

# Most Publications Regarding Arthroscopic Treatment of Posterolateral Corner Injuries of the Knee Have a Low Level of Evidence and Provide Limited Information to Determine the Most Effective Treatment



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**Purpose:** To examine the Level of Evidence and overall quality of studies addressing arthroscopic posterolateral corner reconstructions of the knee. **Methods:** A search was performed using the PubMed/Medline, Web of Science, and Google Scholar databases for all studies investigating arthroscopic treatment of posterolateral corner injuries of the knee. Studies reporting outcomes or describing arthroscopic techniques for treatment of posterolateral corner injuries of the knee were the focus of this analysis. Clinical as well as biomechanical and cadaveric studies were included. Studies only investigating open techniques were excluded. Two independent reviewers determined the level of evidence for each included study using the criteria established by the *Journal of Bone and Joint Surgery* and scored each clinical study from 0 to 100 based on 10 criteria from the modified Coleman Methodology Score. **Results:** Twenty-four studies matched the inclusion criteria. There were 6 cadaveric technique descriptions, 6 clinical technique descriptions, 3 biomechanical studies, 4 technical repair descriptions, and 5 clinical outcome studies. Thirty-eight percent of all studies were of Level V evidence. Fifty percent of studies were of Level IV evidence, and 12% of studies were of Level III evidence. The mean modified Coleman Methodology Score for the clinical studies was  $43 \pm 11.4$ , which is regarded as poor, mainly due to the limited number of patients and the retrospective nature of the studies. **Conclusions:** Most studies addressing arthroscopic posterolateral corner reconstruction of the knee are of low level of evidence and provide limited information about the best treatment options. **Clinical Relevance:** The number of publications on arthroscopic posterolateral corner reconstruction techniques continues to rise. This systematic review evaluates the level of evidence of these studies.

Posterolateral corner injuries of the knee are complex, and the diagnosis, classification, and treatment of injuries in this area have recently gained renewed interest.<sup>1,2</sup> Studies have shown that most

surgeons treat these injuries with either a fibular-based open (1 or 2 femoral tunnels) or a tibiofibular-based open reconstruction<sup>2</sup>. There has been a rise in publications on arthroscopic repair or reconstruction in this area, but this approach has not seen a wide use in the orthopaedic community. Some authors suggest that arthroscopically treating these injuries may provide a less-invasive surgical option with potentially less arthrofibrosis and equal accuracy as with open techniques.<sup>3-9</sup> Other authors underline the potential for neurovascular injury or malpositioning of the tunnels with these techniques.<sup>10-12</sup> A systematic review focused on the technical details of published studies concerning the specific structures that were reconstructed.<sup>13</sup> Since then, there have been technical advances in the surgical techniques to arthroscopically reconstruct the posterolateral corner of the knee, and more data have been published on the clinical outcomes of these techniques.

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The purpose of this systematic review was to examine the level of evidence and overall quality of studies addressing arthroscopic posterolateral corner injuries of the knee. It is hypothesized that the level of current evidence on arthroscopic posterolateral corner reconstructions techniques is low and large heterogeneity exists, therefore compromising the ability to compare biomechanical and clinical results with open techniques.

