Knotless Tape Suture Fixation of Quadriceps Tendon Rupture: A Novel Technique

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Take-Home Points

- Knotless tape suture fixation of the quadriceps tendon is biomechanically superior to traditional fixation techniques.
- When passing locking Krackow stitches, be sure to take all slack out with each pass.
- Consider double tapping the patella pilot holes prior to placing anchors, as the bone is very hard.
- Palpate the articular surface of the patella when drilling pilot holes for safe placement.
- Perform an adequate retinacular repair to complete the repair.

Quadriceps tendon rupture is an uncommon yet potentially devastating knee injury with an estimated incidence of 1.37 in 100,000.1 It most often occurs in male, middle-aged or older patients with degenerative tendon changes and serious systemic diseases, such as chronic renal failure, diabetes mellitus, rheumatoid arthritis, and disorders requiring long-term steroid use (tissue quality is often compromised by patient age and comorbidities).2-10 Whereas partial tears with an intact extensor mechanism may be managed nonoperatively, prompt operative intervention is indicated in cases of complete tear or an incompetent extensor mechanism to facilitate early range of motion (ROM) and return of knee function.2,4,8,9

The standard of care is repair with a nonabsorbable suture passed through transosseous patellar tunnels, often with several weeks of postoperative immobilization to protect the repair.3,4,7,10-12 Reported complications of this method include significant extension lag, decreased strength, and ROM compared with the contralateral knee, chronic pain, and iatrogenic patellar fracture.8,13-18 Repair techniques using suture anchors have been proposed as viable alternatives, but biomechanical studies comparing them with standard transosseous repair have reported mixed results.7,10,12,18-20 Two studies found improved biomechanical characteristics with suture anchors,10,21 but 2 others found the characteristics of suture anchor fixation equal to11 or worse than12 those of transosseous fixation.
In light of the controversy regarding strength and clinical outcomes of suture anchor repair compared with transosseous repair, new and potentially superior surgical interventions should be considered.

We recently completed a cadaveric study comparing the biomechanical properties of a novel quadriceps tendon repair technique using 4.75-mm biocomposite knotless suture anchors with suture tape and the properties of conventional techniques using either transosseous or suture anchor repair alone. In the cadaveric model, compared with transosseous and fully threaded suture anchor techniques, repair of quadriceps tendon ruptures with this knotless suture anchor with suture tape technique was biomechanically superior in cyclic displacement, construct stiffness, and ultimate load to failure. Additionally, this method allows for less extensive dissection, shorter operative times, and the potential for earlier and more aggressive rehabilitation protocols. We propose this technique, presented in this article, as a superior alternative to traditional quadriceps tendon repair techniques.

**Technique**

The patient is placed in supine position with a tourniquet placed on the proximal thigh. A midline incision is made from the proximal pole of the patella, proximally by 5 cm. A combination of sharp and blunt dissection is performed through skin and subcutaneous tissues down to the extensor mechanism, exposing the proximal pole of the patella and the torn quadriceps tendon.

The distal aspect of the quadriceps tendon is then débrided of any devitalized tissue and secured with an Allis clamp. A long tape suture (FiberTape; Arthrex) is then used to place a locking Krackow stitch in a distal-to-proximal and then proximal-to-distal direction for 5 throws in each direction within the quadriceps tendon, with the tails exiting distally at the tear site. Care is taken with each pass to ensure that there is no slack within the system.

The proximal pole of the patella is then prepared by débriding any remaining soft tissue back to an area of exposed subcortical bone, which is débrided to a bleeding bony bed. Holes are drilled in the medial and lateral thirds of the patella at the proximal pole using the drill for 4.75-mm biocomposite knotless suture anchors (SwiveLock; Arthrex). The tap for the 4.75-mm anchors is then passed at each guide hole. In hard bone, double-tapping is recommended.

Next, the medial strand of tape suture is loaded within a 4.75-mm biocomposite knotless suture anchor eyelet and reduced to the patella. The medial anchor is malleted and screwed into place, while tension is kept on the lateral strand with the knee in full extension. The lateral strand is then placed into its 4.75-mm biocomposite knotless suture anchor, reduced to the patella, and then malleted and screwed into place in the lateral hole, thereby completing the core portion of the repair (Figures A-D). The core strands from the 4.75-mm biocomposite knotless suture anchors are then back-passed in mattress fashion and tied, and medial and lateral retinacular repairs are then performed using supersuture tape (SutureTape or FiberWire; Arthrex).

