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ACL regeneration and osteointegration using a new silk fiber-based scaffold: Results from a study in sheep

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Because of ongoing limitations with ACL reconstruction, new approaches in the treatment of ACL injuries, in particular strategies based on tissue engineering have gained increasing research interest. To allow ACL regeneration, a structured scaffold which provides the mechanical basis, cells from different sources, and mechanical as well as biological factors are needed. The optimal scaffold for ACL regeneration is regarded to be biocompatible and biodegradable to allow tissue ingrowth, but also needs to have the right mechanical properties to provide immediate mechanical stability.

Hypothesis: A degradable silk-fiber based scaffold with mechanical properties similar to the native ACL is able to initiate ligament regeneration and osteointegration after ACL resection and reconstruction under in-vivo conditions.

Methods: Thirty-three mountain sheep underwent ACL resection and randomization to two experimental groups: 1) ACL reconstruction with scaffold alone (SA), 2) ACL reconstruction with cell-seeded scaffold (CS). Histological evaluation of the intra-articular portion of the reconstructed/regenerated ligament was performed after six and twelve months. Additional bone histology was performed to assess osteointegration.

Results: After six months, connective tissue surrounded the silk scaffold with ingrowth in some areas. The cell seeded scaffolds had significant lower silk content compared to the unseeded scaffolds and demonstrated higher content of newly formed tissue. After twelve months, the density of the silk fibers decreased significantly, and the ingrowth of newly formed tissue increased in both groups. No differences between the two groups regarding the silk fiber degradation as well as the regenerated tissue were detected anymore at twelve months. Bone histology revealed good osteointegration after 12 months.

Conclusions: The novel silk-fiber based scaffold was able to stimulate ACL regeneration as well as osteointegration under in-vivo conditions. Additional cell seeding lead to increased tissue regeneration and decreased silk-fiber content after 6 months, whereas these differences diminished after twelve months.

Biography

Thomas Nau has completed his MD from Karl-Franzens University Graz, Austria and his specialist orthopaedic trauma training at the Medical University of Vienna, Austria. As academic surgeon he is an Adjunct Professor at the LBI for Experimental and Clinical Traumatology, Austrian Cluster for Tissue Regeneration where he is directing the bone and ligament regeneration group. He is a Consultant Orthopaedic Surgeon at American Hospital Dubai.

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