## Methods

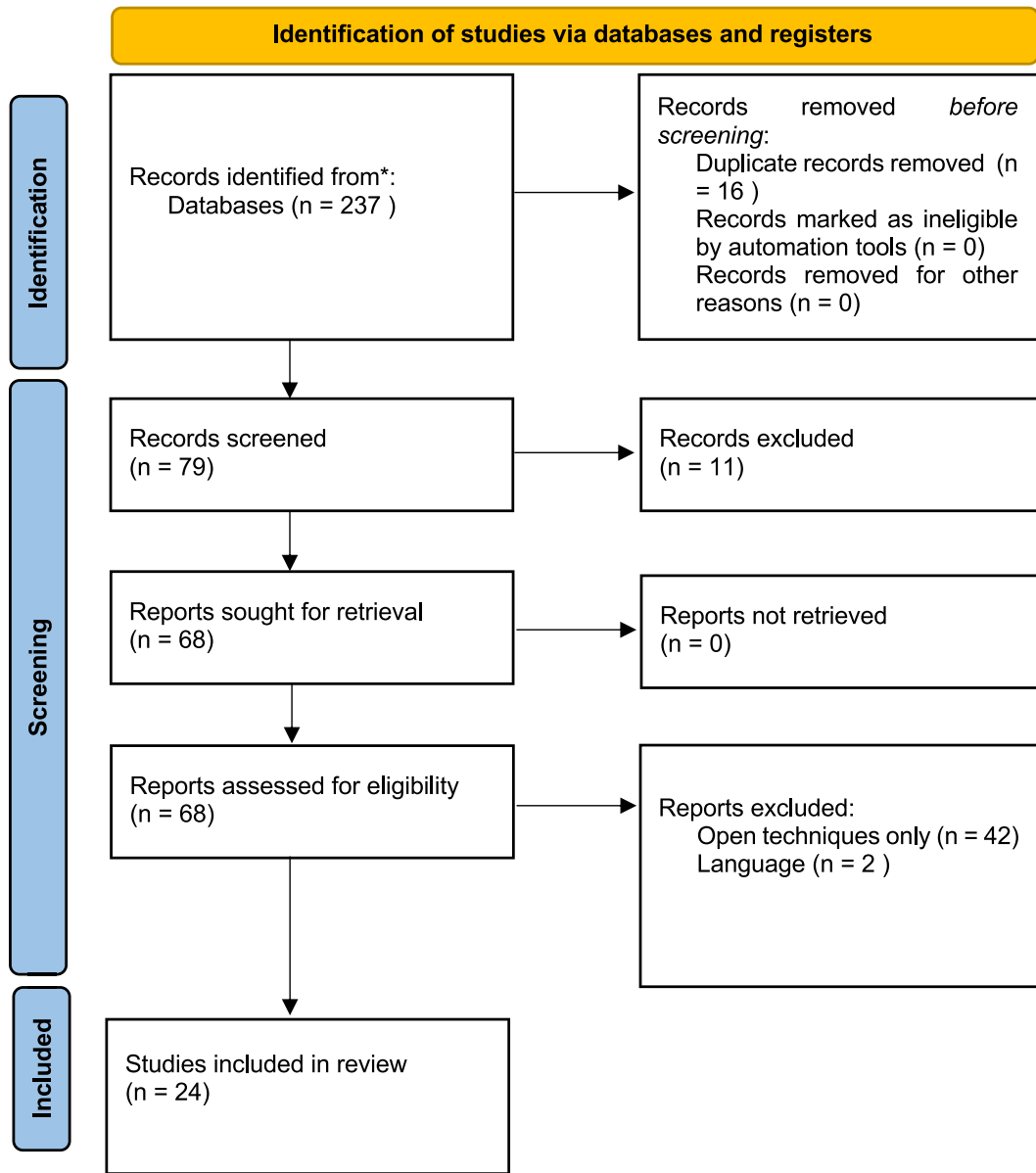
A systematic review of the literature was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The study was registered with the International Prospective Register of Systematic Reviews (PROSPERO) database. The following search terms were used in PubMed (MEDLINE), Web of Science, and Google Scholar databases with a variation of combinations of these terms and their synonyms: “posterolateral” AND “corner” AND “popliteofibular” AND “popliteus” AND “arthroscopic” AND “reconstruction” AND “arthroscopy” on August 15, 2023. In addition, all references of the included articles were reviewed. Inclusion criteria were technical descriptive papers on arthroscopic or minimally invasive posterolateral corner reconstruction or repair and biomechanical and clinical studies on arthroscopic or minimally invasive posterolateral corner reconstructions. Exclusion criteria were papers on purely open reconstruction/repair techniques and case reports or articles not in English, Dutch, French, or German. Two reviewers independently performed the search and applied the inclusion and exclusion criteria. Studies were assessed for eligibility and voted yes, no, or maybe. All voting was blinded. Studies that were deemed eligible were extracted for full-text review. Studies that were evaluated as maybe also were extracted for full-text review. Differences between reviewers were discussed and resolved by consensus. The Level of Evidence was extracted from the text or determined according to the guidelines.<sup>14</sup> The Coleman Methodology Score (CMS) was calculated for all studies with exception of the cadaveric and biomechanical studies.<sup>15</sup> Information on the surgical technique used in each study was collected, specifically if the technique was fibular or tibiofibular based and the use of a transeptal portal. Posterolateral corner reconstruction techniques can be separated largely into 2 groups: fibular-based and tibiofibular-based (with use of a tibial sling). The open fibular-based reconstruction technique is used by about half of the knee surgeon community, probably due to the fact that it is less invasive and technically easier.<sup>1,16</sup> The addition of a tibial sling to the reconstruction in a tibiofibular based reconstruction adds to the stability of the construct as has been shown in biomechanical

studies.<sup>16</sup> The transeptal portal is used in many of the published surgical techniques for arthroscopic posterolateral corner reconstruction. Due to the proximity of this portal to the neurovascular bundle, the use of this portal could be one of the main concerns for less experienced surgeons to utilize these techniques, despite no reports of neurovascular injury in the literature.<sup>17</sup> Information from biomechanical studies of these reconstructions was gathered. The level of evidence of all available studies was assigned according to the classification as specified by Wright et al.<sup>18</sup> In clinical studies, patient demographics, subjective and objective outcomes, and follow-up time was recorded.

