Meta-analysis

Single-Bundle and Double-Bundle Posterior Cruciate Ligament Reconstructions: A Systematic Review and Meta-analysis of 441 Patients at a Minimum 2 Years' Follow-up

Jorge Chahla, M.D., Ph.D., Gilbert Moatshe, M.D., Mark E. Cinque, B.S., M.S., Grant J. Dornan, M.Sc., Justin J. Mitchell, M.D., Taylor J. Ridley, M.D., and Robert F. LaPrade, M.D., Ph.D.

Purpose: To perform a systematic review on the techniques and a meta-analysis on the functional and objective outcomes after single-bundle (SB) versus double-bundle (DB) posterior cruciate ligament (PCL) reconstructions. **Methods:** A systematic review of the techniques, as well as functional and objective outcomes of clinical studies comparing SB versus DB PCL reconstruction with a mean follow-up of at least 24 months and minimum level of evidence of III were performed. After review of the literature, a quality analysis of the studies (Detsky score) and a meta-analysis comparing raw mean differences in data between SB and DB PCL groups were performed. Clinical outcome measures included in the meta-analysis were functional outcomes (Lysholm, Tegner, and objective International Knee Documentation Committee [IKDC] scores) and objective measurements (arthrometer and stress radiographs). **Results:** The systematic search identified 11 studies (441 patients). Three studies were prospective randomized controlled trials and the other 8 studies were case-control studies. Two hundred thirty-two patients were treated with SB PCL reconstruction, whereas 209 were treated with DB PCL reconstruction. Only 4 studies satisfied the threshold for a satisfactory level of methodologic quality (>75%). There were no significant differences between SB and DB PCL reconstructions in postoperative Lysholm ($P = .6$, 95% confidence interval [CI], −0.98, 2.18) or Tegner scores ($P = .37$, 95% CI, −0.19, 0.92). DB PCL reconstruction provided significantly better objective posterior tibial translation stability than the SB technique using the Telos technique at 90° ($P = -.58$, 95% CI, −1.06, −0.10). **Conclusions:** Improved patient-reported outcomes and knee stability were achieved with both SB and DB PCL reconstruction surgery. DB PCL reconstruction provided significantly improved objective posterior tibial stability and objective IKDC scores when compared with SB PCL reconstruction in randomized clinical trials. No significant difference was found for the other patient-reported outcomes. **Level of Evidence:** Level III, systematic review and meta-analysis of Level II and III studies.

The understanding of the diagnosis and treatment options for posterior cruciate ligament (PCL) injuries has rapidly evolved in recent years, leading to advancements in surgical techniques and improved clinical outcomes. Historically, good to excellent outcomes were initially reported after nonoperative treatment of isolated PCL tears[1,2]; however, recent studies have shown declining clinical outcome scores and early osteoarthritis after complete isolated and combined PCL injuries treated nonoperatively.[3-5] These findings have prompted

From the Steadman Philippon Research Institute (J.C., G.M., M.E.C., G.J.D., R.F.L.) Vail, Colorado, U.S.A.; Oslo University Hospital, Oslo, Norway (G.M.); Department of Orthopaedics, University of Minnesota, Minneapolis, MN (T.J.R.); Gundersen Health System, Department of Sports Medicine (J.J.M.), La Crosse, Wisconsin; and The Steadman Clinic (R.F.L.), Vail, Colorado, U.S.A.

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Address correspondence to Robert F. LaPrade, M.D., Ph.D., Steadman Philippon Research Institute, The Steadman Clinic, 181 West Meadow Drive, Suite 400, Vail, CO 81657, U.S.A. E-mail: drlaprade@sprivail.org

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surgeons to consider early operative intervention in symptomatic grade III (complete) tears.[6]

The PCL is composed of 2 main bundles, a larger anterolateral (ALB) and a smaller posteromedial bundle (PMB),[7-9] and functions as the primary restraint to posterior tibial translation of the knee.[10] Near-normal knee kinematics have been reported when the ALB is preserved and the PMB is sectioned, and therefore these data initially suggested that the ALB should be the focus of traditional single-bundle (SB) reconstruction.[11,12] However, Kennedy et al.[13] found similar results when the ALB was sectioned and the PMB was left intact, validating that both bundles have a codominant relationship and biomechanically showing that both bundles should be reconstructed. Recent biomechanical studies have revealed that SB PCL reconstructions fail to restore native knee kinematics whereas double-bundle (DB) PCL reconstructions restore knee kinematics to a near native state.[13,14]

