

Editorial Commentary: The Posterior Cruciate Ligament Posteromedial Bundle Is Small but Vital to Posterior Cruciate Ligament Biomechanics: Don't Ignore the Underdog



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Abstract: Posterior cruciate ligament (PCL) reconstruction leads to outcomes less favorable than those of anterior cruciate ligament reconstruction. In recent years, we have seen a surge of publications regarding PCL anatomy, isometry, and reconstruction techniques. PCL reconstruction has been revolutionized with lessons learned from analysis of PCL behavior, such as the distinct role of the posteromedial bundle (PMB) in the biomechanics of the knee at different flexion angles, as well as its co-dominant role with its counterpart, the anterolateral bundle. With the knee in extension, the PMB serves to restrict posterior translation, whereas in knee flexion, the PMB restricts internal rotation. It is rather too early to know whether the biomechanical advantage of double-bundle reconstruction will result in better clinical outcomes in the long term; however, the increased interest and the refinement of both single- and double-bundle reconstruction techniques will certainly advance our knowledge, ultimately translating into better patient outcomes.

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Optimization of surgical techniques is key for clinical success. In the past, posterior cruciate ligament (PCL) injuries were treated conservatively, but the development of early osteoarthritis and alteration of patellofemoral biomechanics have led to the recognition of PCL reconstruction as a viable option for complete PCL injuries.¹ Outcomes after PCL reconstruction remain generally inferior to those of anterior cruciate ligament reconstruction.² Despite the fact that the biomechanical advantage of double-bundle PCL reconstruction was recognized early, it was only recently that clinical data showing superior International Knee Documentation Committee and stability scores for double-bundle reconstruction reignited a conversation about improving our PCL reconstruction technique.^{3,4}

In their exceptional article “Dynamic Three-Dimensional Computed Tomography Mapping of

Isometric Posterior Cruciate Ligament Attachment Sites on the Tibia and Femur: Single- Versus Double-Bundle Analysis,” Forsythe, Patel, Lansdown, Agarwalla, Kunze, Lu, Puzziello, Verma, Cole, LaPrade, Inoue, and Chahla⁵ found that the position of the femoral tunnel and the angle of fixation contribute the most to the changes in PCL length. In double-bundle PCL reconstruction, the posteromedial bundle (PMB) had a high degree of isometry throughout the range of motion, whereas the anterolateral bundle was more anisometric. Forsythe et al. recommended fixation of the anterolateral bundle at 90° to avoid overconstraint of the graft. At the same time, single-bundle PCL reconstruction was associated with laxity at lower degrees of knee flexion.

Given the fact that several biomechanical studies have shown that the native PMB is tight in knee extension, one can understand that the laxity seen in single-bundle reconstruction could be the result of the missing PMB. Indeed, with the knee in extension, the PMB serves to restrict posterior translation, whereas in knee flexion, the PMB restricts internal rotation.^{6,7} The distinct attachment sites of the 2 PCL bundles not only are suggestive of their synergistic and co-dominant role in knee biomechanics but also offer a technical advantage

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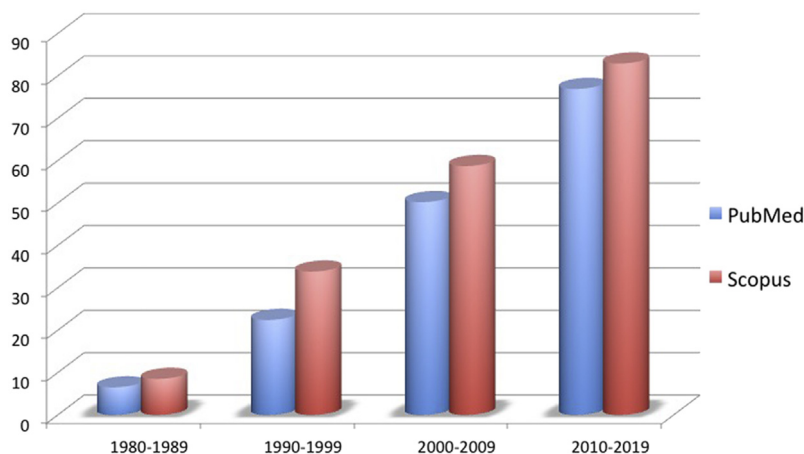


Fig 1. Average number of posterior cruciate ligament (PCL) studies published per year by decade.

for safe tunnel placement when double-bundle reconstruction is attempted.

The study by Forsythe et al.⁵ adds to the series of recent work that has attempted to recognize important aspects in PCL reconstruction, such as the position of the femoral tunnel,⁸ the importance of fixation,⁹ the timing from injury to reconstruction,¹⁰ the graft bending angle,¹¹⁻¹³ the role of the tibial slope,¹⁴ the role of remnant tissue,^{15,16} and the optimization of grafts.^{17,18} The number of published articles about PCL injury showed an exponential increase in the past decade, reaching 76.9 and 82.9 articles published per year in the PubMed and Scopus databases, respectively (Fig 1). At the same time, several technical pearls have been presented, with the promise of a brighter future for our patients with PCL injury.¹⁹⁻²³

It is extremely difficult to predict whether the improved biomechanics resulting from double-bundle reconstruction will translate into a measurable patient-reported outcome long term. However, discussion about optimizing the PCL reconstruction technique, as well as the recognition of the femoral attachment site position and the fixation angle as important factors, will inevitably lead to improvement in both single- and double-bundle PCL reconstructions.

We have several historical examples in which underdogs were able to accomplish significant achievements against stronger opponents, such as David against Goliath and Leonidas against Xerxes. Traditionally, the critical error of the favored opponent is unawareness and overconfidence owing to greater size. With certain analogy, the smaller size of the PMB should not bias us to underestimate its importance in PCL reconstruction.

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