## Results

Initially, 68 studies were retained after screening for duplicates, and after implementing the exclusion criteria, 24 studies were included in this review. These articles were reviewed for surgical technique, use of a transeptal portal, number of patients, outcome, and follow-up. The search process is depicted in [Figure 1](#). A summary of the studies included in the study can be found in [Table 1](#).<sup>4-7,9,19-38</sup> Thirty-eight percent of all studies were of Level V evidence, 50% of studies were of Level IV evidence, and 12% of studies were of Level III evidence.

There were 6 cadaveric technique descriptions,<sup>19-24</sup> 6 clinical technique descriptions,<sup>6,25-29</sup> 3 biomechanical studies,<sup>30-32</sup> 4 technical repair descriptions,<sup>33-36</sup> and 5 clinical outcomes studies.<sup>5,7,9,37,38</sup> There was inconsistency in the structures that are repaired in the repair studies, ranging from an arcuate fracture repair, posterolateral capsule repair, to repair of a femorally avulsed popliteus tendon. Clinical outcomes were reported for 3 patients for these repair techniques, with a follow-up time from 1 to 2 years. We found 6 cadaveric descriptions of techniques to arthroscopically reconstruct posterolateral corner injuries of the knee. Four studies reported using a transeptal approach.<sup>21-24</sup> Three studies used a tibiofibular-based reconstruction,<sup>20,21,23</sup> 1 technique was purely fibular-based,<sup>22</sup> and 2 techniques were purely tibial-based reconstructions.<sup>19,24</sup> We further identified 3 biomechanical studies.<sup>30-32</sup> One study validates an arthroscopic Arciero technique (fibular based reconstruction) on 12 cadavers with robotic testing of varus and external rotation.<sup>30</sup> One study reports that the popliteus bypass is superior to restoring external rotation than the Larson technique in a cadaveric setup.<sup>31</sup> Another study reports equal restoration of varus stability with use of an arthroscopic popliteus bypass procedure and minimally invasive lateral collateral ligament (LCL) reconstruction compared to an open LaPrade technique.<sup>32</sup> Six technical descriptive articles were identified in which the technique was described and already performed on patients: 4 used a tibial-based reconstruction



**Fig 1.** Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart of the current study.

technique<sup>7,8,37,38</sup> and 2 used a fibular-based reconstruction technique.<sup>31,38</sup> Four authors used a trans-septal approach.<sup>5,7,8,32</sup> In 2 of these studies, there was no mention of the number of patients and in 4 studies no outcome was noted. Five case series or case-control series were identified for a total of 141 patients. Three studies were Level III evidence. Only 2 studies reported a comparison between an arthroscopic or open technique for posterolateral corner reconstruction.<sup>7,9</sup> The results were comparable in these 2 studies. The mean CMS score of all studies with exception of the biomechanical and cadaveric studies was  $43 \pm 11.4$ , which is rated as poor. The low score, however, is mainly due to the limited number of patients and the retrospective nature of the studies and not because of study set-up.

## Arthroscopic Reconstruction of the Posterolateral Corner of the Knee

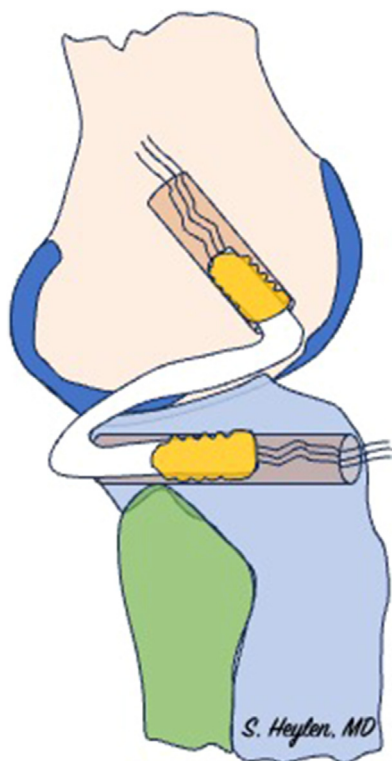
### Arthroscopic Popliteus Tendon Reconstruction

