A novel magnesium-incorporated bioactive artificial ligament for ACL reconstruction

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Abstract:

INTRODUCTION: Artificial ligaments serve as an option for ligament reconstruction surgeries. However, conventional products often lack the ability to assist ligament-bone integration and thus result in bone tunnel widening. A novel magnesium-incorporated bioactive artificial ligament has been herein developed for ACL reconstruction to improve the ligament-bone integration process.

METHODS: The conjugated coaxial electrospinning method was applied to fabricate the bioactive ligament. Characterizations (mechanical testing and Mg^{2+} release testing, etc.), in vitro experiments (cell adhesion, osteogenic differentiation, etc.), and in vivo experiments (ACL reconstruction surgery on rats and goats) were performed.

RESULTS SECTION: The property tests showed that the bioactive ligament could provide reliable tensile properties and sustainable Mg^{2+} release ability. The in vitro experiments showed that the bioactive artificial ligament could enhance cell adhesion as well as osteogenic differentiation, and the in vivo experiments proved that it could promote the ligament-bone integration process, as indicated by the enhanced bone and fibrocartilage formation surrounding the graft.

DISCUSSION: A novel magnesium-incorporated bioactive artificial ligament has been successfully developed for ACL reconstruction. The product demonstrated the potential in promoting the ligament-bone integration process and provided a promising alternative to graft selection in ACL reconstruction.

SIGNIFICANCE/CLINICAL RELEVANCE: The product showcased the capability to facilitate the process of ligament-bone integration and offered a hopeful substitute for graft choice in ACL reconstruction.

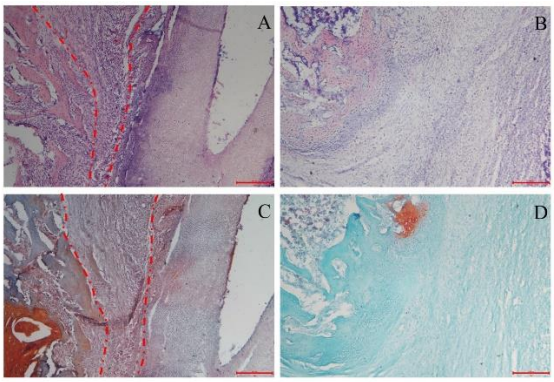

Figure 1. (A, B) HE staining of the tibial tunnels of ACL reconstructed rats 3 and 6 weeks postoperatively, respectively; (C, D) SOFG staining of the tibial tunnels of ACL reconstructed rats 3 and 6 weeks postoperatively, respectively. (Bar: 200μm)

Figure 2. General image showing the reconstructed ACL in the goat knee 6 weeks postoperatively.