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CONTRIBUTIONS AT THE TREATMENT OF ARTICULAR CHONDRAL DEFECTS

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Summary

Performing preliminary studies regarding cell biology, osteoarticular biomechanics and scaffolds parameters. Isolation and cultivation of cell types required for seeding on the 3D supports. Elaboration of technologies for achieving scaffolds in osteoarticular reconstruction. Seeding and cell culture on 3D supports. In vivo animal experimental studies concerning the applicability of the developed techniques. Achievement of protocols required for moving on to clinic assessment of used biomaterials and procedures.

Sick or traumatized cartilage has a limited regeneration capacity.

Tisular engineering catalogues among possible therapeutically methods (1, 4, 7, 11) for the articular chondral defects repair using scaffolds implants loaded with chondro-progenitor cells (3, 5, 9, 10, 12, 13).

In the present study we proposed *in vivo* checking of the possibility to use collagenic scaffolds (with or without hydroxyapatite support) loaded with chondroblasts, arise by cultivation from mesenchymal stem cells, for articular chondral defects repair on dogs.

Materials and methods

The study was made on a group of 21 healthy common bread dogs. From each individual, bone marrow was sampled by proximal humeral epiphyseal puncture (6). The samples were processed for chondroblasts obtaining on Immunophysiology and Biotechnology Centre of University of Medicine and Pharmacy "Victor Babes" Timisoara. As support for growing-loading-transplant two types of collagenic scaffolds with or without hidroxyapatite produced by SC Glass and Ceramics Poneti Bucharest were used. Under general anesthesia (table 1), cartilage defects were made on femoral trochlea, femoral condyle and humeral head as shown in table 1. The size of the defects corresponded with the dimension of the collagen matrix (loaded with chondroblasts at Immunophysiology and Biotechnology Centre of University of Medicine and Pharmacy "Victor Babes" Timisoara) of 0.5/1 cm.

The matrix fixation on femur was made by the help of maxillofacial reconstruction osteosynthetic screws. The screw on of the screws was made in such way that the head of the screw to be under the level of articular cartilage surface. Defects of the cartilage of humeral head were filled by injection of 1 cm^3 chondroblasts suspension (obtained at the Immunophysiology and Biotechnology Centre of University of Medicine and Pharmacy "Victor Babes" Timisoara).

Table 1.

Repartition of defects on experimental and control groups

no.	Weigt (kg)	Sex	Group	Defect place
1	15,5	female	experimental	right humeral head, great caudal tuberculum
2	13	male		
3	15	female		
4	12,5	female		
5	15,5	female	control	
6	11,5	male		
7	15,4	female		
8	10	female	experimental	femoral trochlea (between condyles)
9	11	male		
10	17	male		
11	14	male		
12	12,5	female	control	
13	13	female		
14	13,5	male		
15	14	female	experimental	lateral surface femoral lateral condyle
16	15	male		
17	10,5	male		
18	11,2	male		
19	11	male	control	
20	12	female		
21	15	male		

Evaluation of the healing process was made at 110 days by arthroscopic way of scapulohumeral and femuro-tibio-patellar joints. Classical arthroscopic access was used, by lateral approach of scapulohumeral and respectively craniolateral approach of femuro-tibio-patellar joint (2).

Results and discussions

Arthroscopic examination of cartilage defects made on the control subjects shows absence of its complete healing. More than 2/3 of the surface of the defect made on humeral head was uncovered by cartilage tissue. From the healthy zone irregular areas in which articular cartilage appears present on the surface of the defect can be observed. Color of the cartilage from these areas was white-blue and differs from the color of healthy cartilage (white-sidefic). At the subjects from experimental group the healing of cartilage is evident, images made show the surface of the defect covered in 90-95% with new formed cartilage.

Similar to the humeral control group, subjects from control group with femoral defects has shown the absence of cartilage healing process being present only the start of this process from the periphery area. On 75% of the experimental group subjects (2 – condyle defect and 4- trochlea defect) head of the screw was not covered by the cartilaginous tissue despite the fact that the screw was covered by implanted matrix. In all cases the cartilage has recovered only in the area close to the screw.

In two subjects in whom the matrix was applied on lateral surface of the condyle, the partial covering of the screw head, from the periphery to the center, with cartilaginous tissue was observed. Cartilage corresponding to the topographic area in which matrix was applied appears crossed by thin blood vessels.

The obtained result at the control group, the abrasive aspect of the cartilage or uncovered aspect of the bone, reveal the reduced regenerating capacity of articular cartilage in absence of one specific treatment (10, 11).

Used saffolds have the capacity to mimic natural extracellular cartilage matrix, having a similar behaviour like PLGA (poly-lactic-co-glycolic acid) and PLA-PEG (poly-d,l-lactic acid/polyethylene glycol) scaffolds used by Fan. et al. – 2006 (3), respectively by Tamai et al. – 2005 (12). The quality of post implanted resulted cartilage didn't show any difference between two types of used scaffolds. The macroscopically aspects are one of a hyaline cartilage.

The obtained results after joint injection (scapulo-humeral) with 1 cm^3 of condroblasts suspension are similar of those obtained on rabits (8).

Tested means for mechanical scaffold fixation, at 110 days, are only partial covered by cartilage, condition that impose furter researches, depending on recorded data that will be obtained at control exam at 200 days.

Conclusions

Spongious collagenic scaffolds represent a structural support which allows a faster cartilage tissue formation.

Biological structural scaffolds transplants (collagen-hydroxyapatite loaded with chondroblasts) represent an efficient method for articular cartilage defect treatment.

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