In 2009, Feng et al.<sup>25</sup> described an arthroscopic treatment of a posterolateral corner injury of the knee. The publication is in the form of a technical note of an arthroscopic popliteus tendon reconstruction, which the authors named the posterolateral sling reconstruction of the popliteus tendon (Fig 2). The same group continued their interest in minimally invasive posterolateral corner reconstruction with a technical description of a minimally invasive popliteofibular ligament reconstruction in combination with a posterior cruciate ligament reconstruction (PCL) reconstruction.<sup>39,40</sup> In 2011, Zhang et al.<sup>41</sup> reported performing the

**Table 1.** Overview of Studies Included in the Review

Author	LOE	Technique	Transseptal	Technical Description	Clinical	Number of Patients	Outcome Measures	Follow-up
Frosch et al., 2015 <sup>24</sup>	V	Tibial-based	+	+	–	/	/	/
Hermanowicz et al., 2018 <sup>19</sup>	V	Tibial-based	–	+	–	/	/	/
Hermanowicz et al., 2019 <sup>20</sup>	V	Tibiofibular-based	–	+	–	/	/	/
Kolb et al., 2019 <sup>21</sup>	V	Tibiofibular-based	+	+	–	/	/	/
Frings et al., 2019 <sup>22</sup>	V	Fibular-based	+	+	–	/	/	/
Freychet et al., 2020 <sup>23</sup>	V	Tibiofibular-based	+	+	–	/	/	/
Feng et al., 2009 <sup>25</sup>	IV	Tibial-based	+	+	+	6	?	?
Kodkani, 2011 <sup>26</sup>	IV	Tibial-based	–	+	+	6	?	?
Ayala-Mejias et al., 2011 <sup>27</sup>	IV	Tibial-based	–	+	+	1	Dial test	4 mo
Song et al., 2015 <sup>6</sup>	IV	Fibular-based	+	+	+	1	Dial test	24 mo
Ahn et al., 2019 <sup>28</sup>	IV	Fibular-based	+	+	+	?	?	?
Abreu et al., 2022 <sup>29</sup>	IV	Tibial-based	+	+	+	?	?	?
Liu et al., 2020 <sup>30</sup>	V	Fibular-based	/	+	–	/	/	/
Drenck et al., 2021 <sup>31</sup>	V	Tibiofibular vs fibular-based	/	+	–	/	/	/
Chernchujit et al., 2020 <sup>32</sup>	V	LaPrade vs popliteus bypass and LCL-R	/	+	–	/	/	/
Babu et al., 2019 <sup>37</sup>	IV	Tibial-based	–	+	+	12	IKDC, Tegner	18 mo
Razi et al., 2016 <sup>38</sup>	IV	Tibial- or fibular-based	?	–	+	39	IKDC, dial test, varus stress test	58 mo
Li et al., 2019 <sup>9</sup>	III	Tibial-based	+	+	+	38	Lysholm, Tegner, IKDC, PSR	31 mo
Weiss et al., 2023 <sup>5</sup>	III	Tibiofibular vs fibular-based	+	+	+	19	Lysholm, Tegner, IKDC, dial test, varus stress test	12 mo
Zhang et al., 2016 <sup>7</sup>	III	Popliteus bypass vs open PFL-R	+	+	+	33	Dial test, PSR, varus stress test	24 mo
Zhang et al., 2011 <sup>33</sup>	IV	Repair	+	+	+	1	Dial test	12 mo
Salzler et al., 2012 <sup>34</sup>	IV	Repair	–	+	+	1	Dial test	12 mo
Ohnishi et al., 2017 <sup>35</sup>	IV	Repair	–	+	+	?	?	?
Koukoulas et al., 2020 <sup>36</sup>	IV	Repair	–	+	+	1	Dial test	24 mo
Drenck et al., 2022 <sup>4</sup>	III	Tibial-based	+	+	+	23	Lysholm, Tegner, varus stress test, dial test	46 mo

IKDC, International Knee Documentation Committee; LCL-R, lateral collateral ligament reconstruction; LOE, Level of Evidence; PFL-R, popliteofibular ligament reconstruction; PSR, posterior stress radiography.



