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ORIGINAL PAPER

The biomechanics of biodegradable versus titanium interference screw fixation for anterior cruciate ligament augmentation and reconstruction

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Abstract
Purpose The ligament augmentation and reconstruction system (LARS) is one of the options available for anterior cruciate ligament (ACL) reconstruction. To date, however, there are no published data regarding the biomechanical properties of LARS fixation for ACL reconstruction. The aim of this study was to investigate the biomechanical properties of various LARS interference-screw fixations.
Methods A total of 100 LARS ligaments were fixed in porcine femurs with five different interference screws (four biodegradable screws and one titanium interference screw) introduced from inside-out or extra-articularly outside-in. Each group consisted of ten specimens. The constructs were cyclically stretched and subsequently loaded until failure. We evaluated the maximum load before failure, elongation during cyclic loading, stiffness, and failure mode.
Results Elongation during cyclical loading for all devices tested was significantly larger between the first and 20th cycles than between the 20th and 500th cycles ($p<0.05$). Maximum failure load was not significantly lower for the biodegradable screws than for the titanium screws ($p>0.05$). All specimens failed because of ligament pull-out from the bony tunnel.
Conclusions Our findings suggest that biomechanical secure fixation of the LARS for ACL reconstruction can be achieved using either biodegradable or titanium interference screws. The stability of fixation is independent of the approach, type of investigation, and type of fixation (extra-articular outside-in or intra-articular inside-out).

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Keywords LARS · ACL reconstruction · ACL biomechanics · Interference screw

Introduction

The ligament augmentation and reconstruction system (LARS; Surgical Implants and Devices, Arc-sur-Tille, France), which consists of polyethylene terephthalate (PET), has been available for anterior cruciate ligament (ACL) reconstruction for two decades [19]. This synthetic material was popular for ACL reconstruction during the early 1990s. After problems associated with the material were reported, however, interest and application waned significantly [6, 19]. Currently, interest in PET devices has arisen once again, particularly in Australia and Asia [7, 14], as problems such as synovitis and tendon ruptures are no longer being reported. Applications of new material have been proposed. To date, however, clinical and biomechanical data for this device are sparse. To our knowledge, in the only prospective randomized trial comparing LARS to bone–patellar tendon–bone (BPTB) ACL reconstruction, no differences were found in clinical outcomes with regard to complications and failure rates [13]. The proponents of this device claim faster rehabilitation, lack of donor-site morbidity, and reduced operating time. The LARS consists of intra-articular and extra-articular sections, the former consisting of single free fibres. Potential advantages include resistance to fatigue and a porous surface, which may facilitate osseous integration [14]. In contrast to the intra-articular portion of the device, the extra-articular portion is composed of knitted fibers combined with longitudinal fibers, which are designed to provide strength and resistance to elongation [14].