Polymeric Tubular Scaffold Engineered with MSCs for Esophagus Circular Resection Replacement

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Abstract

Congenital esophageal malformations such as severe atresia, and acquired such as malignant esophageal cancer, requires esophagectomy resulting in full thickness resection which cannot be left untreated. The limitations of the current surgical procedures that used autologous conduit highlight a critical need for tissue engineered circular grafts for esophageal wall reconstruction. The present study proposed the development of polymeric tubular scaffold engineered with Mesenchymal Stem cells (MSCs) to promote and speedup regeneration process[1,2,].

Medical grade copolymer Poly-L-lactide-co-poly-ε-caprolactone (PLA-PCL) 70:30 ratio and 85:15 ratio were chosen. Electrospinning apparatus equipped with rotating mandrels was used to collect tubular scaffolds with different tubular geometries (Figure 1 a and b).

Scaffolds were characterized for their morphology and mechanical properties. Morphological analysis performed by SEM and processed by ImageJ software showed that fibers in a nanometer size range (700 ± 0.30nm) were collected using both mandrel types. Using asymmetrical one more aligned fibers were collected in the junction section (Figure 1 c). Mechanical tensile test reported Young's Modulus values for asymmetric tubular scaffold (0.52 ± 0.28 MPa) closer to those obtained for pig's esophagus used as reference control (0.22 ± 0.014MPa).

MSCs from pig bone marrow were used for scaffolds engineering. Different cells seeding methods (vertical and horizontal) were optimized to improve cell adhesion inside cylindrical and asymmetrical scaffolds (Figure 1 d and e). Biological characterization performed by MTT after 7 and 14 days test confirmed that cell viability was always higher than 80% in all scaffolds analyzed. Cells distribution on scaffolds surface was detected by DAPI staining and Scanning Electron Microscopy (SEM) analysis. Horizontal cell seeding methods demonstrated more uniform cell distribution along the whole scaffold surface (Figure 1 f).

The asymmetrical tubular scaffolds geometry resulted to improve mechanical properties compare to cylindrical tubular geometry and compared to explanted pig esophagus. Result could be related also to the higher fibers alignment in asymmetrical tubular scaffolds, induced by higher electrical density of geometry surface.

Image

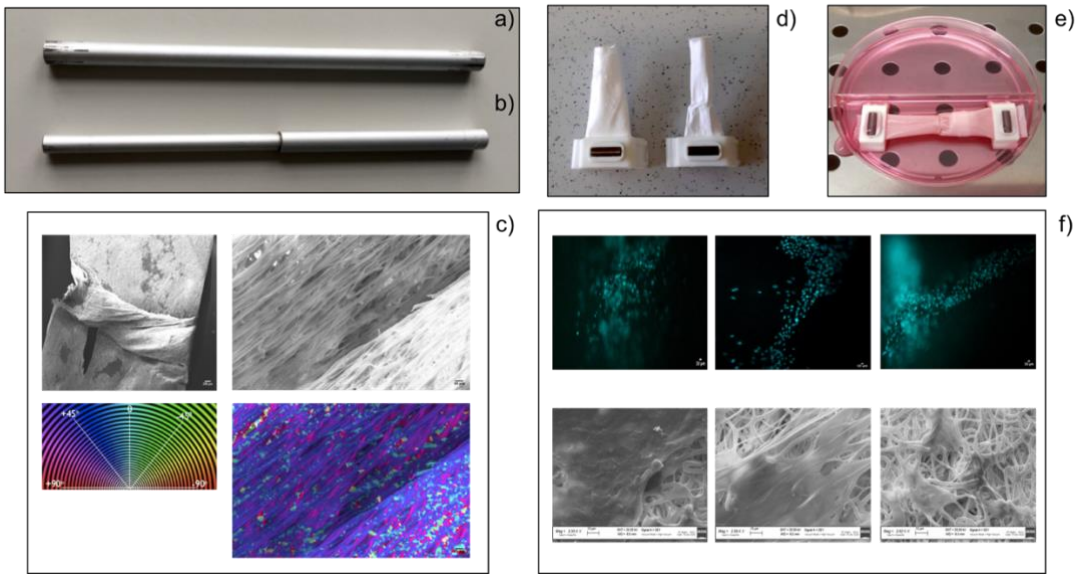


Figure 1: a) cylindrical tubular mandrel; b) asymmetric tubular mandrel; c) morphological characterization and orientation analysis of asymmetric tubular scaffold. Images of tubular asymmetric scaffold incubation: d) vertical cell seeding; e) horizontal cell seeding. f) Dapi staining and SEM analysis of asymmetric tubular scaffold.

Reference:

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Biography:

Silvia Pisani, postdoc at Foundation IRCCS Hospital San Matteo (Pavia- Italy) working on a research project focus on esophageal tissue regeneration using engineered bioscaffolds.

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