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Gelatin-Grafted Electrospun Fibrous Membranes for Rotator Cuff Repair

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Summary:
We investigated whether augmented repairs withGelatin-grafted poly(L-lactide) electrospun fibrous membranes could aid the reconstruction of the tendon-bone insertion and will enhance rotator cuff healing

Abstract:
Background: Rotator cuff tears (RCTs) are a common cause of shoulder pain and disability in middle and older age. Despite improvements in the understanding of this disease process and advances in surgical treatment, rotator cuff (RC) repair failure rates remain high. Insufficient healing capacity is likely the main factor for failure of reconstruction.

Materials and methods: We fabricated implantable biodegradable gelatin-grafted poly(Llactide) (PLLA) fibrous membranes using electrospinning technology and evaluated them using in vitro cell proliferation assays. Then, we established chronic rat RCT models and randomly assigned rats into one of three groups. In group 1 (n=48), the detached supraspinatus tendon was repaired to its anatomic footprint (transosseous repair). In groups 2 and 3, the rats underwent transosseous repair and were implanted with either pure PLLA membranes (n=48) or gelatin-PLLA membranes (n=48) to augment the repairs. The animals were killed at 2, 4, and 8 wk postoperatively, which was followed by histomorphometric and biomechanical evaluation.
Results: Histologic observations revealed that gelatin-PLLA membranes have excellent biocompatibility and biodegradability. At 2, 4, and 8 wk postoperatively, the gelatin-PLLA membranes significantly increased the area of glycosaminoglycan staining at the tendon-bone interface compared with the control group ($P < 0.05$) and significantly improved collagen organization, as measured by birefringence under polarized light at the healing enthesis compared with the control and PLLA groups ($P < 0.05$). Biomechanical testing revealed that the gelatin-PLLA group had a greater ultimate load to failure and stiffness than the control group at 4 and 8 wk ($P < 0.05$). The gelatin-PLLA membranes had the highest stress of the healing enthesis.
Conclusions: Local application of gelatin-PLLA fibrous membranes to the healing tendonbone interface after RC repair in a rat chronic RCT model was found to strengthen the healing enthesis, increase the area of fibrocartilage, and improve collagen organization compared with repair alone. Augmentation with gelatin-grafted PLLA may enhance healing after RC repair and might eventually lead to improvement of clinical surgical outcomes.