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Paper #51

Anatomic Reconstruction of the Medial Patellofemoral Ligament in Children and Adolescents with Open Growth Plates: Ideal Tunnel Positioning following a Digital Three-Dimensional Model

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Summary:
We determined ideal tunnel direction for anatomic reconstruction of medial patellofemoral ligament in patients with open growth plates, based on magnetic resonance imaging derived three-dimensional models, which was obtained by aiming cephalic (15-30°) or caudal (15°) in the coronal plane, and anterior (15-20°) in the sagittal plane, regardless of sex.

Abstract:

Introduction

Anatomic reconstruction of the medial patellofemoral ligament (MPFL) is a key component of recurrent patellar instability treatment. In patients with open growth plates, there is a risk of compromising the distal femoral physis (DFP) because of its proximity to the anatomic insertion of the MPFL. Although ideal femoral insertion point for the anatomic reconstruction has been determined (as per Schöettle/Stephen), a tunnel direction that avoids damage on the DFP has yet to be defined. We set out to determine the optimal direction for femoral tunneling during an anatomic reconstruction of MPFL that minimizes the damage of the open DFP.

Methods

We obtained 80 magnetic resonance (MR) images of subjects aged 10 through 17. They were randomly sampled from our institutional database, making sure we had five male and five female patients of each age. We excluded patients with history of knee surgery or physeal damage around the knee. We developed a software to obtain 3D models of the distal femur and the DFP from MRI images. In each model, we determined the anatomic insertion point of the MPFL. We simulated drilling 30mm depth from the insertion point in every possible direction using 5, 6 and 7mm drills. We determined physeal damage for each pair of angles (coronal or cephalic-caudal; and sagittal or anteroposterior) and each drill size. Damage was expressed as a percentage of total physis volume with a 95% confidence interval). Statistical analysis was done using Student's t test, one-way ANOVA and Scheffeé test, with significance set at 5%.

Results

Physeal damage was mapped for every combination of drill size with every direction according to pair of angles.

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Maximum physeal damage (7.7% [6.8 to 8.6]) was obtained with the 7mm drill when drilling 0° cephalic and 25° anterior from insertion, without differences between sexes (p=0.36). Minimal physeal damage (1.02% [0.52 to 1.51]) was obtained using the 5 mm drill aimed 45° caudal and 0° anteroposterior, without differences by sex (p=0.9). Safe drilling zones, considering less than 3% physeal damage and avoiding intraarticular drilling, were obtained aiming 15-30° cephalic and 10-30° anterior, or 15° caudal and 15-20° anterior.

Conclusions

Optimal direction for femoral tunneling during an anatomic reconstruction of MPFL in our model, minimizing open DFP damage, was obtained when aiming cephalic or caudal in the coronal plane, and anterior in the sagittal plane, regardless of sex.