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All-Arthroscopic Technique to Repair Knee Cartilage Defects Using the Autologous Matrix-Induced Chondrogenesis

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Summary:
Here, we present results of all-arthroscopic technique to reconstruct extensive cartilage defects (without bone defects). The procedure is a single-stage, all-arthroscopic technique based on the open AMIC procedure. The early results suggests the method could be useful for all arthroscopic treatment of cartilage lesions. Clinical studies comparing this method with other methods or with active re

Abstract:
One of the most promising fields of medical scientific research is regenerative medicine. Its major tools include both isolated cells and specially designed biomaterials. Bone marrow cells were introduced into clinical practice much earlier than other cell types due to their ability to differentiate into many types of cells. In fact, bone marrow mesenchymal stem cells are considered to be an attractive source of cells for the regeneration of tissues and organs, including articular surface cartilage. The simplest method for utilising stem cells in the regeneration of a damaged cartilage layer is the microfracture technique. Autologous Matrix-Induced Chondrogenesis (AMIC) is a variant of the microfracture method that utilises a collagen matrix to serve as a scaffold for new cells, allowing effective reconstruction of even large fragments of a damaged cartilage surface. Currently, such procedures are performed by means of surgically opening the knee joint.

The goal of this article is to present an results of arthroscopic technique for reconstructing damaged knee cartilage fragments using the AMIC technique in conjunction with a collagen matrix and fibrin glue and present results of treatment.

Material and Methods:
Indications for cartilage reconstruction included International Cartilage Repair Society grade IV symptomatic damage of the burdened knee cartilage surface. The defect area was between 1,5 and 6 cm2. All surgical procedures were performed by a single surgeon (by the first author). The first part of the procedure is diagnostic knee arthroscopy. After complete inspection of the joints and assessment of the defects, the chondral lesions are carefully debrided down to the subchondral bone with a curette, spoon, and shaver until a stable shoulder surrounded the defect. Next, the size of each defect was assessed by a circular sharp punch. Corresponding numbers of circles are cut (with the same knives) in the collagen matrix after being moistened with physiological saline.

The second part of the procedure is performed under dry arthroscopic conditions. According to recommendations specific to this method, numerous bores are drilled at 5-mm intervals in the subchondral layer with a 1.1-mm K-wire. Next, Chondro-Gide matrix circles of corresponding diameters are placed in the reconstruction area with pean clamps. The circular patches overlap. According to the original technique, the porous surface of the membrane is facing the bone surface. Fibrin glue is applied to all membrane-covered areas. Next, excess glue is separated from the surrounding soft tissue, and the glue is left for 5 minutes to set. Then, 10 knee movements (consisting of flexion and extension) are performed to check the stability of the reconstructed cartilage surface.

Paper #170

The preliminary results of largess prospective study are presented. We assessed 87 patients before operation, and controlled 60 cases 6 months, 35 cases 1 year and 20 cases 2 years after operation. The follow up examination included MRI scans, IKDC2000, Lysholm scale. MRI of the study knee of each patient was acquired with a 1.5 Tesla whole-body scanner using a commercial circumferential knee coil. For the description of the repair tissue, we used the MOCART system previously published by Marlovits et al.. Nine variables were used to describe the morphology and signal intensity of the repair tissue compared to the adjacent native cartilage. The repair was considered complete when the repair tissue appeared as thick as the adjacent native cartilage with complete integration of the margins, and had a smooth articular surface that reproduced the original articular contour with no adhesions and an intact subchondral bone plate and marrow. The signal intensity of the repair tissue was evaluated separately for FSE (dual T2-FSE) and fat-suppressed.

Results:
Before surgery average results of IKDC 2000 and Lysholm was appropriately 44,03 (min. =21,8, max.= 67,7) and 71,22 (min. = 29 max.= 90) After 6-month observation period average results of IKDC 2000 and Lysholm was appropriately 58,6 (min. = 37,9 max.= 73,1) and 82.05 (min. = 67 max.= 99). After 12-month observation period average results of IKDC 2000 and Lysholm was appropriately 71,15 (min. = 54,3 max.= 97,7) and 91,23 (min. = 74 max.= 100). After 24-month observation period average results of IKDC 2000 and Lysholm was appropriately 88,47 (min. = 85,3 max.= 98,7) and 92,58 (min. = 79, max.= 100).
According to scheme published by Marlovits et al., MOCART total scores for the cartilage is graded from 0 to 17. After 6-months follow up 68% have 15 points, 21% have 14 points, and 11% have 12 points. After 12-months follow up 57% have 16 points, 28% have 15 points, 10% have 14 points, and 5% have 12 points. After 24-months follow up 71% have 16 points, 24% have 15 points, and 25% have 14 points. 24 months of follow-up an intact subchondral lamina was found in none of the patients (0%) and an intact subchondral bone in 29%.

Conclusion:
Here, we present results of all- arthroscopic technique to reconstruct extensive cartilage defects (without bone defects). The procedure is a single-stage, all- arthroscopic technique based on the open AMIC procedure. The early results suggests the method could be useful for all arthroscopic treatment of cartilage lesions. Clinical studies comparing this method with other methods or with active rehabilitation in randomized control trials is needed before the method can be recommended as a routine procedure.