

The Advantages of Attached Semitendinosus Tendon Graft Applied in Anterior Cruciate Ligament Reconstruction in a Rabbit Model

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I HAVE NO FINANCIAL CONFLICTS TO DISCLOSE



Background

The semitendinosus tendon graft with intact tibial insertion has sustainable blood supply and might be beneficial for graft maturation following anterior cruciate ligament reconstruction (ACLR); however, its potential advantages for graft tendon-bone healing is still unclear.

Methods

Sixty-four healthy New Zealand white rabbits underwent unilateral ACLR with semitendinosus tendon autograft after random enrollment into two groups (Study group: thirty-two rabbits with semitendinosus tendons preserved tibial insertion. Control group: thirty-two rabbits with free semitendinosus tendons). At week 3, 6, 12, and 24 postoperative, 8 rabbits in each group were killed respectively to evaluate the tendon-bone healing by histological staining, micro-CT examination, and biomechanical test.

Results—Histological staining

The grafts in study group maintained similar cell count with no signs of necrosis or hypocellularity across all time points, but the grafts in control group underwent a characteristic stage of necrosis at week 3 and 6 postoperative. (Figure 1)

Sharpey-like fibers were observed from 3 weeks postoperative at tendon-bone interface in study group, and a normal-insertion-like structure was formed at week 12, which became more mature at week 24. While in control group, Sharpey-like fibers could not be observed until week 12 postoperative, and a normal transition through cartilage from bone to tendon was not observed at any time points. (Figure 2)

Histological scores of tendon-bone interface in study group were significantly higher than those in control group at week 6, 12, and 24 postoperative ($P = 0.04, 0.00, 0.04$).