After surgery, the patient is placed in a knee brace locked in full extension and allowed to weight-bear as tolerated using crutches. During the first week, knee ROM is allowed up to 30°. During weeks 2 to 6 passive ROM is gradually increased to 90°, and use of crutches is tapered. At week 6 the brace is unlocked for ambulation; it may be discontinued after 7 to 8 weeks or when determined safe. Light activity is permitted from month 4 to month 6. A patient who achieves satisfactory strength, is clinically examined, and progresses through rehabilitation is allowed to return to fully unrestricted sport.
讨论

股四头肌腱断裂是一个不常见的临床实体，需要早期手术管理。标准护理是通过转孔技术传递不可吸收缝线，但与缝线锚修复的修复有争议。这可能允许较少的组织损伤，减少手术时间，安全的早期康复方案，减少风险的髌骨骨折或损伤。3,7,10-12,18-20,21,23 尽管这些潜在优势，生物力学研究已经产生不一致的结果，关于转孔修复与缝线锚修复的优越性。7,10-12,18-20 我们建议股四头肌腱修复使用4.75毫米生物复合材料无结锚与缝线带技术作为生物机械上更优越的替代方案，无论是转孔的还是单独的缝线锚修复，与生物机械相比，显著的优势在和出手术室。

生物力学研究表明，转孔修复和标准缝线锚修复在结果上有所分歧，尽管他们研究方法和端点的异质性使得直接比较困难。7,10-12,18-20 Petri和同事10和Sherman和同事21报告了统计显著更高的负载到失败10和减少的周期加载10,21期间的间隙与缝线锚修复相对转孔修复。然而，Hart和同事12发现，修复用缝线锚降低了极限拉力，他们得出结论，转孔修复更优。Lighthart和同事11没有显著差异的早期和晚期的移动，和在转孔修复。在我们的解剖生物力学研究中，一个全新的4.75毫米生物复合材料无结锚与缝线带技术被与传统3隧道转孔修复和标准2锚缝线锚修复比较。22统计显著的优越性被发现在一个多参数，包括初的腱位移动，刚度，和极限的负载到失败（与5.5毫米生物复合材料完全螺纹缝线锚修复），以及初期和晚期的移动，刚度，和极限的负载到失败（与转孔修复）。22

虽然结论很难直接比较，但我们的研究结果清晰的表示出，4.75毫米生物复合材料无结锚与缝线带技术修复与早期修复及制作一个潜在的更有利于生物力学的修复技术。22

同样地，标准的修复与缝线锚，修复使用4.75毫米生物复合材料无结锚与缝线带技术，这消除了需要暴露髌骨的远端。7,10-12,21这允许一个更小的手术切口，更少的组织的破坏，和防止可能的干扰与髌骨腱。7,10-12,21

此外，它消除了因穿刺髌骨和转孔导致的髌骨的损伤和髌骨的表面。17,18 我们的回顾性研究与我们的4.75毫米生物复合材料无结锚与缝线带技术，以及研究的修复在关节内表面钻孔的转孔隧道。17,18 两组患者的结局表明，4.75毫米生物复合材料无结锚与缝线带技术比转孔修复，有显著的运转成功。21更短的手术时间，和更小的手术切口对于这些有医疗合并症的患者是有利的。

康复协议对于股四头肌腱修复是争议的。多项研究的修复转孔髌骨隧道描述了6周固定，但最近有推动早期运动。7,13,23,24 报告的长期的固定包括有限的屈曲，疼痛，力量，下降的髌骨的移动和髌骨的下移。14 研究表明，过度的加载可以引起间隙的形成，和削弱修复，一些控制的运动是必要的来恢复肌肉的强度和防止进一步的损伤。23,25 并且减少僵硬和萎缩的风险。14 4.75毫米生物复合材料无结锚与缝线带技术的生物力学特性，允许早期的安全的运动和减少的康复时间。
exercises and accelerated rehabilitation protocols.

In our early experience with this technique, functional outcomes have been excellent. A formal 2-year outcome study of patients who have undergone quadriceps tendon repair with this 4.75-mm biocomposite knotless suture anchor with tape suture technique is under way.

**Key Info**

**Figures/Tables**

Figures / Tables:

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**References**

**References**


**Multimedia**

**Product Guide**

- **STRATAFIX™ Symmetric PDS™ Plus Knotless Tissue Control Device**
- **STRATAFIX™ Spiral Knotless Tissue Control Device**
- **BioComposite SwiveLock Anchor**
- **BioComposite SwiveLock C, with White/Black TigerTape™ Loop**

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