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Original article

Hamstring tendons insertion – an anatomical study☆,☆☆

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ABSTRACT

Objective: To study the anatomy of the hamstring tendons insertion and anatomical relationships.

Methods: Ten cadaver knees with medial and anterior intact structures were selected. The dissection was performed from anteromedial access to exposure of the insertion of the flexor tendons (FT), tibial plateau (TP) and tibial tuberosity (TT). A needle of 40 × 12 and a caliper were used to measure the distance of the tibial plateau of the knee flexor tendons insertion at 15 mm from the medial border of the patellar tendon and tibial tuberosity to the insertion of the flexor tendons of the knee. The angle between tibial plateau and the insertion of the flexor tendons of the knee (A-TP-FT) was calculated using Image Pro Plus software.

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☆☆ Study conducted at the Biological Sciences Sector, Universidade Federal do Paraná, Curitiba, PR, Brazil.

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Results: The mean distance TP-FT was 41 ± 4.6 mm. The distance between the TT-FT was 6.88 ± 1 mm. The (A-TP-FT) was 20.3 ± 4.9°.
Conclusion: In the anterior tibial flexor tendons are about 40 mm from the plateau with an average of 20°.

Estudo anatômico da inserção dos tendões flexores do joelho

Palavras-chave:
Anatomia
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Joelho

RESUMO

Objetivo: Determinar parâmetros anatômicos para localizar a inserção dos tendões flexores do joelho na tíbia.
Métodos: Foram selecionados 10 joelhos de cadáveres com estruturas mediais e anteriores íntegras. A dissecção foi feita por acesso ântero-medial até a exposição adequada da inserção dos tendões flexores (TF), do planalto tibial (PT) e da tuberosidade anterior da tíbia (TAT). Uma agulha 40×12 e um paquímetro digital foram usados para aferir a distância do planalto tibial da inserção dos tendões flexores do joelho a 15 mm da borda medial ao tendão patelar e da tuberosidade anterior da tíbia à inserção dos tendões flexores do joelho. O ângulo formado entre o planalto tibial e a inserção dos tendões flexores do joelho (Â PT-TF) foi calculado com o auxílio do software ImagePro Plus®.
Resultados: A distância PT-TF foi de 41 ± 4,6 mm em média. A distância entre a TAT-TF foi de 6,88 ± 1 mm. A angulação (Â PT-TF) foi de 20,3 ± 4,9 graus.
Conclusão: Na região anterior da tíbia os tendões flexores estão a cerca de 40 mm do planalto com um ângulo médio de 20 graus.

Introduction

Reconstruction of the anterior cruciate ligament is the principal surgical procedure performed in sports medicine.[1] The arthroscopic technique used for reconstructions of the anterior cruciate ligament presents satisfactory results with regard to stability, which allows patients to return to sports practise.[2,3]

Semitendinosus and gracilis tendons (knee flexors) are currently the main source of grafts for intra and extra-articular ligament reconstruction.[4] Among the advantages of using this graft is the fact that it is autologous, gives rise to less morbidity at the donor site, preserves the integrity of the knee extensor and has a lower rate of anterior knee pain.[4,5]

Lack of knowledge of the anatomy of the insertions of the flexor tendons may lead to technical problems during harvesting, such as injury to the saphenous nerve and technical difficulty in harvesting because the incision was made in an inappropriate location.[4,6] It is not uncommon for the flexor tendons to be lost, with a consequent need to harvest another graft from a second donor site.[6,7] There is a shortage of articles in the literature relating to applied anatomy of the knee flexor tendons.

The aim of this study was to determine anatomical parameters for locating the insertions of the knee flexor tendons in the tibia.

Materials and methods

This study was conducted in the Department of Anatomy of the Biological Sciences Sector of UFPR, during April and May 2011. The inclusion criteria were that the material should be knees from cadavers with intact medial and anterior structures. Ten knees from cadavers that fulfilled these criteria were dissected. All of these were conserved in formol. An anteromedial access was used, with dissection in layers until obtaining a complete view of the tibial plateau and the insertion of the knee flexor tendons.

The distance from the tibial plateau to the insertion of the knee flexor tendons was measured 15 mm from the medial border of the patellar tendon. The horizontal distance from the anterior tibial tuberosity to the insertion of the knee flexor tendons was also measured (Fig. 1).

The qualitative nature of this specific region of the flexor tendons was also observed.

The points were previously marked out using 40 × 12 needle and were measured with the aid of digital calipers (Aero Space – 150 mm).

The angle formed between the tibial plateau and the insertion of the knee flexor tendons was also measured with the aid of the ImagePro Plus® software 4.5 for Windows (Media Cybernetics, Inc., USA).

