presented grade 2 and 16 patients grade 3 KL OA. All participants knee joints were examined with a 1.5T MRI system using knee coils and the use of PD Fat Sat ax., sag., cor, T1 sag. sequences before and 6-7 months after BMSC treatment. Status prior to BMSC treatment and changes 6-7 months following treatment were assessed by Whole-Organ Magnetic scale (WORMS). Cartilage, bone marrow, subchondral changes, articular surface, osteophytes, meniscus, ligaments, synovial tissue were semi-quantitatively scored in 15 different subregions according to WORMS.

15 subjects (9 females and 6 males) showed positive changes after BMSC therapy. Before BMSC treatment WORMS scores were M=53; SD=32,02; 6-7 months after BMSC treatment M=50,08; SD=32,08 (p< 0.05).

In 30% of cases (7 patients) 6-7 months post-injection MRI showed restoration of cartilage - WORMS scores changed from 20.1 before treatment (range 2.5 to 50) to 19.5 after treatment (p = 0.16).

10 patients had bone marrow edema before treatment, 6-7 months post-injection 7 patients had positive changes - WORMS scores before treatment M=1.78; SD= 2.6, after treatment M=1; SD= 2.15 (p< 0.05).

Conclusions. MRI using conventional sequences (PD Fat Sat, T1) can be used to monitor the changes before and after BMSC treatment. Results indicate autologous BMSC transplantation is an effective approach in promoting the repair of articular cartilage defects.