Systematic Review

Clinical Outcome of Posterior Cruciate Ligament Reconstruction With and Without Remnant Preservation

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Purpose: The purpose of this study was to analyze clinical outcomes in patients who underwent posterior cruciate ligament reconstruction (PCLR) with and without remnant preservation. **Methods:** A search of the literature was performed with the established medical databases Medline, Embase, and the Cochrane Register. Two authors screened the selected articles for title, abstract, and full text in accordance with predefined inclusion and exclusion criteria. The inclusion criteria were as follows: English-language articles on isolated posterior cruciate ligament injury; clinical trials with a clear description of surgical technique; outcome evaluation using a well-defined knee score, arthrometry, and posterior stress radiography; follow-up longer than 2 years; and a Coleman Methodology Score (CMS) of 65 points or greater. The methodologic quality of all articles was assessed by 2 authors according to the CMS. **Results:** Eleven studies were included, with a mean CMS of 78.9 points (SD, 5.37 points). There was no direct comparative study between remnant-preserving PCLR and standard PCLR. At final follow-up, the knees of 72% to 100% of patients who underwent remnant-preserving PCLR and 41% to 95% of patients who underwent standard PCLR were rated as normal or nearly normal on the International Knee Documentation Committee subjective knee assessment. Patients who underwent remnant-preserving PCLR showed an increase of 16.4 to 47 points in Lysholm scores, and patients who underwent standard PCLR showed an increase of 22 to 29 points. The ranges of mean postoperative side-to-side differences on KT-1000 (MEDmetric, San Diego, CA) testing were 0.7 to 2.8 mm in patients who underwent remnant-preserving PCLR and 1 to 3.5 mm in patients who underwent standard PCLR. The ranges of mean postoperative side-to-side differences on stress radiography were 2.2 to 5 mm in patients who underwent remnant-preserving PCLR and 4.7 to 6 mm in patients who underwent standard PCLR. **Conclusions:** All studies on PCLR with remnant preservation showed satisfactory outcomes despite using numerous surgical techniques, graft types, intervals from injury to surgery, and follow-up periods. **Level of Evidence:** Level IV, systematic review of Level II through IV studies.

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The authors report that they have no conflicts of interest in the authorship and publication of this article.

Received August 14, 2014; accepted March 16, 2015.

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0749-8063/14696/$36.00

http://dx.doi.org/10.1016/j.arthro.2015.03.018

The posterior cruciate ligament (PCL) is known to have a spontaneous healing capability superior to that of the anterior cruciate ligament,[1,2] and indeed, good results have been reported for nonoperative treatment of PCL ruptures with mild to moderate instability.[3] Long-term follow-up studies, however, have described increased incidences of arthritis and declining knee function, making posterior cruciate ligament reconstruction (PCLR) more widely accepted with evolving operating techniques.[2,4]

A number of PCLR techniques have been reported. With standard techniques, the remnant fibers generally are removed to obtain an adequate operative view and to facilitate the passage of a graft.[5,6] However, techniques that preserve the remnant fibers have been

introduced, under the assumption that such preservation contributes to postoperative posterior stability, grafted-tendon healing, and recovery of proprioception.[7-9] In addition, recent histologic studies have confirmed that portions of mechanoreceptors and vessels in PCL remnants can improve the biological healing status of grafted tendons.[10,11] Some authors, moreover, have reported that preservation of the original PCL fibers can reduce the killer-turn effect.[7,12,13] However, there are no reports that remnant-preserving PCLR is superior to standard reconstruction in terms of clinical and functional outcomes.

The purpose of this systematic review was to analyze clinical outcomes in patients who underwent PCLR with and without remnant preservation. The hypothesis of this study was that patients who underwent remnant-preserving PCLR would have more satisfactory clinical outcomes than patients who underwent standard PCLR.

Methods

Literature Search

Two of the authors (J-G.S., H-J.K.) independently performed comprehensive online literature searches of the PubMed, Medline, Embase, and Cochrane Library databases between March 3 and March 10, 2014. The following search terms were used: (''Posterior Cruciate Ligament''[Mesh] OR ''Posterior cruciate ligament''[tiab] OR PCL[tiab]) AND (''Surgical Procedures, Operative''[Mesh] OR surgical[tiab] OR surgery[tiab] OR reconstruction[tiab] OR reconstructive [tiab] OR reconstructed[tiab] OR augmentation[tiab]). The inclusion criteria were as follows: English-language articles; clinical trials of isolated PCLR with an adequate description of remnant preservation or removal for PCLR; studies reporting a minimum of 2 years' follow-up; studies with a publication date or in press online date of January 1, 2000, or later; studies with Level I, II, III, or IV evidence; and studies with a Coleman Methodology Score (CMS) of 65 points or greater.

The 2 authors independently screened the title and abstract of each search-returned article and then reviewed the full text of each article that had been selected based on the inclusion and exclusion criteria (Table 1). They then pooled their independently selected articles and finalized the studies to be analyzed. In cases of disagreement between the authors on a study's inclusion, the final decision was made by the senior author (K.W.N.). In cases of 2 or more studies by the same author or center, we determined whether the patients were duplicated. If duplicated, we included only the latest study.

Quality Assessment

The methodologic quality of each of the studies included in the analysis was evaluated by 2 of the authors (J-G.S., N.N.B.) individually according to the CMS,[14] consisting of 10 assessment criteria. Each study was assessed for each of the 10 criteria, resulting in a final score ranging from 0 to 100 points. A perfect score of 100 points indicates a study design that largely avoids the influence of chance, various biases, and confounding factors. Each author scored the methodologic quality of the studies twice, with a 10-day interval between assessments. In cases of disagreement, the 2 investigators debated the controversial score until reaching a consensus. To increase the strength of reported findings, data were extracted only from studies with a CMS of 65 points or greater.

Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Studies on patients who underwent PCLR without combined ligamentous reconstruction	Studies on patients who underwent PCLR with combined ligamentous reconstruction
Studies with an adequate description of the technique of remnant preservation or removal for PCLR	Studies without an adequate description of the remnant-preservation technique for PCLR
Studies reporting a minimum of 2 years' follow-up data on clinical, functional, and imaging outcomes of PCLR	Studies reporting <2 years' follow-up data on clinical, functional, and imaging outcomes of PCLR
Level I, II, III or IV evidence	Level V evidence (case report, technique note, letter to editor), biomechanical reports, and review articles
Articles written in English	Articles written in language other than English
Human subjects	Non-human subjects
Study publication or in press online date of January 1, 2000, to March 1, 2014	Study publication or in press online date before January 1, 2000
Coleman score ≥65 points	Coleman score <65 points

PCLR, posterior cruciate ligament reconstruction.

Data Abstraction

The following data were extracted from the selected studies, without contacting the study authors to verify the accuracy of the data or obtain further information. The patients within the studies were divided into 1 of 2 treatment groups, consisting of those who underwent remnant-preserving PCLR and those who underwent standard PCLR. Details of the surgical techniques, as extracted from the studies, included (1) time from injury to surgery, (2) surgical procedure for managing PCL remnant, (3) surgical technique (transtibial/tibial inlay), (4) type of graft, and (5) surgical procedure (single/double bundle and preservation method). These data are summarized in Table 2. Clinical outcome data extracted from the studies included (1) follow-up, (2)