**Fig 2.** Arthroscopic popliteus tendon reconstruction with interference screw fixation of auto- or allograft in the tibial and femoral tunnel (tibia-based reconstruction) for Fanelli type A posterolateral corner injuries

arthroscopic popliteus reconstruction technique in combination with an open direct repair of a femoral avulsion of the LCL in a multiligamentous knee reconstruction case. Also in 2011, Kodkani<sup>26</sup> reported on their variation of the previously published arthroscopic posterolateral sling reconstruction. The authors avoid using the transseptal portal and the posterolateral portal due to the neurovascular injury risk. An anterolateral portal is made slightly more lateral than usual for access to the lateral gutter and a far lateral accessory portal is used, which the authors named “the popliteus portal.” The direction of the tibial tunnel is posterolaterally aimed away from the neurovascular bundle with the starting point between the lateral border of the patella tendon and Gerdy’s tubercle, which is obviously more medial than described by Feng et al.<sup>25</sup> In that same year, Ayala-Mejías et al.<sup>27</sup> described their technique for arthroscopic popliteus reconstruction. They visualized through a posterolateral portal and drill the tibial tunnel with an anterior cruciate ligament tibial guide through the anterolateral portal. They also mentioned the arthroscopic posterolateral sling procedure by Feng et al.<sup>25</sup> and, like Kodkani,<sup>26</sup> reported on wanting to avoid the transseptal portal. They did, however, use visualization through the posterolateral portal. In 2015, Frosch et al.<sup>24</sup> described their technique

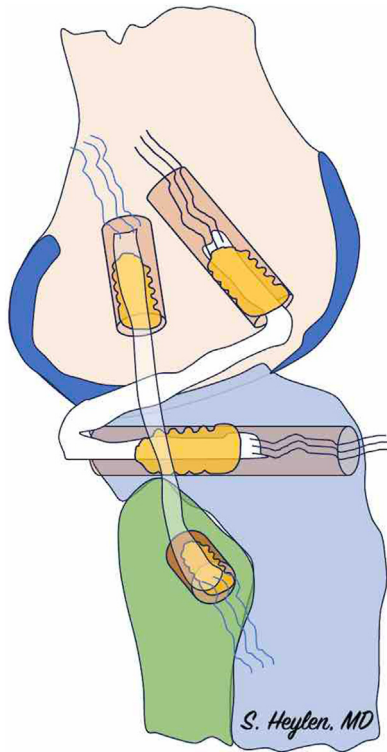
to reconstruct the popliteus complex. The study was set up as a cadaveric feasibility study. The authors also mentioned drilling the tunnel for an LCL reconstruction. They mentioned high accuracy in the tibial tunnel positioning via the arthroscope and noted that the fibular head could not be safely reached arthroscopically because of the fibular nerve. In 2019, Hermanowicz et al.<sup>20</sup> described a minimally invasive arthroscopic-assisted posterolateral corner reconstruction. The authors mentioned the need for a high level of arthroscopic experience and the high risk of popliteal vessel injury in all-arthroscopic posterolateral corner reconstructions and developed this technique to counter some of these downsides. The next step in their reconstruction was a minimally invasive LCL reconstruction with a small vertical incision over the fibular head a small horizontal incision over the lateral femoral epicondyle. The authors mentioned the benefits of minimally invasive approach, such as decreased arthrofibrosis and wound infections, but did not provide any data or references for this statement. In 2022, Abreu et al.<sup>29</sup> described performing an arthroscopic popliteus bypass procedure in combination with a PCL reconstruction. The tibial popliteus tunnel is drilled in the position, as described by Frosch et al.<sup>24</sup> The authors mentioned their experience with this technique, which they deemed to be superior to the open technique due to more respect for the anatomy and with fewer complications. They mentioned that this was an evolution in the treatment of posterolateral corner injuries.

#### Arthroscopic Popliteofibular Ligament Reconstruction

In 2015, Song et al.<sup>6</sup> described an arthroscopic technique to reconstruct the popliteofibular ligament. In 2019 Ahn et al.<sup>28</sup> reported their technique of an all-arthroscopic reconstruction of the posterolateral corner. The authors did not use a tibial tunnel for the reconstruction. They mentioned that the popliteofibular ligament does not attach to the posterolateral tibia and used the native popliteus musculotendinous junction to reconstruct this structure and the popliteus tendon.