The available literature comparing PCL reconstruction techniques is limited and highly heterogeneous with respect to indications, timing, and outcome assessment. Additionally, despite the aforementioned biomechanical studies showing that DB PCL reconstruction is superior in restoring knee kinematics to the native state, data on clinical outcomes comparing the 2 techniques remain limited. To improve recommendations for future care of PCL injuries and to promote further research, this study aimed to perform a systematic review of the techniques and a meta-analysis of the functional and objective outcomes after SB versus DB PCL reconstructions. Our hypothesis was that both SB and DB PCL reconstruction would result in improved patient outcomes after surgery, but DB PCL reconstruction would result in increased objective stability after surgery compared with SB PCL reconstruction.

Methods

Article Identification and Selection

This study was conducted in accordance with the 2009 Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) statement.[15] A systematic review of the literature regarding the existing evidence for the outcomes and complications of SB versus DB PCL reconstruction was performed using the Cochrane Database of Systematic Reviews, the Cochrane Central Register of Controlled Trials, PubMed (1980-2014), EMBASE (1980-2014), and MEDLINE (1980-2014). The queries were performed in July 2016. Systematic review registration was done in August 2016 using the

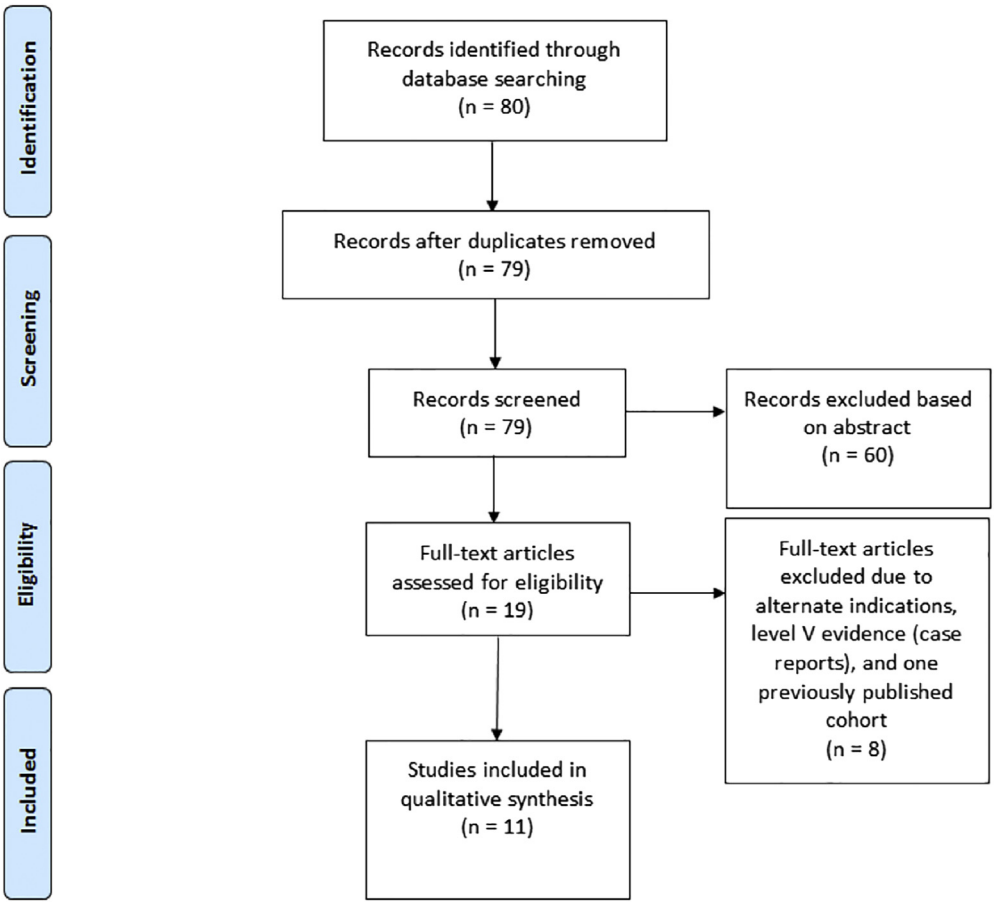

Fig 1. PRISMA flowchart of the study selection criteria.