3D Polycaprolactone meniscal substitute promotes mesenchymal stem cell adhesion and matrix synthesis

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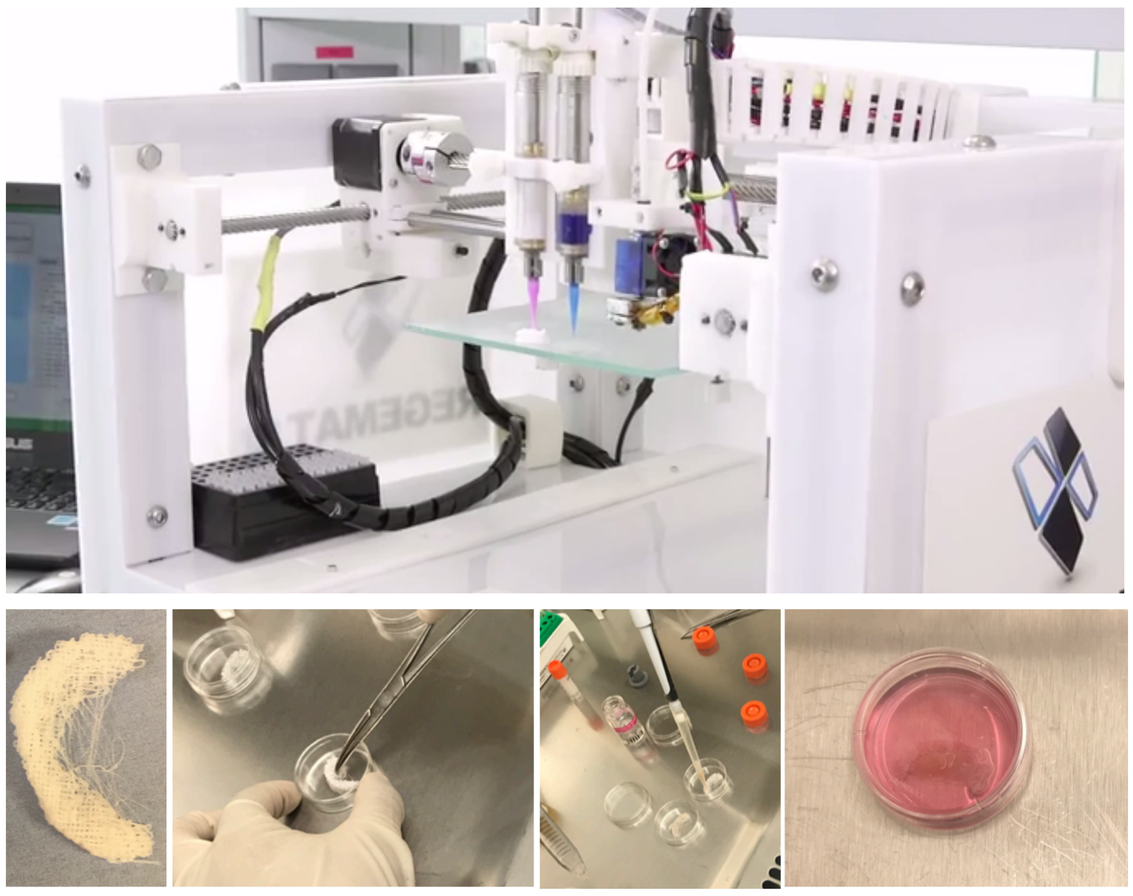
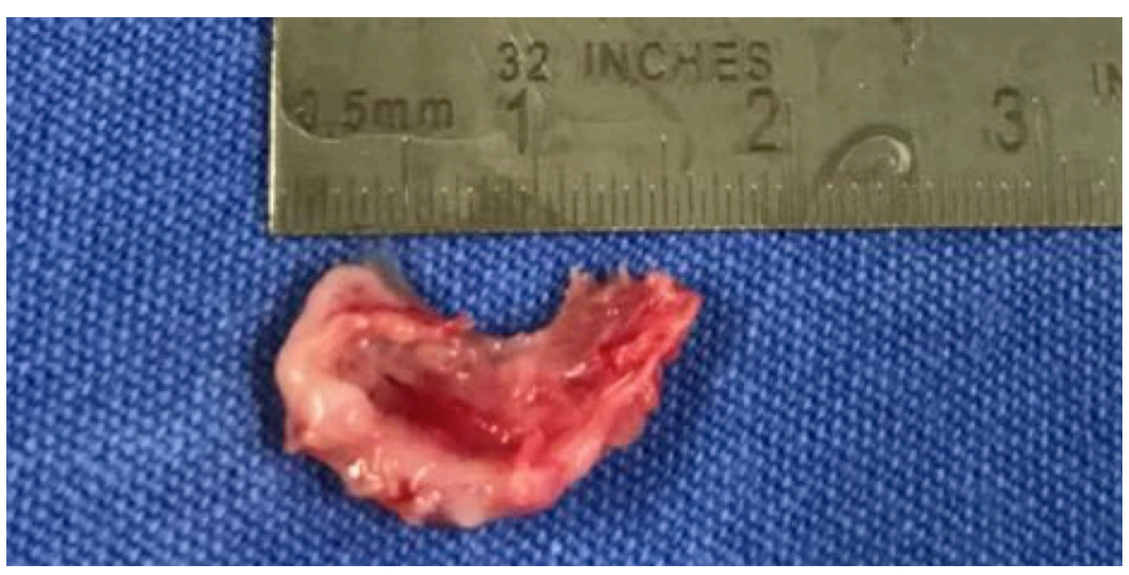
Purpose: To evaluate the biocompatibility and growth potential of 3D-printing polycaprolactone meniscal scaffold to mesenchymal stem cells.