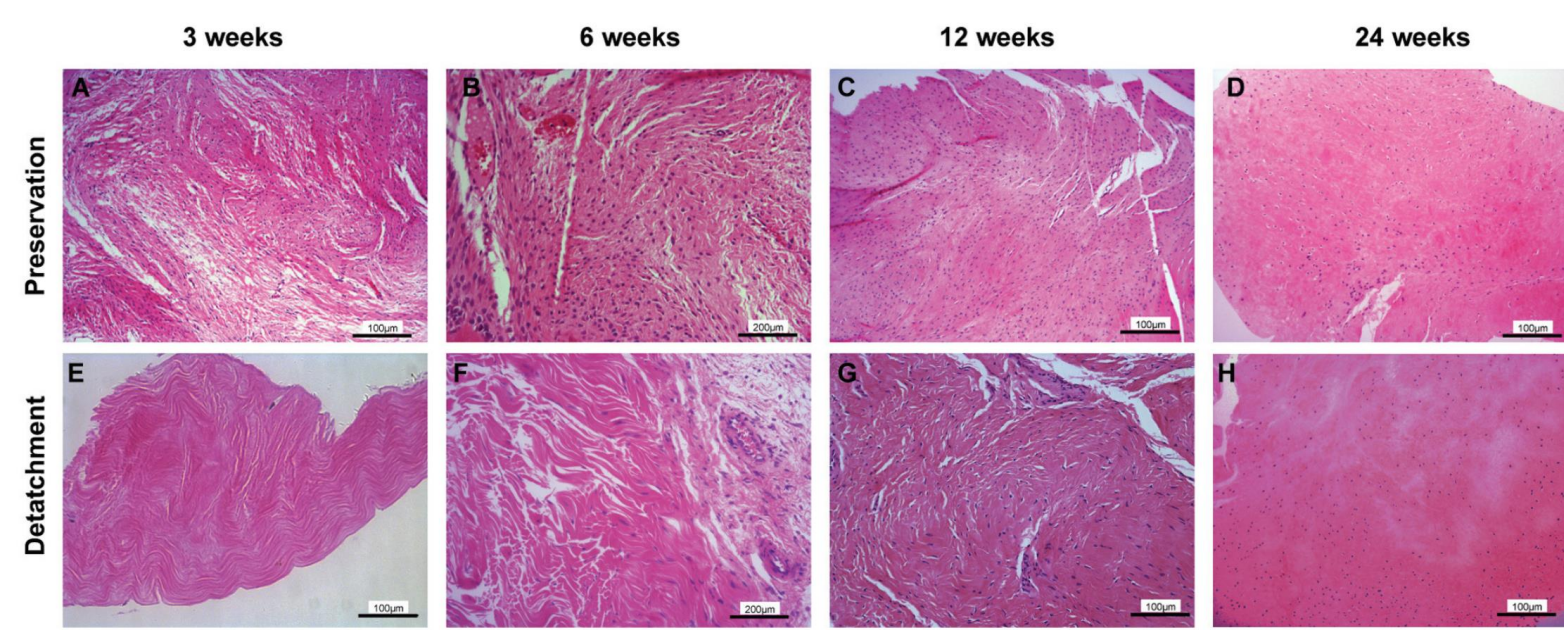
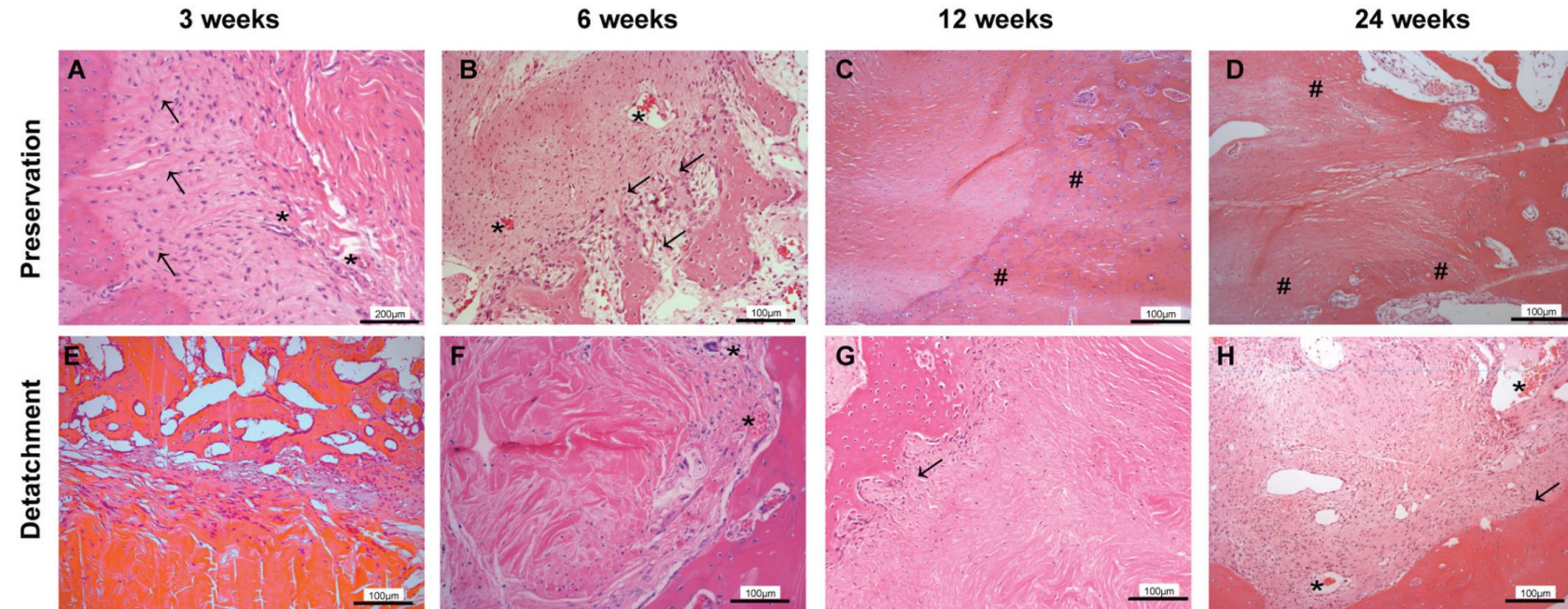


Figure 1. Hematoxylin and eosin staining of the intra-articular portion of (A-D) insertion-preserved and (E-H) insertion-detached grafts at weeks 3, 6, 12, and 24, respectively. (A-D)

Figure 2. Hematoxylin and eosin staining of the tendon-bone interface of (A-D) insertion-preserved and (E-H) insertion-detached grafts at weeks 3, 6, 12, and 24, respectively. Arrow (→), Sharpey-like collagen fibers; asterisk (*), vessels; hash (#), cartilage.



