

Relationship of Surgical Technique and Bony Morphology on Anterior Cruciate Ligament (ACL) Failure

Effect of Surgical Volume on Surgical Technique

Akademisk avhandling

Som för avläggande av medicine doktorsexamen vid Sahlgrenska akademien, Göteborgs universitet kommer att offentligens försvaras i R-aulan Sahlgrenska Universitetssjukhuset, Mölndal

Måndagen den 13 maj 2024, kl. 09.00
av

Jonathan D. Hughes

Fakultetsopponent:
Professor Gilbert Moathse
Universitetet i Oslo, Norge

Avhandlingen baseras på följande delarbeten

- I. Byrne K, Hughes JD, Gibbs CM, Vaswani R, Meredith SJ, Popchak AJ, Lesniak BP, Karlsson J, Irrgang JJ, Musahl V. "Non-Anatomic Tunnel Position Increases the Risk of Revision Anterior Cruciate Ligament Reconstruction." *Knee Surg Sports Traumatol Arthrosc.* 2022 Apr;30(4):1388-1395. doi: 10.1007/s00167-021-06607-7. <https://doi.org/10.1007/s00167-021-06607-7>
- II. Hughes JD, Gabrielli AS, Dalton JF, Raines BT, Dewald D, Musahl V, Lesniak BP. "More anterior placement of femoral tunnel position in ACL-R is associated with postoperative meniscus tears." *J Exp Orthop.* 2023 Jun 30;10(1):66. doi: 10.1186/s40634-023-00630-y. <https://doi.org/10.1186/s40634-023-00630-y>
- III. Hughes JD, Gibbs CM, Almast A, Atte A, Sansone M, Karlsson J, Musahl V. "More Anatomic Tunnel Placement for Anterior Cruciate Ligament Reconstruction by Surgeons with High-Volume Compared to Low-Volume." *Knee Surg Sports Traumatol Arthrosc.* 2022 Jun;30(6):2014-2019. doi: 10.1007/s00167-022-06875-x. <https://doi.org/10.1007/s00167-022-06875-x>
- IV. Godshaw BM, Hughes JD, Lucidi GA, Setliff J, Sansone M, Karlsson J, Musahl V. "Posterior Tibial Plateau Impaction Fractures Are Not Associated With Increased Knee Instability: A Quantitative Pivot Shift Analysis." *Knee Surg Sports Traumatol Arthrosc.* 2023 Jul;31(7):2998-3006. doi: 10.1007/s00167-023-07312-3. <https://doi.org/10.1007/s00167-023-07312-3>
- V. Hughes JD, Boden RA, Belayneh R, Dvorsky J, Mirvish A, Godshaw BM, Sansone M, Karlsson J, Musahl V. "Smaller Intercondylar Notch Size is Associated with Graft Failure after Anterior Cruciate Ligament Reconstruction." *Orthop J Sports Med* 2024. In Press.
- VI. Setliff JC, Nazzal EM, Drain NP, Herman ZJ, Mirvish AB, Smith C, Lesniak BP, Musahl V, Hughes JD. "Anterior cruciate ligament reconstruction with all-soft tissue quadriceps tendon versus quadriceps tendon with bone block." *Knee Surg Sports Traumatol Arthrosc.* 2023 Jul;31(7):2844-2851. doi: 10.1007/s00167-022-07254-2. <https://doi.org/10.1007/s00167-022-07254-2>

SAHLGRENKA AKADEMIN
INSTITUTIONEN FÖR KLINISKA VETENSKAPER



Relationship of Surgical Technique and Bony Morphology on Anterior Cruciate Ligament (ACL) Failure

Effect of Surgical Volume on Surgical Technique

Jonathan D. Hughes

Department of Orthopaedics, Institute of Clinical Sciences, Sahlgrenska akademien, Göteborgs universitet, Sverige.

Abstract

Anterior cruciate ligament (ACL) injuries are becoming increasingly common and can have a detrimental effect on patients and their activities. While various non-modifiable and modifiable risk factors for ACL injuries and ACL graft failures have been identified, failure rates still remain unacceptably high, possibly due to un-identified patient bony morphological factors as well as surgical technique and expertise. The overall aim of this thesis was to identify technical and previously unknown bony morphological risk factors for ACL tears and ACL graft failure.

Study I evaluated the relationship of femoral tunnel position and risk of revision ACL reconstruction. This study found an increased risk of revision ACL reconstruction in patients with more anterior and proximal (high) femoral tunnels. Additionally, in those patients undergoing revision ACL reconstruction, patients who had a non-traumatic failure had more anteriorly-placed femoral tunnels than those patients who had a traumatic failure. Study II assessed femoral and tibial tunnel position after ACL reconstruction and risk for recurrent or de novo meniscus tears postoperatively. This study found an increased risk of recurrent or de novo meniscus tears after index ACL reconstruction in patients with anteriorly-placed femoral tunnels. Study III examined how surgeon volume effected femoral and tibial tunnel placement after ACL reconstruction. This study showed low-volume surgeons placed their femoral and tibial tunnels significantly more anterior and proximal (high) and posterior, respectively, during ACL reconstruction compared to high-volume surgeons. Study IV investigated the role of posterolateral tibial plateau fractures on rotatory knee laxity after ACL injury. This study found that posterolateral tibial plateau impaction fractures did not significantly increase rotatory knee laxity based on subjective and objective peri-operative examination. Study V evaluated the role of the intercondylar notch width with ACL graft failure. This study found an intercondylar notch size less than 16mm had an odds ratio of 5.0 for ACL graft failure, while an intercondylar notch size less than 15mm had an odds ratio of 5.6 for ACL graft failure. Study VI compared patient-reported and clinical outcomes in patients undergoing ACL reconstruction with all soft tissue quadriceps tendon autograft (sQT) and quadriceps tendon autograft with bone graft (bQT). This study found no difference in patient-reported outcomes, clinical outcomes, nor time and rate of return to sport between patients undergoing ACL reconstruction with sQT compared with bQT. The rate of ACL graft failure was 5% and 6% in the sQT and bQT groups, respectively.

The main findings of this thesis are tunnel position and surgeon volume can affect postoperative outcomes and failure rates after ACL reconstruction, there are equivalent outcomes between sQT and bQT autografts in ACL reconstruction, posterolateral tibial plateau fractures and intercondylar notch width do not affect clinical outcomes, and a smaller intercondylar notch width is associated with increased ACL graft failures. These findings will assist the treating surgeon in providing an individualized approach to anatomic ACL reconstruction while avoiding pitfalls that may lead to postoperative complications including ACL graft failure.

Key Words: ACL reconstruction, tunnel position, failure, surgeon volume, quadriceps tendon, notch width