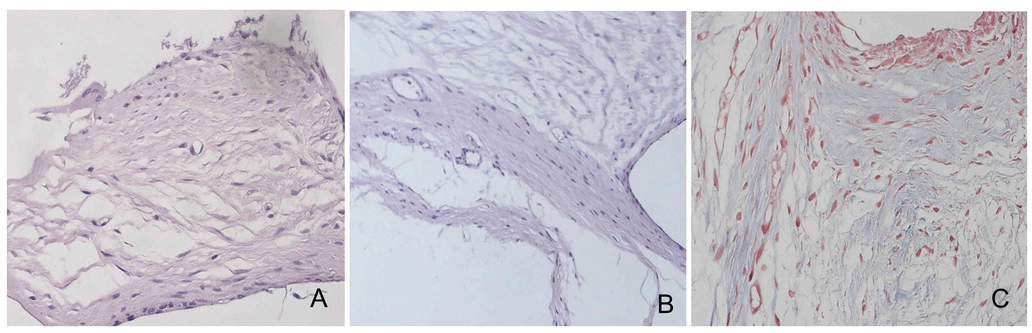
Methods: MRI of a patient was used for segmentation of medial meniscus. A polycaprolactone (PCL) meniscal scaffold was fabricated with a Regemat® 3D printer (Fig. 1) in a 50% scale. MSCs were isolated from bone marrow & characterized by flow cytometry (CD90+, CD73+, CD105+). Cells were cultured in monolayer during 21 days in DMEM + 20% adult human serum, + 1% antibiotic/antimycotics & then seeded in the 3D scaffold during 14-days. The construct was implanted in the subdermic region of the knee in New Zealand white rabbits for 6-weeks. Cell viability assesed with calcein. Histology & immunofluorescence were performed.

