INTRODUCTION:
Despite the recent advances in our understanding of the anatomy and biomechanics of the posterior cruciate ligament (PCL), current methods of PCL reconstruction continue to lack the clinical success that anterior cruciate ligament (ACL) reconstruction has experienced, with many patients developing residual posterior laxity following surgery [1]. One variable that directly affects the load elongation behavior of the graft — and thereby the laxity after reconstruction — is the length of the graft between its fixation points (i.e. the effective graft length). It was found that the closer the fixation was located to the ligament insertions, the stiffer the graft [2]. Historically, the most common method for tibial fixation during PCL reconstruction used the transtibial technique, in which the graft — fixed distally in the tibial tunnel with an anterior screw — passes proximally and posteriorly through the tibia, makes a 90° turn around the superior edge of the posterior aperture of the tibial tunnel before entering the knee joint. A tibial inlay technique was developed to provide a more anatomic site of tibial fixation, eliminating the “killer turn” that was thought to contribute to graft elongation and residual posterior laxity. However, the tibial inlay technique has an increased operative time, and added risks of surgery due to the proximity of the neurovascular structures and variability in the posterior vascular anatomy. In addition, the effective graft length remained longer than the native PCL’s length. Based on the stiffness testing data, an aperture fixation, whereby the graft is fixed at the proximal aperture of the transtibial tunnel, creating the shortest possible graft, would be preferable. Cadaveric testing demonstrated that a combined proximal and distal tibial fixation in PCL reconstruction indeed decreased the effective graft length and increased the stiffness of the PCL graft, resulting in significantly less posterior tibial translation, as compared to the transtibial technique [3]. However, the results of this study applied only to the time of initial graft fixation and did not reflect in-vivo graft performance over time. The objective of this study was to evaluate the clinical outcome of the combined proximal and distal tibial fixation technique in PCL reconstruction.

METHODS:
Between 2003 and 2008, a total of 25 PCL reconstructions with a combined proximal and distal tibial fixation were performed by the senior author (TJG). The prospective data were retrospectively reviewed, and all patients were invited for a follow-up examination. The functional assessment was done by Lysholm and Tegner activity scale and scoring system, and the International Knee Documentation Committee (IKDC) 2000 scale. The KT-2000 arthrometer was used to compare anteroposterior laxity with the contralateral knee. Two patients did not respond, and one patient died of unrelated causes. For the remaining 22 patients (17 male, 5 female) the mean age at surgery was 35 years (range, 19 to 64). The average time between injury and surgery was 3.14 years (range, 1.5 months to 21 years). The average follow-up time was 2.2 years (range, 1 to 3.3). Nine of the 22 patients in our series experienced associated ligament injuries. Five ruptured the ACL, three ACL, and dual fluoroscopic imaging technique [5]. It was found that the tibiofemoral kinematics of seven of the included patients have been measured in detail using a combined MR and dual fluoroscopic imaging technique [5]. It was found that the combined proximal and distal tibial fixation technique successfully restored the anteroposterior tibial translation to level, not significantly different from the contralateral knee, indicating that the graft fixation provides a stable reconstruction. However, future studies should explore the optimal method for restoring the PCL’s function in the mediolateral direction as well, whether it is through alternate graft orientation, the addition of an extra bundle, or a tibia osteotomy, since a persistent abnormal increased lateral tibial translation was observed [5].

RESULTS:
The average Lysholm score was 86 ± 17 at final follow-up. Instability scored an average of 22.3 out of 25 points. The average Tegner score before injury was 5.83 ± 1.1 and post-operatively was 5.75 ± 1.3 (P=0.35). Only one patient was unable to return to the previous activity level. In this case the difference was one activity level, and the patient maintained the ability to perform moderately heavy labor (Level 4). Average postoperative IKDC score was 83.5 ± 7.6, versus an average preoperative IKDC score of 43.1 ± 15.5 (p<0.05). No patient had a >5 mm difference in anterior or posterior displacement from the contralateral knee (average 1.54 mm and .89 mm respectively post-operatively.

DISCUSSION:
Combined proximal and distal tibial fixation of the graft in PCL reconstruction resulted in significantly improved functional results. In addition, the side-to-side anteroposterior stability measured with the KT-2000 arthrometer was comparable between the intact and reconstructed knees. Subjectively, the patients all stated that they were very satisfied with the procedure, and would have the surgery again for the same problem. Comparing the present results with those of a proximal tibial fixation technique in the literature [4], the clinical outcome following the augmentation with the additional distal screw resulted in improved scores (Lysholm score of 86 versus 65, for combined proximal-distal versus proximal-only fixation, respectively). In addition, nine of the 22 patients in the present study had significant associated injuries. The average Lysholm scores for the combined and isolated were 83 and 91, respectively (p = 0.25), indicating that the current technique is beneficial for either injury condition.

It should be noted that the tibiofemoral kinematics of seven of the included patients have been measured in detail using a combined MR and dual fluoroscopic imaging technique [5]. It was found that the combined proximal and distal tibial fixation technique successfully restored the anteroposterior tibial translation to level, not significantly different from the contralateral knee, indicating that the graft fixation provides a stable reconstruction. However, future studies should explore the optimal method for restoring the PCL’s function in the mediolateral direction as well, whether it is through alternate graft orientation, the addition of an extra bundle, or a tibia osteotomy, since a persistent abnormal increased lateral tibial translation was observed [5].

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