

Evaluation of Poly-L/D-Lactide (PLDLA) 96/4 Scaffolds Implanted in the Subcutis of Rats.

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Background:

Various scaffolds have been developed for tissue engineering. Knitted PLDLA 96/4 scaffolds have recently been introduced to replace Swanson prosthesis used for MCP joint replacement in rheumatoid patients. The scaffold is aimed to follow the principles of in situ tissue-engineering and form a functional MCP joint by inducing ingrowth of fibrous tissue. So far, no in vivo information has been available on this scaffold.

Aims:

To study the poly-L/D-lactide (PLDLA) 96/4 scaffolds in vivo (in the subcutaneous tissue of rats).

Material and methods:

Cylindrical knitted mesh scaffolds were made of PLDLA 96/4 (15x3.5 mm). Three types were evaluated: Dense (weight 30 g), ordinary (25 g) and loose (20 g). Four scaffolds (2 ordinary, one dense and one loose type) were implanted in the dorsal subcutis of each of 32 Sprague-Dawley male rats of 16-18 weeks old (average 17). The implants were retrieved after 3 days, 1, 2, 3, 6, 12, 24 and 52 weeks postoperatively. The implants were removed with 5 mm of surrounding tissues. One ordinary scaffold was examined for characterisation of mechanical properties. The rest were examined histologically for tissue reaction and ingrowth in special and temporal terms. Tissue ingrowth into the scaffolds and its maturation was evaluated. The thickness of the fibrous capsule was measured (minimum of 20 measurements from each slide, 5 samples from each follow-up group, except for the 3-days-group which consisted of three samples only). The data was evaluated statistically.

Results:

No postoperative complications were encountered. Tissue ingrowth reached the innermost part of the implants within three weeks. Tissue ingrowth occurred in similar from the top, the bottom and from the sides of the implant. Fibrin was the first to fill in the scaffold followed by the cells and at last collagen fibers were found in the structure. The thickness of the capsule

surrounding the scaffold changed by the time, being thickest at 3 weeks then gradually getting thinner. The orientation of the collagen fibers inside the implant changed from non-oriented to highly oriented fibers making septae. The septae appeared first between PLDLA 96/4 bundles of filaments (i.e. between PLA fibers), later also between individual PLDLA 96/4 filaments. Thus the septae grew first into the larger pores then into the smaller gaps. At the longest follow-up periods the septae were highly oriented between PLDLA 96/4 fibers and filaments. e.

Conclusions:

Upon implantation in rats, fibrous tissue ingrowth proceeds from all sides of the scaffold filling it completely at 3 weeks. The scaffold is encapsulated into a fibrous tissue that reaches highest thickness at 3 weeks and gets thinner afterwards. Fibrous tissue first fills spaces between PLDLA 96%4 fibers and then the smaller spaces between individual PLDLA 96/4 filaments. Fibrous tissue collagen fibers get more organized by time.

Keywords: fibrous tissue, PLDLA, scaffold, tissue engineering