Results—microCT & biomechanical test

Compared to the control group, the study group was shown on micro-CT to have a significantly smaller bone tunnel area at week 6 postoperative ($P = 0.01$) and larger bone volume/total volume values at week 3 and 6 ($P = 0.00, 0.01$). (Figure 3)

Also, the study group had a significantly higher failure load at week 12 and 24 ($P = 0.03, 0.03$) and a significantly higher stiffness at week 24 ($P = 0.00$) than the control group. (Figure 4)

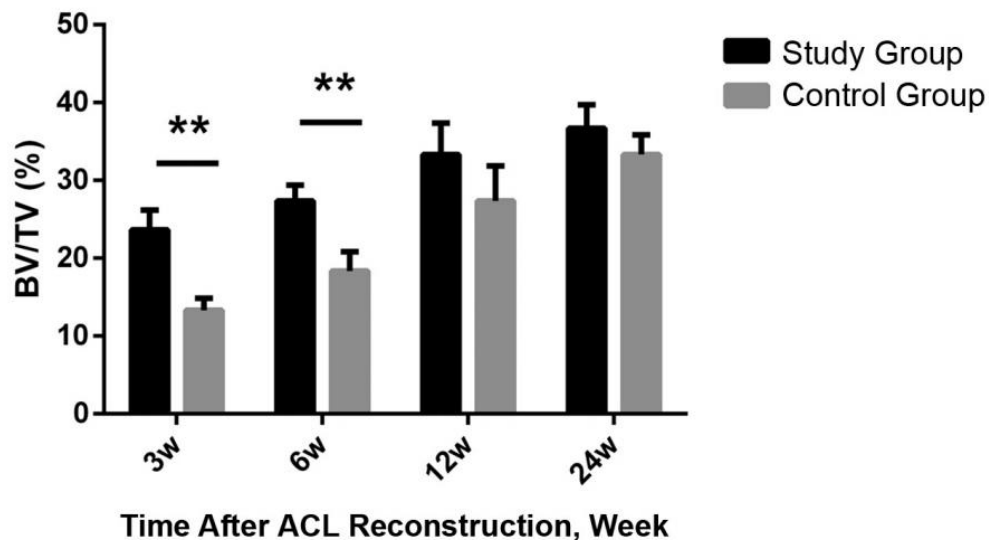
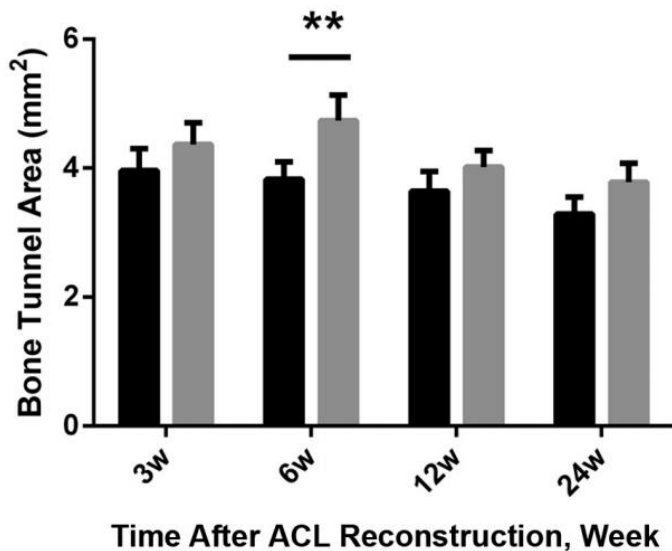


Figure 3. Bone tunnel areas and bone volume/total volume (BV/TV) in the study (preserved) and control (detached) groups at weeks 3, 6, 12, and 24. Values are presented as mean \pm SD. **P < .01. ACL, anterior cruciate ligament.

