



Original article

Prediction of flexor tendon graft diameter in reconstruction of the anterior cruciate ligament by means of magnetic resonance imaging[☆]



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ABSTRACT

Objective: To evaluate the diameter of the flexor tendons in preoperative magnetic resonance imaging (MRI) examinations and compare this with the diameter of the graft obtained intraoperatively.

Methods: This was a retrospective longitudinal epidemiological study. Forty-four patients were eligible for the study and their MRI examinations and surgical data were evaluated. The tendons were measured on MRI across their largest diameter in the axial plane, using the medial epicondyle of the femur as the slice level. In the surgery, routine graft preparation was performed, consisting of folding the gracilis and semitendinosus tendons to form a four-strand graft. Its measurement was recorded.

Results: To evaluate the association between the variables, Pearson's correlation coefficient was estimated. A significant correlation was found between the measurements of the gracilis and semitendinosus tendons and the final diameter of the graft ($p < 0.001$). A ROC curve was fitted to the sum of the tendon diameters in order to determine a cutoff point associated with the graft diameter (≤ 8 mm or > 8 mm). If the sum was greater than 5.28 mm, the chance of obtaining a graft larger than 8 mm would be 75%.

Conclusion: Measurement of the diameters of the gracilis and semitendinosus tendons through a preoperative MRI examination is a simple and effective way to predict the final size of the graft to be used in ACL reconstruction surgery.

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Predição do diâmetro do enxerto dos tendões flexores na reconstrução do ligamento cruzado anterior por meio da ressonância nuclear magnética

R E S U M O

Palavras-chave:

Ligamento cruzado anterior
Reconstrução do ligamento cruzado anterior
Espectroscopia de ressonância magnética
Procedimentos ortopédicos

Objetivo: Avaliar o diâmetro dos tendões flexores em exames de ressonância magnética (RNM) pré-operatória e comparar com o diâmetro do enxerto obtido no ato intraoperatório.
Métodos: Em um estudo epidemiológico longitudinal retrospectivo, 44 pacientes foram elegíveis ao estudo e tiveram os exames de RNM e dados de cirurgias avaliados. Os tendões foram medidos na RNM no seu maior diâmetro no plano axial com o uso do epicôndilo medial do fêmur como nível de corte. Na cirurgia foi feito preparo de rotina do enxerto, dobraram-se os tendões grácil e semitendinoso, formou-se um enxerto quádruplo que teve sua medida registrada.

Resultados: Para a avaliação da associação entre as variáveis foi estimado o coeficiente de correlação de Pearson. Foi encontrada correlação significativa entre as medidas dos tendões grácil e semitendinoso e o diâmetro final do enxerto ($p < 0,001$). Ajustou-se uma curva ROC para a soma do diâmetro dos tendões, para a determinação de um ponto de corte associado ao diâmetro do enxerto (≤ 8 mm ou > 8 mm). Caso a soma seja maior do que 5,28 mm, a chance de obter um enxerto maior do que 8 mm é de 75%.

Conclusão: A medida do diâmetro dos tendões grácil e semitendinoso no exame da RNM pré-operatória é uma maneira simples e eficaz na predição do tamanho final do enxerto a ser usado na cirurgia de reconstrução do LCA.

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Introduction

Rupture of the anterior cruciate ligament (ACL) is the most common knee ligamentous injury, affecting over 100,000 people annually in the United States. Its incidence has been increasing due to a greater stimulus to and practice of sports by the population.^{1,2}

The ACL originates in the posterior portion of the lateral femoral condyle and inserts laterally and anteriorly to the medial tibial spine. It features an intra-articular and extrasynovial course, with a mean length of 38 mm and a mean diameter of 11 mm.³⁻⁵

Currently, it is known that the ACL is composed of two sets of fibers or bands: one anteromedial (AM) and another posterolateral (PL). At the femoral origin, the AM band emerges more proximally and posteriorly, while the PL band emerges more distally and anteriorly. The bands are twisted along their path in the intercondyle zone, and the tibial insertion follows the order which gives them their name: anteromedial for the AM and posterolateral for the PL.⁵⁻⁸

Surgical treatment based on ligament reconstruction is recommended for most ACL injuries. Currently, there are several options for grafts to replace it; the flexor tendons (semitendinosus and gracilis), patellar tendon, and quadriceps tendon are most used.^{2,9} Choice should consider profile and patients' age, type of sport, associated lesions, and surgeons' experience. The ideal graft has not been defined yet; some studies show that grafts with diameters less than 7 mm are associated with a higher chance of failure and relapse.¹⁰⁻¹³

Along with the advancement of imaging, preoperative measurement of the diameter of the tendons on magnetic

resonance imaging (MRI) is possible, which is the gold standard imaging study for the diagnosis of this injury, allowing an objective parameter for the graft to be chosen in ACL reconstruction prior to surgery.^{1,2,14-20}

This study aimed to evaluate the diameter of the flexor tendons on preoperative MRI and compare with the diameter of the graft obtained intraoperatively.

Material and methods

After approval by the Research Ethics Committee through the Platform Brazil website, under the Certificate of Presentation for Ethical Assessment (Certificado de Apresentação para Apreciação Ética [CAAE]) No. 39346814.4.0000.0020, 100 MRI scans and data from surgeries performed between 2012 and 2014 were collected and reviewed for this retrospective, longitudinal, epidemiological study.

Inclusion criteria comprised skeletally mature patients with complete ACL injury and no history of previous ligament or degenerative injuries. Exclusion criteria were: previous surgery, ligamentous laxity, chronic use of steroids, and dysplasia of the intercondylar notch (width of the distal femur/condylar fossa < 0.2).

After subject selection according to inclusion and exclusion criteria, 44 patients were eligible for the study.

Variables of this study were measured on MRI studies by a single radiologist using the following equipment: Achieva 1.5 T (Philips Healthcare, Best, The Netherlands) and HDx 1.5 T (GE Medical Systems, Milwaukee, USA). All studies were made using the proton density technique with fat suppression. On MRI, the semitendinosus and gracilis tendons were measured

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