Preparation of Cell-implanted Suture with Texturing Processing

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1. INTRODUCTION

Recently, although surgical techniques have greatly changed, the needle and suture have simply been altered to permit more specific subtypes of surgery. The conventional sutures[1] have limitations regarding application to the tissue engineering because of their characteristic compact structure. To address this problem, cell-implanted suture was prepared with poly (lactide-co-glicolide) (PLGA) and it was applied as the scaffold in this study[2].

Firstly, PLGA multifilament was fabricated by conventional melt-spinning process and the fineness of the PLGA filament was 400 deniers consisted of 224 filaments. To modulate the pore characteristics of PLGA fibers, we performed the texturing process in the second step, resulting in the bulky, looping and crimping structures[3]. This process imparts the unique structure of the suture because deformation, caused by the twist, has been set in the fiber. Finally, the cell was seeded and cultured on PLGA bulky suture to apply on tissue therapy.

2. EXPERIMENTAL

2. 1. Suture Preparation

Smart suture was fabricated by adopting three-step procedure. Firstly, We span PLGA(10:90) into filament using multi nozzle by conventional melt-spinning process at 240℃. Secondly, bulky yarn(DTY) was made from POY by draw-false twisting process(texturing process). The POY delivered to a main heater between the 1st roller and the 2nd roller was adjusted to maintain temperature not less than 115℃ during Z-twisting. And then, the Z-twisted POY was delivered to sub heater between the 2nd and the 3rd heater at 100℃ during S-twisting. The numbers of Z and S twists were exactly the same. Additional drawing (Draw ration 1.05) was conducted to enlarge the bulky structure. Considering the convenience of implantation in the living body, the edge area of bulky suture was coated with PLGA.

2. 2. Cell Seeding

NIH 3T3 Fibroblast cell from mouse embryo tissue was seeded and cultured on PLGA suture at seeding density of 1×10^4 cells/cm^2. The density and morphology of cells were analyzed by SEM and fluorescent microscope.

3. RESULTS AND DISCUSSION

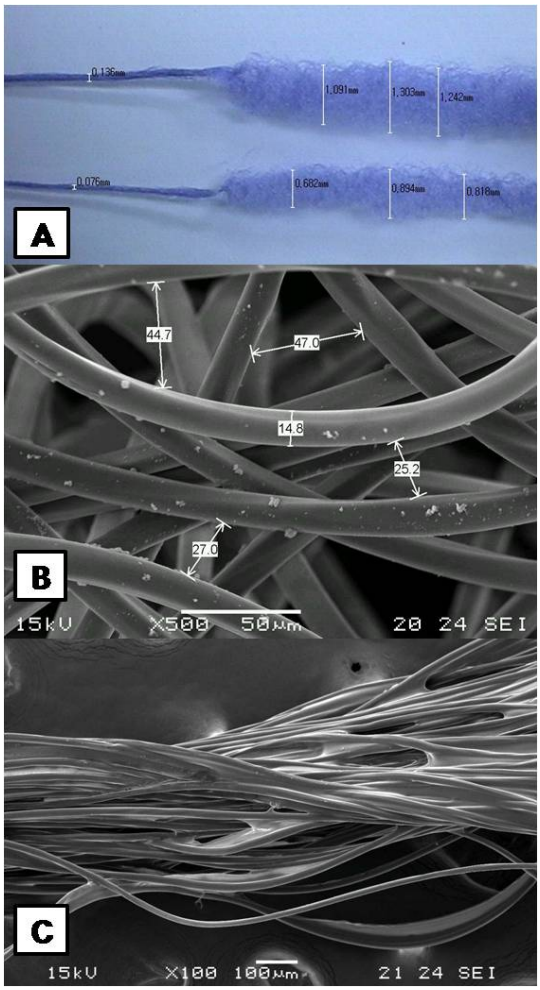

Fig. 1. Configuration of bulky suture. Optical micrograph (A); SEM micrographs of bulky area (B); SEM micrographs of compact area(C).

The developed smart suture showed a unique configuration compared to those of other sutures in Fig. 1(A). Smart suture consisted of 2 parts; bulky area and compact area. The width of bulky part was about 5 times larger than that of compact area. In the architecture of bulky suture, the filaments can hold the cells and the pore between the filaments can offer the sufficient space for cell proliferation.

The average diameter of individual filament of smart suture was 14.3 μm and the mean pore diameter in bulky area was 38.5 μm. Their distribution is disclosed in Fig. 1(B), 2. By analyzing the pore size and distribution, we could observe that developed suture presented a heterogeneous pore structure fitting for cell culturing.

The cell proliferation was measured after 3, 5, 6, and 7 days by using a fluorescent microscope. Fig. 3 showed that NIH 3T3 Fibroblast cell was well attached to the suture, covering the pores between fibers. Also, the density of cells attached to the smart suture increased significantly during incubation and the number of cells increased about 4 times during 7 days incubation in this study.

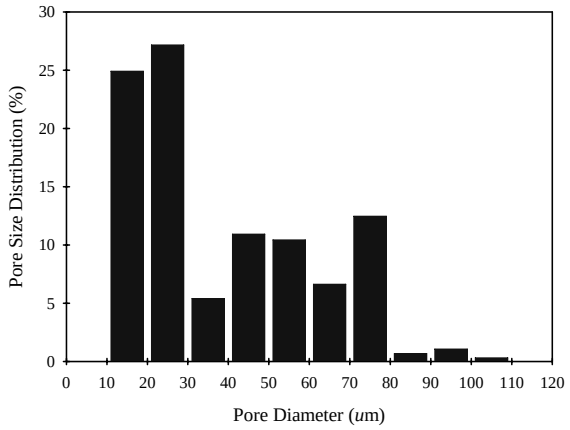

Fig. 2. Pore diameter and Pore size distribution of bulky part of smart suture.

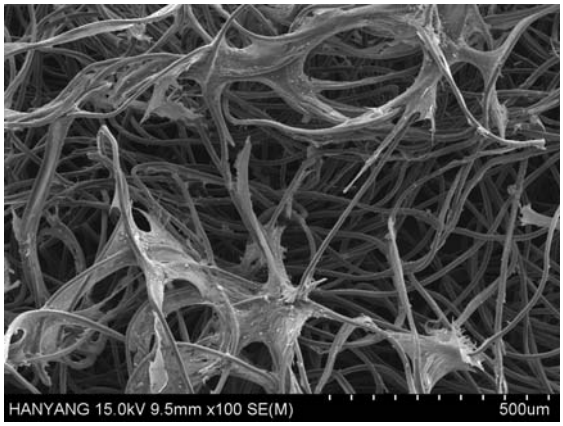

Fig. 3. SEM micrograph of cell-cultured suture(3 days incubation).

4. CONCLUSIONS

Smart suture (cell-implanted suture) was prepared with poly (lactide-co-glicolide). By using melt -spinning and texturing process, we could fabricate microfibrous bulky suture which had heterogeneous macropore. Microfibrous structure has great potentiality as biomimicking architecture for cell growth and maintaining cell functions.

The result of cell seeding showed that pore size, pore distribution, and fiber fineness of sutures were suitable as a biocompatible scaffold in vitro for NIH 3T3 Fibroblast cell. Also, we expect that prepared cell-implanted suture will provide numerous benefits as a noninvasive alternative for tissue engineering applications.

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5. REFERENCE

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