Avoiding Mismatch in Allograft Anterior Cruciate Ligament Reconstruction: Correlation Between Patient Height and Patellar Tendon Length

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Purpose: The purpose of this study was to evaluate whether a correlation exists between patient height and soft-tissue patellar tendon length. **Methods:** Magnetic resonance imaging (1.5 T) was performed for knee pathology on 403 patients. The patellar tendon length was measured in the midsagittal plane by a board-certified musculoskeletal radiologist. Patient height was recorded to the nearest inch. Patients were grouped into 6 subgroups with 4-inch range intervals based on height. The entire study group was analyzed. Subgroup analysis and gender analysis were performed to determine statistical significance. **Results:** The mean patellar tendon length was 45 ± 7 mm (range, 30 to 66 mm). Wide ranges were noted among each height subgroup irrespective of gender. Significant differences were noted between most height subgroups independent of gender. **Conclusions:** This study showed that a correlation exists between patient height, gender, and patellar tendon length. Although variation occurs among patients of the same height, significant differences in mean patellar tendon lengths do exist between patients in different height subgroups. **Clinical Relevance:** Parameters are provided using patient gender and height to reduce the potential for graft-construct mismatch when ordering bone–patellar tendon–bone allografts for anterior cruciate ligament reconstruction.

Anterior cruciate ligament (ACL) reconstruction is one of the most common surgical procedures in orthopaedics. Although multiple graft options are available, the use of allograft tissue is increasing in popularity to reduce postoperative pain and perioperative morbidity associated with autograft harvest.[1-6] One potential problem specific to patellar tendon grafts during endoscopic ACL reconstructions is the possibility of graft-tunnel mismatch.[5,7-10] This occurs when the relative length of the bone-tendon-bone (BTB) construct exceeds the combined length of the femoral tunnel, intra-articular ACL distance, and tibial tunnel length, resulting in extrusion of the tibial plug. It is specific to endoscopic ACL reconstruction with BTB autograft and allograft and not encountered with the 2-incision ACL reconstruction technique. Renewed interest in anatomic ACL reconstruction has led to an increase in femoral tunnel drilling through an accessory medial portal. Some recent research indicates that this may result in shorter femoral tunnel lengths and intra-articular distances, thereby increasing the chances of graft-tunnel mismatch.[11] If inadequate bone from the tibial plug lies within the tibial tunnel, fixation of the graft may be compromised.

When graft-tunnel mismatch occurs, options to rectify the problem include femoral recession, graft rotation, and alternative tibial fixation techniques including stapling and tying the graft over a post.[5,10,12,13]

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The incidence of graft-tunnel mismatch has been reported to be between 10% and 26%,[5,14,15] with 1 study by a group at our institution, Verma et al.,[15] indicating an increased risk when using BTB allografts as compared with autografts.

To date, most methods of addressing mismatch have focused on how to estimate the tibial tunnel length based on the graft length, rather than focusing on obtaining an appropriate-sized graft. Only 1 study has attempted to make recommendations for ordering allografts of specific lengths based on patient factors such as height.[16] Furthermore, to our knowledge, there are only 2 previous studies that attempted to examine whether a correlation between patellar tendon length and height exists. Brown et al.[16] used a magnetic resonance imaging (MRI) method similar to that used in our study and noted a strong positive correlation between intra-articular graft length of the ACL and patient height but no significant association between patient height and patellar tendon length. Denti et al.[8] studied 50 knees that underwent endoscopic ACL reconstruction and 9 cadaveric knees to look for associations between the length of the intra-articular ACL graft or that of the patellar tendon length and compared them with patient weight or height and then with each other. They reported a weak correlation between patellar tendon length and patient height.

With increasing numbers of ACL allograft reconstructions being performed, there is an increased potential for graft-construct mismatch when "short" patients receive tendon grafts from "taller" patients. The purpose of this study was to (1) evaluate whether a correlation exists between patient height, gender, and patellar tendon length and (2) use this correlation, if it exists, to provide parameters for ordering an allograft of specific length given the recipient patient's height.

METHODS

After we obtained institutional review board approval, we enrolled 403 consecutive patients (260 men and 143 women) who were undergoing knee MRI (1.5 T) for a variety of pathologies. Skeletally immature patients, patients with patellar tendon ruptures, patients with quadriceps tendon ruptures, and patients who had previous surgery on the affected knee were excluded. The distal pole of the patella and tibial tubercle insertion site on the MRI scan was used as a standardized reference point in the midsagittal plane. By use of the hard copy images, a piece of paper was placed at the posterior margin of the mid patellar tendon. Marks were made proximal and distal on the paper to denote the tendon length. This marked paper was then placed on the scale provided on each MRI scan to ascertain the tendon length (Fig 1). MRI measurements were made by a single fellowship-trained musculoskeletal radiologist. All MRI scans were proton-density images, with a representative repetition time/echo time of 2,295/22 milliseconds.

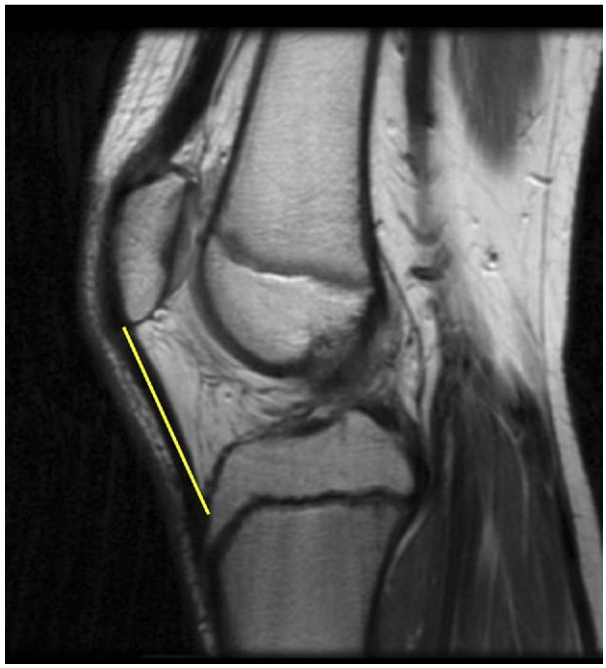

Figure 1. A T1-weighted midsagittal MRI scan showing measurement of patellar tendon length. Distance was measured from the inferior pole of the patella to the tibial tubercle (line).

Patient height, gender, and age were also recorded. Patient height was measured to the closest inch in a standing position. Patients were divided into gender-specific subgroups based on 4-inch increments in height: group 1, 58 to 61 inches; group 2, 62 to 65 inches; group 3, 66 to 69 inches; group 4, 70 to 73 inches; group 5, 74 to 77 inches; and group 6, 78 to 81 inches. Statistical analysis was performed with SPSS software (SPSS, Chicago, IL), including mean, SD, range, and Pearson correlation coefficient. Comparison between genders was conducted with an unpaired t test. Differences in mean patellar tendon length between groups used an analysis of variance with post hoc testing by the Bonferroni method. Statistical significance was defined as $P < .05$.