Results

The mean distance between the insertion of the flexor tendons and the tibial plateau, measured 15 mm from the medial border of the patellar tendon (TP-FT), was 41 ± 4.6 mm. The mean distance from the insertion of the flexor tendons to the anterior tibial tuberosity (ATT-FT) was 6.88 ± 1 mm. The mean angle between the insertion of the flexor

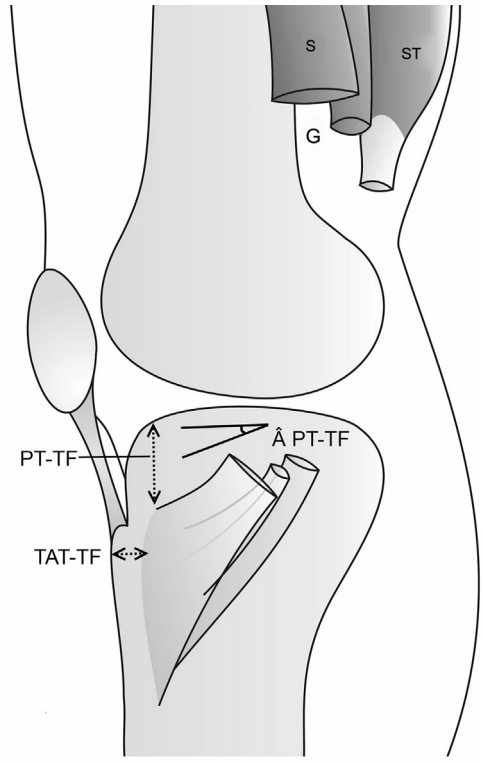

Fig. 1 – Muscle tendons: S – semimembranosus, G – gracilis, ST – semitendinosus.

tendons and the tibial plateau (TP-FT angle) was 20.3 ± 4.9° (Table 1).

It was observed that the gracilis and semitendinosus tendons were covered with a thin fibrotic cap formed by the tendon of the sartorius muscle, which has a broad insertion (Fig. 1). Its tendon is shorter and thinner than the other flexors.

The semitendinosus tendon was the thickest and longest of the tendons analyzed. The insertions of the semitendinosus and gracilis were in the same dissection layer and were more restricted than the insertion of the sartorius.

Discussion

Grafts from tendon flexors are commonly used for ligament reconstructions.[8] Knowledge of the anatomy of the insertions of these tendons is important for ensuring that the harvesting process is precise and safe.

Incision at the correct location is the first step toward success in this procedure. One common mistake is to make the incision too proximally, which creates difficulty in finding the flexor tendons. In such cases, greater wounding of soft tissues is necessary in order to harvest the tendon. The parameter of 40 mm from the tibial plateau may help the surgeon to make the incision in the appropriate location.

The incision to harvest the flexor tendon may be transverse, vertical or oblique. Oblique and transverse incisions facilitate releasing the tendon from deep bindings. Sometimes the tendon is palpable and the incision can be made by following its upper edge. In obese patients, the tendon cannot be palpated. In order to make an oblique incision that follows along the tendon, the parameter of 20° can be used.

With a more precise incision, the soft-tissue injury is lessened. This leads to a less painful postoperative period. The anatomical parameters of the insertions of the knee flexion tendons help in the precision of the procedure. It is important to emphasize that making a precise incision with a low degree of soft-tissue injury does not signify a small incision. The incision needs to be of a size that makes it comfortable to perform the procedure. Incisions that are too small may cause skin lacerations through pulling the skin back or through losing the tendon because of difficulty in viewing the structures. The size of the incision diminishes naturally with the number of procedures that the surgeon performs. This learning curve should not be artificially altered.

The anatomy of the insertions of the knee flexor tendons has been described in some important orthopedic textbooks in the following order from proximal to distal: sartorius, gracilis and semitendinosus.[9] Although it is correct to teach this in this manner, it may lead to confusion with regard to surgical anatomy because the tendon of the sartorius is not in the same dissection layer as the other two tendons. It is shorter and more superficial, and its insertion is broader. The tendon of the sartorius covers the tendons of the gracilis and semitendinosus, which are just below, with insertions that are much more restricted (Fig. 1). Better surgical comprehension of the anatomical images can be achieved through using 3D images.[10] This type of technology can place the teaching material studied closer to the reality of surgical procedures.

Table 1 – Mean values of the anatomical measurements on the insertions of the knee flexor tendons.

	TP-FT (mm)	ATT-FT (mm)	TP-FT angle (°)
Mean	40.96	6.88	20.30
Standard deviation (SD)	4.59	0.96	4.89

TP-FT angle, angle between the tibial plateau and the insertion of the flexor tendons; SD, standard deviation; TP-FT, distance from the tibial plateau to the insertion of the flexor tendons; ATT-FT, distance from the anterior tibial tuberosity to the flexor tendons.

Conclusion

The flexor tendons are inserted on average 40 mm distally to the tibial plateau and 7 mm medially to the anterior tibial tuberosity.

The insertion of the knee flexor tendons is oblique and is at an angle of 20° in relation to the tibial plateau.

The sartorius is more superficial and broader than the other tendons and is not in the same dissection layer.

Conflicts of interest

The authors declare that there were no conflicts of interest.

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