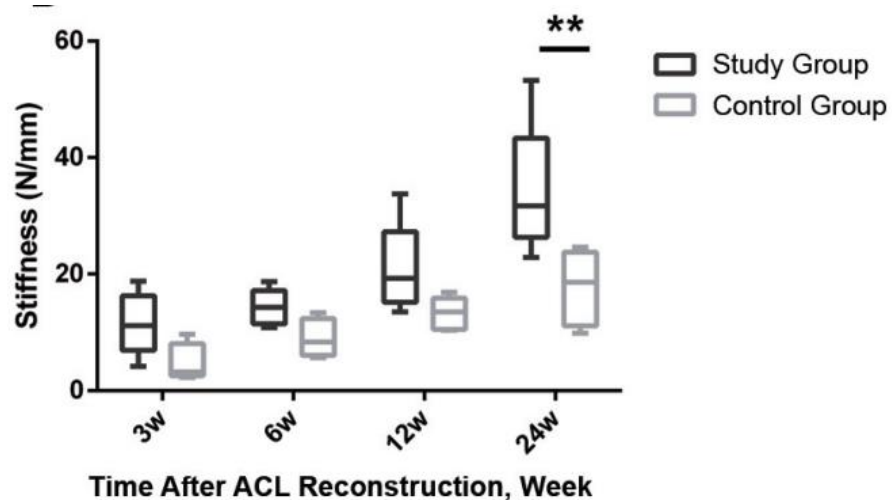
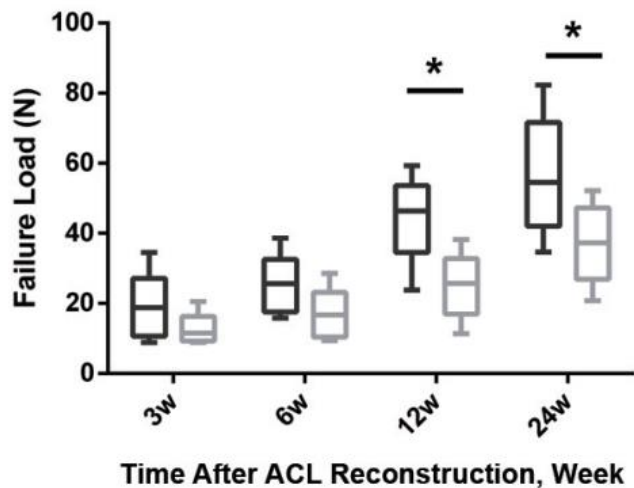


Figure 4. Maximum failure load and stiffness in the study (preserved) and control (detached) groups at weeks 3, 6, 12, and 24. Values are presented as mean \pm SD, and 95% CI. *P < .05. **P < .01.

Conclusion

The semitendinosus tendon graft with an intact tibial insertion in ACLR would bypass the graft avascular necrosis stage, which improves tendon-bone healing and biomechanical strength.

References

1. Liu S, Li H, Tao H, Sun Y, Chen S, Chen J. A randomized clinical trial to evaluate attached hamstring anterior cruciate ligament graft maturity with magnetic resonance imaging. *Am J Sports Med.* 2018;46(5): 1143-1149.
2. Papachristou G, Nikolaou V, Efstathopoulos N, et al. ACL reconstruction with semitendinosus tendon autograft without detachment of its tibial insertion: a histologic study in a rabbit model. *Knee Surg Sports Traumatol Arthrosc.* 2007;15(10):1175-1180.
3. Zaffagnini S, Golano P, Farinas O, et al. Vascularity and neuroreceptors of the pes anserinus: anatomic study. *Clin Anat.* 2003;16(1):19-24.