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Knee Defects Biological Resurfacing by Adipose Stem Cells and Collagen Membrane Scaffold

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Summary:
Stem cell-based therapies are nowadays retained of interest as alternative therapeutic solutions in the treatment of osteochondral lesions and osteoarthritis. Stomal vascular fraction (SVF), containing adipose derived stem cells (ASCs) can be easily harvested in large quantity from adipose tissue and has been clearly demonstrated to possess high regenerative capacity.

Abstract:
GOAL
Stem cell-based therapies are nowadays retained of interest as alternative therapeutic solutions in the treatment of osteochondral lesions and osteoarthritis. Stomal vascular fraction (SVF), containing adipose derived stem cells (ASCs) can be easily harvested in large quantity from adipose tissue and has been clearly demonstrated to possess high regenerative capacity.

We report on the one-step technique combining adipose stem cells and a collagen scaffold in the treatment of patients with osteochondral defects of the knee.

MATERIAL & METHODS
Once the osteochondral defect has been arthroscopically identified and debrided, in local anesthesia, we extract, by simple liposuction aspirate, the marrow tissue from adipose tissue of the abdomen. Then, the stromal-vascular fraction of cells is separated from the mature lipid-laden adipocytes and the water cell-free component in few minutes inside a new closed device, named MyStemEvoTM kit. Completed the lesion debridement, microfractues are performed onto the bed of the defect and the latter is closed by applying the Chondro-gideTM collagen membrane soaked with the stromal vascular fraction obtained. At the end, fibrin glue is applied to all the membrane covered areaand a final intra=-articular injection on ASCs is performed.

RESULTS
We have prospectively (range 3-24 months) followed the grade 3 and 4 chondral defects of the knee treated by ASCc implantation together with a collagen membrane scaffold. All the patients have been treated by the same surgeon and have followed the same post-operative regimen. Patients have, from short to mid term follow-up, showed and maintained significant improvements in all scores and no adverse reaction has been noted.

DISCUSSION AND CONCLUSIONS
Adipose tissue contains a large number of multipotent cells, which is an essential prerequisite for stem-cell-based therapies. A bone marrow transplant contains approximately 6 × 106 nucleated cells per mL, of which only 0.001-0.01% are stem cells. In comparison, the number of SVF cells that can be isolated from subcutaneous liposuction aspirates is approximately 0.5-2.0 × 106 cells per gram of adipose tissue, whereby the percentages of stem cells range from 1 to 10%. Therefore, approximately 0.5 × 104 to 2 × 105 stem cells can be isolated per gram of adipose tissue.

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This proposed procedure is simple, quick and low cost. Specifically, it has the advantage of not requiring harvesting of cells from the joint surface, and its associated donor site morbidity. The adipose tissue lipoaspirate procedure is well known, simple and low-risk. The direct , closed and sterile separation and withdrawal in the OR of the stromal vascular fraction, without the need to perform collagenase lysis, makes it a quick and safe procedure, perfectly adapting to the timing requested for a single step chondral defect repair procedure. The follow-up MRI's have showed a nice coverage layer of the defect with an early return to the presence of the natural chondral lamina.

One step patient-side surgery is certainly becoming the technique of choice for chondral and osteochondral defects repair. This single-step ASCs implantation procedure together with a collagen membrane scaffold riduces time, costs and is less invasive to the patient, but although promising, needs more patients and longer follow-ups.