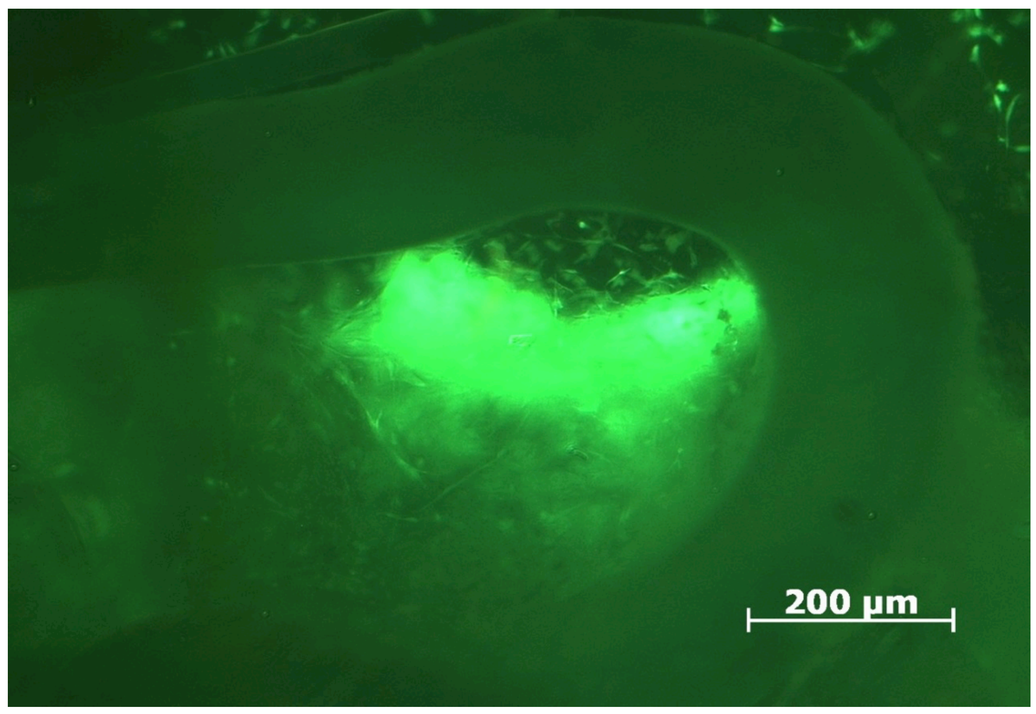


Results: At 14 days of seed and cultured cells with fibroblastic characteristic were observed on the surface and thickness of the meniscus scaffold. Cell viability was established in implant using calcein stain (green).

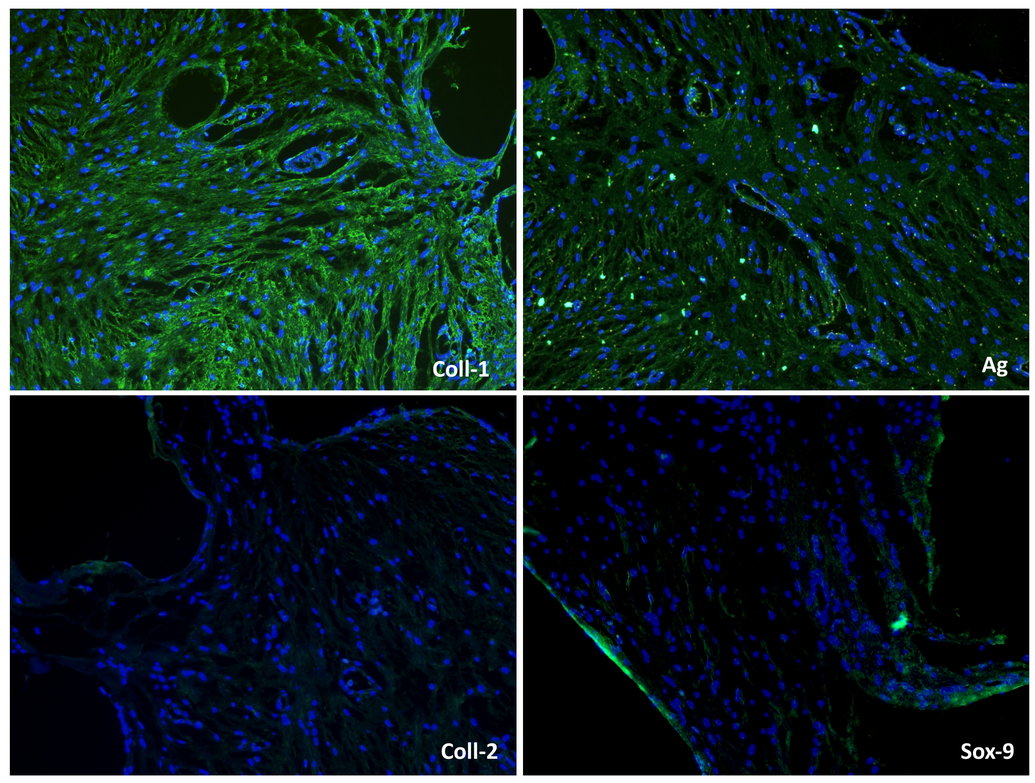


In gross apearance fibrous like-tissue was observed.





Cell viability was observed at 14-days of culture in the PCL meniscal scaffold.



Type-1 collagen & aggrecan expression was positive by immunofluorescence.

Conclusions: 3D-printed polycaprolactone meniscal scaffold showed to be biocompatible to MSCs. MSCs were viable after cultured into 3D-printed scaffold. Fibrocartilage like tissue was formed at 6-weeks of implantation in a biorreactor with positive cartilage proteins expression.

References: 1. Aufderheide, AC, Athanasiou, KA. Comparison of scaffolds and culture conditions for tissue engineering of the knee meniscus. Tissue Eng. 2005;11(7-8):1095-1104. 2. Kang, SW, Son, SM, Lee, JS. Regeneration of whole meniscus using meniscal cells and polymer scaffolds in a rabbit total meniscectomy model. J Biomed Mater Res A. 2006;77(4):659-671. 3. Kweon, H, Yoo, MK, Park, IK. A novel degradable polycaprolactone networks for tissue engineering. Biomaterials. 2003;24(5):801-808.