



## Original Article

# Radiological evaluation of the femoral tunnel positioning in anterior cruciate ligament reconstruction<sup>☆</sup>

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## ABSTRACT

**Objective:** To evaluate the inclination and the length of the femoral tunnel in patients submitted to anterior cruciate ligament reconstruction (ACL) surgery by transtibial and anatomical techniques.

**Methods:** This is an analytical observational study in patients with ACL injury that underwent arthroscopic reconstruction through transtibial and anatomical surgical techniques. In the immediate postoperative period, computed tomography (CT) and anteroposterior (AP) view digital radiographs (X-rays) were performed to evaluate the inclination and length of the femoral tunnel.

**Results:** Forty-two patients were analyzed: 27 underwent anatomical reconstruction and 15, transtibial reconstruction. The inclination angle and tunnel length by the transtibial technique are always greater than by the anatomical technique. The mean inclination angles were 59.75° (53.9–66.1°) in the X-rays and 54.17° (43.5–62.3°) in CT for the transtibial technique, and 42.91° (29.3–57.4°) in the X-rays and 39.10° (23.8–50.6°) in CT for the anatomical technique. Regarding the length of the femoral tunnel, the transtibial technique promotes longer tunnels: mean 55.7 mm (40.0–70.2 mm) in the transtibial and 35.5 mm (24.5–47 mm) in the anatomical technique. No statistically significant correlation was observed between the length and the inclination of the tunnel, regardless of the technique used. Thus, these variables can be considered as independent.

**Conclusion:** The anatomical reconstruction technique presented shorter femoral tunnels and lower angle of inclination than the transtibial technique. The CT showed smaller inclination angle than the X-rays, regardless of the surgical technique.

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## Avaliação radiológica do posicionamento do túnel femoral na reconstrução do ligamento cruzado anterior

R E S U M O

### Palavras-chave:

Articulação do joelho  
Ligamento cruzado anterior  
Reconstrução do ligamento cruzado anterior  
Radiografia  
Tomografia computadorizada por raios X

**Objetivo:** Avaliar a inclinação e o comprimento dos túneis femorais em pacientes submetidos a reconstrução do ligamento cruzado anterior (LCA) pelas técnicas transtibial e anatômica. **Métodos:** Estudo observacional analítico em pacientes com lesão do LCA submetidos à reconstrução artroscópica pelas técnicas cirúrgicas transtibial e anatômica. No pós-operatório imediato foram feitos os exames de tomografia computadorizada (TC) e radiografia digital simples (RX) na incidência anteroposterior para avaliação da inclinação e do comprimento do túnel femoral.

**Resultados:** Dos 42 pacientes analisados, 27 foram submetidos à reconstrução anatômica e 15 à reconstrução pela técnica transtibial. O ângulo de inclinação e o comprimento do túnel na técnica transtibial são sempre maiores do que na reconstrução anatômica. Os ângulos de inclinação na técnica transtibial foram 59,75° (53,9°-66,1°) no RX e 54,17° (43,5°-62,3°) na TC; na técnica anatômica, 42,91° (29,3°-57,4°) no RX e 39,10° (23,8°-50,6°) na TC. Em relação ao comprimento do túnel femoral, a técnica transtibial gera túneis mais longos. Em média 55,7 mm (40-70,2 mm) na técnica transtibial e 35,5 mm (24,5-47 mm) na anatômica. Não encontramos correlação estatisticamente significativa nos valores do comprimento *versus* inclinação do túnel, independentemente da técnica usada. Portanto, são variáveis independentes.

**Conclusão:** A técnica de reconstrução anatômica apresentou túneis femorais mais curtos e com ângulo de inclinação menor do que a técnica transtibial. A TC apresentou valores de inclinação do túnel menores do que o RX, independentemente da técnica cirúrgica.

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## Introduction

The anterior cruciate ligament (ACL) is one of the most frequently injured ligaments in the human body. The incidence of ACL injuries is estimated to range from 0.24 to 0.34 injuries per thousand inhabitants per year.<sup>1</sup> Currently, due to the increase in the practice of sports activities, an increase in the incidence of injuries of this ligament has been observed mainly among young patients.<sup>2,3</sup>

Although ACL reconstruction is one of the most commonly performed surgeries worldwide (estimates indicate that between 75,000 and 100,000 procedures are performed annually in the United States),<sup>4</sup> there are still discussions regarding reconstruction techniques. With the development of arthroscopic techniques, the initial aim of isometric or transtibial surgeries did not re-establish the original ACL anatomy in most cases, failing to achieve rotational stability of the knee. Currently, there is a growing interest in ACL anatomical reconstruction techniques, which may promote better clinical results by being closer to the original anatomy.<sup>5</sup>

In ACL reconstruction surgery, the femoral and tibial tunnels that are made, determine the graft functional axis. The correct positioning of these tunnels is decisive for the success of the procedure. Several authors believe that inadequate positioning of these tunnels is the main cause of ACL reconstruction failure.<sup>6,7</sup> Some errors, such as creating femoral tunnels far from the native site of the ACL, result in excessive strain on the graft and can lead to failure.<sup>7,8</sup> Moreover, the vertical orientation of the graft fails to reproduce the natural

obliqueness of the ACL, which may limit the restoration of normal knee kinematics and the control of rotational stability.<sup>6,9</sup>

In addition to positioning, tunnel length is another important factor for the success of ligament reconstruction. It is a consensus in the literature that a proper contact of the tendon with the bone surface of the tunnel is essential for bone-tendon integration. However, there is no consensus regarding the ideal tunnel length for an adequate biological fixation.<sup>10,11</sup>

The aim of this study is to evaluate the inclination and length of femoral tunnels in patients who underwent ACL reconstruction through transtibial and anatomical techniques.

## Material and methods

This was an observational and analytical study conducted from February to December 2014, including 42 patients with ACL injuries that were attended at an outpatient knee surgery facility of a tertiary hospital.

The inclusion criterion was ACL injuries confirmed by magnetic resonance imaging. Patients with ACL injuries associated with other ligament injuries and/or osteochondral fractures that could jeopardize the positioning of the femoral or tibial tunnels were excluded.

Patients underwent arthroscopic reconstruction of the ACL through transtibial and accessory anteromedial transportal anatomical surgical techniques, with flexor tendons or patellar tendon grafts.

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