Histological characteristics and ultrastructure of polyethylene terephthalate LARS ligament following the reconstruction of anterior cruciate ligament in rabbits

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Abstract

BACKGROUND: LARS ligament was designed by JP Laboureau in 1985. Clinical applications have proved the artificial ligament is satisfactory in a middle- and short-term, but few reports the histological turnover after implantation.

OBJECTIVE: To study the histological characteristics and ultrastructure of polyethylene terephthalate (PET) LARS artificial ligament after the reconstruction of anterior cruciate ligament in rabbits.

DESIGN, TIME AND SETTING: Randomized control experiments were conducted at the laboratory in the Second Affiliated Hospital of Soochow University from January to December in 2007.

MATERIALS: PET LARS ligaments were the stump of artificial posterior cruciate ligament obtained from operations (provided by Shanghai Kelong Company Limited). Twelve skeletally matured New Zealand white rabbits were used in this study.

METHODS: Twelve rabbits were divided into two groups according to systematic sampling. The PET LARS was transplanted to substitute the original anterior cruciate ligament, and the transplanted PET LARS was covered with the remnant of anterior cruciate ligament in 9 rabbits (L-LARS group), while only PET LARS was transplanted in 3 rabbits, which no covering with the remnant of anterior cruciate ligament (LARS group).

MAIN OUTCOME MEASURES: The grafts and synovium were harvested at 1, 3 and 6 months after implantation, and were processed into the stain by hematoxylin-eosin and Masson. Transmission electron microscope investigation was performed on the grafts at 6 months to observe ultrastructural findings.

RESULTS: At 1 month after implantation, the grafts in joints were covered with recipient connective tissues in L-LARS group, but were not covered anything after 6 months in LARS group. At 3 months, there were moderate to severe inflammatory reaction or foreign body reaction adjacent to the LARS fibers in bone tunnel or between LARS ligament fiber bundles. At 6 months, there were still irregularly aligned collagen fiber bundles slightly or in some portions. The tissue in the LARS ligament showed no mature ligamentization. Inflammatory cell reaction or foreign body reaction began to diminish. Marked trabecular bone grew into the bone tunnels, newly formed woven bone originated from the wall of bone tunnel and grew into the artificial materials. Electron microscopy investigation showed the tissue near LARS fibers was highly cellular with collagen fibrils (50–100 nm diameter). Among the collagen fiber bundles of the stroma were numerous osteoblasts and fibroblasts that were elongated, with large nuclei and an abundant, granular endoplasmic reculum.

CONCLUSION: The PET LARS ligament show good biocompatibility. Using recipient tissues cover LARS ligament could facilitate its “biolization”. Whether there is bone ingrowth in the bone tunnel of this artificial ligaments should be investigated further.
a: Collagen fibers grew into the inter-fiber of LARS ligament in the group of L-LARS at one month after implantation (×100)

b: Collagen fibers appeared to be more oriented in the group of L-LARS at six months after implantation (×200);

c: No collagen fibers ingrew into the inter-fiber of LARS ligament in the group of LARS at six months after implantation (×100)

Figure 2  Histology of LARS ligament grafts (Hematoxylin-eosin staining)

a: Fibrous connective tissues filled the bone-artificial ligament and grew into the artificial ligament fiber bundles at one month after operation (×100)

b: Fibrous connective tissues encapsulated the LARS ligament at three months after operation (×200)

c: Inflammatory response appeared in bone tunnel in the group of LARS (Arrow indicated megakaryocytes)

d: New woven bone encapsulated partial fibers of LARS ligament at six months after operation (×400)

Figure 3  Histology of bone tunnel of grafts in the groups of LARS and L-LARS (Hematoxylin-eosin staining)

a: Collagen fibers grew into the fiber bundles of LARS ligament at one month after operation in the group of L-LARS (×100)

b: New vessels appeared among the fibers of LARS ligament at three months after operation in the group of L-LARS (×100)

c: The detritus were noted among the fibers of LARS ligament in the bone tunnel at six months after operation in the group of LARS (×100)

Figure 4  Photograph of LARS ligament stained by Masson

Inflammatory response remarkably decreased in the group of LARS (Arrow indicated monocytes)

Figure 5  Histocompatibility of the grafts (×100)


Lavoie P, Fletcher J, Duval N. Patient satisfaction needs as related to knee stability and objective findings after ACL reconstruction using the LARS artificial ligament. Knee 2000; 7(3): 157-163


Fan QB, Fan JF. Zhongguo XiuFu Zhongjian Waike Zazhi 2008; 22 (6):676-679

Figure 6 Ultrastructure of the grafts

a: Among the artificial fiber, the collagen fibers were observed at six months after operation in the group of L-LARS (∼3 000)
b: Among the artificial fiber, many fibroblasts were observed with dilated cisterns in their granular rough endoplasmic reticulum (∼10 000)
c: Among the artificial fiber, many osteoblasts were observed with dilated cisterns in their granular rough endoplasmic reticulum (∼10 000)