A novel model of hyaline cartilage-producing chondrocytes for the healing of articular lesions: a possible glimpse into the future

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Purpose: Damage to surfacing cartilage of joints, caused by trauma or osteoarthritis, results in pain, and altered quality of life. Since cartilage tissue does not heal spontaneously, permanent joint functional rehabilitation may be achieved by replacement the lesion with cartilage producing cells. The current study is aimed at developing highly reproducible, genuine hyaline cartilage-producing cells.

Methods and Materials: Anovel chondrocytes cell culture originating from neonatal porcine-derived mandibular condyle (MC) is proposed. MC-derived chondrocytes (MCDC) spontaneously differentiate into mature chondrocytes. These cells express type II collagen and aggrecan; thus producing a genuine hyaline cartilage. Prolonged MCDC cultures form a continuous cartilage film (Cartimove™) that can be mechanically handled and re-plated while preserving its proliferation and differentiation abilities.

Results: In pilot studies, conducted in goats, have shown that both MCDC cells and Cartimove implanted in knee articular lesions of deep cartilage damage developed into aggrecan type II collagen containing surfacing tissue. Six months post implantation an almost full thickness layer of cartilage is observed. The newly produced cartilage forms a close integration with adjacent cartilage and subchondral bone. No signs of immunoreactivity, or of cells/tissue necrosis are observed indicating of no rejection reaction.

Conclusions: Hence, we propose that porcine-derived MCDC cells, or as cartilage film, is capable to replenish cartilage lesions becoming an authentic hyaline cartilage without provoking immunological reaction.

Combined autologous bone and chondrocyte transplantation (CARES-technology) or osteochondritis dissecans

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Purpose: Femoral osteochondritis dissecans lesions (OCD) is common. For the repair different procedures are recommended. We report on the treatment of OCD lesions at the medial femoral condyle with a combination autologous bone-plug transplantation for the repair of the subchondral damage combined with autologous chondrocyte transplantation (CARES-technology: autologous chondrocytes dispensed in a rat-collagen matrix).

Methods and Materials: 22 patients with OCD-lesions (grade III & IV (ICRS-classification)) were treated in a two-step procedure: First, during arthroscopy the diagnosis was confirmed and the chondrocytes harvested. In the second operation the subchondral sclerosis was removed and the bony defect restored with autologous cancellous bone plugs harvested from the proximal tibia. The cartilage layer was reconstructed with matrix-associated autologous chondrocytes. Partial weight-bearing was limited to 15 kg for the first 6 weeks and until the 12th week to 30 kg, afterwards full weight-bearing was allowed. Sports activities were restricted for one year. Follow-up was performed using the IKDC score and the patients and physicians contentment scale (excellent-poor). The IKDC score was analysed statistically comparing the preoperative score with the one-year follow-up results.

Results: Follow-up was possible in all 22 patients. The mean preoperative IKDC-score was 35.1 pts., after 1 yr. 67.7 pts. The mean change to baseline was 29.3 (p < 0.0001). Results were clearly depending on the size of the defect and the duration of symptoms. The contentment of the patients/physician resulted in 9/8 excellent, 9/9 good, 4/3 fair and 0/2 poor results.

Conclusions: These results are promising. Further follow-up is necessary to show stability of these results. In addition, comparative studies are desirable.

Second generation ACI with BioCart ™II: Experience of the Souraski Medical Centre

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Purpose: Clinical evaluation of a novel autologous chondrocyte implant, BioCart™II for cartilage repair.

Methods and Materials: BioCart™II is a matrix-assisted, fibrin hyaluronic acid-based implant containing autologous chondrocytes propagated with a unique growth factor variant to maintain their chondrogenic potential. The scaffold is a porous open channel structure enabling a three dimensional distribution of the cells and full thickness repair. Nine patients aged 17-50, with cartilage lesions diagnosed by MRI underwent arthroscopy and biopsy from the anterolateral margin of the intercondylar notch. Two to three weeks later, BioCart™II was implanted through a small 4.5-cm longitudinal parapatellar incision. Deep lesions were treated with two layers. Rehabilitation included 4-6 weeks of non-weight bearing and CPM, followed by 3 weeks of partial weight. Full activities were resumed at 4-6 months and follow-up was 3-22 months.

Results: At diagnosis all patients scored under 4 points in the subjective ICRS questionnaire improving to over 6 post operation. The IKDC score for all patients improved from grades C and D before the intervention to A or B at last operation. Second look arthroscopy and biopsy on one patient due to pain and sensation of catching, showed excellent coverage, full integration and new hyaline-type cartilage. Six months post operative MRI on 6 patients showed good integration of the graft with signs of bone edema at the implantation site.

Conclusions: BioCart™II is safe, effective and user-friendly both for the patient and the surgeon. The short time from biopsy to implantation and good to excellent clinical outcome further encourage the continued use of this technique and product.

A prospective study of alginate seeded with mature allogenic human chondrocytes in the treatment of articular cartilage defects

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Purpose: Aim of the Study: To produce tissue-engineered cartilage by human articular chondrocytes cultured in a biocompatible, biodegradable matrix for the treatment of (osteo)chondral lesions.

Methods and Materials: Earlier studies have shown that chondrocytes proliferate in alginate, and synthesize a cartilage- like matrix for up to 8 weeks. Allogenic human chondrocytes were cultured in 1.0% alginate beads for 2 weeks before implantation into cartilage defects of the knee joint. Prior to the surgical intervention a small part of the alginate beads was dissolved and the chondrocytes were tested for their phenotypical stability. The (oste)chondral lesion of the femoral condyle in 22 patients (3 lateral – 19 medial) was debrided by an open technique, and covered by an autologous periostal flap. Subsequently the defect was filled with the alginate beads. The cartilage lesion was finally injected with 0.5% fibrin gel. Parameters that were followed pre- and postoperatively, were the leukocytes index, the WOMAC, the VAS-score, and Gd-DTPA MRI. A follow-up arthroscopy to assess the macroscopic aspect and the integration of repair tissue into surrounding native cartilage was performed at 12 months postoperatively.

Results: Clinically, major adverse reactions to the scaffold used with the cartilage cells, were not observed. The results (mean follow-up: 15months) of clinical examination of the involved joint as well as the functional scores improved with time. Follow-up arthroscopy at 12 months showed an intact articular surface, with good integration into the surrounding cartilage, and a practically normal indentation was felt on palpation.

Conclusions: This surgical procedure is performed in one step. Biodegradable, biocompatible scaffolds could be used in the treatment of cartilage defects. By using a combination of a biodegradable matrix provides an initial support to the chondrocytes, making the implant theoretically initially biomechanically superior to the model in which cells are injected as a suspension under a periostal flap.