



ORIGINAL ARTICLE

MR cartilage imaging in assessment of the regenerative power of autologous peripheral blood stem cell injection in knee osteoarthritis



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Abstract *Background:* Osteoarthritis (OA) describes an age-related, heterogeneous group of disorders characterized pathologically by focal areas of loss of articular cartilage in synovial joints, associated with varying degrees of osteophyte formation, subchondral bone change, and synovitis. Currently, cartilage repair remains a major challenge for physicians, being avascular with limited regenerative capacity. Stem cell therapy opened new horizons for hyaline cartilage repair. Peripheral blood stem cells (PBSC) due to their multi-lineage potential, immunosuppressive activities, and limited immunogenicity, were tried as an intra articular injection.

Aim of study: To find out the regenerative effect of repeated intra articular injections of autologous PBSC in knee joints of OA patients using MR cartilage imaging.

Methods: 10 patients (3 males and 7 females) diagnosed with bilateral knee joints OA were included in this study, they underwent history taking, clinical examination and MR cartilage imaging using the semi-quantitative whole joint assessment score of knee for OA (MOAKS). Three intra articular injections of 8 ml of autologous PBSC in each knee were administered. Clinical and MRI assessments were repeated after 1 year.

Results: A significant reduction was seen in all parameters post injection. MR images analysis showed increased cartilage thickness in 65 knee joint compartments out of 160 affected compartments.

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Conclusion: Limited good level of evidence showed that repeated intra-articular injections of autologous PBSC resulted in an improvement of the quality of articular cartilage repair and physical function as observed by MRI and clinical assessment.

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1. Introduction

Osteoarthritis is a degenerative condition of the cartilage and other tissues such as the synovium in which immunological and inflammatory reactions occur contribute to the development of joint pathology (1) and clinically, patients with osteoarthritis (OA) express variable synovitis. Thickening of the lining layer containing predominantly macrophages produce elevated levels of pro-inflammatory factors and damage-associated molecular pattern molecules (2).

The release of cartilage matrix fragments from damaged cartilage may give a prolonged stimulation of synovial macrophages, thereby forming a positive feedback loop that drives deleterious synovitis. This sheds new light on the potential mechanism of action of mesenchymal stem cell (MSC) therapy in osteoarthritis (1).

Although it is generally accepted that the primary effect of stem cell treatment occurs through tissue-specific differentiation, new data suggest that the therapeutic potential of these cells might also be related to their paracrine effect (3,4).

Some orthopedists try to treat OA patients with biologic reconstruction as soon as possible. Numerous procedures are available. These procedures include micro fracture or micro drilling surgery, autologous chondrocyte implantation (ACI), mosaicplasty, and matrix-guided autologous chondrocyte implantation, among other approaches (5).

However, the drawbacks of ACI include limited cell sources, difficulty in phenotype retention, and donor-site morbidity, all of which challenge autologous cell transfer procedures. Thus, new strategies rely upon cell therapies that explore the use of stem cells rather than primary chondrocytes for cartilage regeneration (6).

Therefore this study of repeated intra articular injections of PBSC in knees of OA patients without prior surgery will declare whether this non invasive application will also help to prevent joint destruction within the human OA joint.

Magnetic resonance imaging (MRI) provides high-spatial-resolution, multiplanar imaging and excellent tissue contrast. This enables a three-dimensional assessment of all components of the joint simultaneously, allowing direct visualization of articular cartilage. With the advances in techniques and development of dedicated sequences, MRI has become the imaging modality of choice in both clinical and research settings of musculoskeletal diseases, in particular osteoarthritis (OA), a chronic joint disease characterized by destruction and progressive loss of articular cartilage and clinical symptoms including pain, stiffness and impaired function (7).

2. Aim of the study

To find out the regenerative effect of repeated intra articular injections of autologous PBSC in knees of osteoarthritis patients using MR cartilage imaging.

3. Materials and methods

10 patients (3 males and 7 females; age range 38–64 years with bilateral knee joints OA) were included in this study which was conducted during a period of one year, in a University Hospitals. The research carried out here on human subjects was in compliance with the Helsinki Declaration, and informed consent was obtained from all study subjects.

Inclusion criteria: include osteoarthritis diagnosed by X-ray and MRI and end stage osteoarthritis candidate for total knee replacement.

Exclusion criteria: include pregnancy or lactating, positive tests for HIV, HCV, and HBV, any bleeding disorders or blood diseases, active neurologic disorder, end organ damage, and uncontrolled endocrine disorders.

All patients underwent history taking and thorough clinical examination with emphasis on:

- 1- WOMAC index (8) questionnaire to evaluate the condition of patients, including pain (0–20), stiffness (0–8), and physical functioning of joints (0–68). 0 = None, 1 = Slight, 2 = Moderate, 3 = Very, 4 = Extremely (11). WOMAC questionnaire is used before and 12 months after treatment.
- 2- The 6-min walk distance (6MWD) is a test where the subject walks for 6 min on level ground, and the distance covered in 6 min is measured (9).
- 3- Plain X-ray A–P and lateral views before treatment to estimate joint space loss and any defect in bone or osteophytes using Kellgren–Lawrence grading scale (10).
- 4- MRI with cartilage imaging technique, to measure the thickness of the cartilage and number of affected compartments, presence of osteophytes, effusion, meniscal extrusion before and 12 months after treatment Fig. 1.

3.1. MR acquisition

MR images of both knees were obtained for all patients with a 1.5-T (Achiva; Philips Medical Systems, Best, the Netherlands) MR system with an extremity coil.

3.2. MR imaging protocol included

Sagittal dual echo TSE sequence TR/TE 3000/50 and 80 ms, thickness, 3.5 mm; gap, 0.35 mm; matrix 256 × 200; FOV 170 × 170 × 84 mm. Sagittal and coronal intermediate weighted SE sequence with fat suppression “SPAIR” TR/TE 3000/50 ms; thickness, 3.5 mm; gap, 0.35 mm; matrix, 256 × 200; FOV 170 × 170 × 77 mm. Coronal T1W_TSE (TR/TE 500/17 ms; section thickness, 4 mm; gap, 0.4 mm; sections, 20; matrix, 292 × 165; FOV 180 × 153 × 88 mm. Axial mFFE sequence “multislice fast field echo” (TR/TE/delta TE, 940/

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