#### Arthroscopic Arciero or LaPrade-Type Posterolateral Corner Reconstruction

In 2019 Kolb et al.<sup>21</sup> and Frings et al.<sup>22</sup> from the group in Hamburg (Germany) described an all-arthroscopic posterolateral corner reconstruction in the form of an arthroscopic execution of the LaPrade technique and Arciero technique, respectively. In 2020, Liu et al.<sup>30</sup> described their technique for arthroscopic posterolateral corner reconstruction. The authors described their arthroscopic adaption of the single-fibular sling technique (Arciero technique). They validated this technique on 12 cadaveric knees and were able to restore posterolateral restraint of the knee. In



**Fig 3.** Arthroscopic tibiofibular-based reconstruction with interference screw fixation of auto- or allografts in the respective tibial, femoral, and fibular tunnels.

2020, Freychet et al.<sup>23,42</sup> described in detail their technique to arthroscopically identify the popliteus tendon, the posterior fibular head, the LCL, the popliteofibular ligament, the biceps femoris tendon, and the peroneal nerve. They also described an arthroscopic LaPrade technique for posterolateral corner reconstruction. In 2021, Frings et al.<sup>43</sup> described their technique for arthroscopically visualizing all key structures of the posterolateral corner. The authors specifically mentioned that arthroscopic neurolysis of the peroneal nerve is not to be recommended, as it increases the risk of injury. The authors commented that a transeptal portal is crucial in arthroscopic posterolateral corner reconstructions for full visualization of this area.

### Arthroscopic Repair of the Posterolateral Corner of the Knee

In 2011, Zhang et al.<sup>33</sup> reported an all-arthroscopic repair of an arcuate avulsion fracture. This article was the first article to describe arthroscopic visualization of the fibular head. In 2012, Salzler and Martin<sup>34</sup> reported an all-arthroscopic anatomic repair of a femorally avulsed popliteus tendon. They combined this technique with an open LCL and posterolateral arcuate complex reconstruction. The reason for performing an arthroscopic repair despite using an open lateral incision for LCL reconstruction was to avoid a capsulotomy

and decrease the risk of postoperative wound drainage, sinus formation, and infection and to increase visualization. In 2017, Ohnishi et al.<sup>35</sup> described their technique of posterolateral capsular plication in patients with increased posterolateral instability without obvious injury to the popliteus tendon, popliteofibular ligament, or LCL. The authors stressed the importance that this technique can only be used if there is no obvious injury to the posterolateral corner structures and mentioned using this technique in isolated posterolateral rotatory instability. In 2018, Hermanowicz et al.<sup>19</sup> described their technique for arthroscopic popliteus tenodesis in case of a posterolateral corner injury with an intact femoral attachment of the popliteus tendon. They mentioned using this technique in combination with other (open) techniques according to the degree of posterolateral corner injury. Injury to the femoral attachment of the popliteus tendon is a contraindication for this technique. In 2020, Koukoulas et al.<sup>36</sup> published a case of a 16-year-old male patient who sustained an isolated popliteus tendon avulsion during a soccer match. The popliteus tendon was reattached fully arthroscopically with a suture anchor.

### Clinical and Biomechanical Studies on Arthroscopic Posterolateral Corner Reconstruction of the Knee

In 2016 Zhang et al.<sup>7</sup> compared the results of 33 patients with a PCL reconstruction and either an arthroscopic popliteus bypass reconstruction or a mini-open popliteofibular ligament reconstruction. The results were comparable. In 2019, Li et al.<sup>9</sup> compared an open popliteus bypass procedure with an arthroscopic popliteus bypass in 38 patients with Fanelli type A posterolateral corner injury and a PCL injury. They found similar subjective and objective outcomes between the 2 groups. In 2019, Chernchujit et al.<sup>32</sup> published their results of a comparative biomechanical study comparing the arthroscopic popliteus bypass and minimally invasive LCL reconstruction (Fig 3) with a classical open LaPrade technique in grade III posterolateral corner injuries. They found no difference between the 2 techniques but only evaluated varus stability. In 2021, Drenck et al.<sup>31</sup> reported that the popliteus bypass was superior to restoring external rotation than the Larson technique in a cadaveric setup. In 2022 Li et al.<sup>8</sup> compared the results of an arthroscopic popliteus bypass procedure with a popliteal tendon recess procedure in patients with Fanelli type A posterolateral corner injuries and found the results to be comparable. In 2022 Weiss et al.<sup>5</sup> reported their results on performing an arthroscopic Arciero technique or an arthroscopic LaPrade technique for 19 patients with Fanelli type B posterolateral corner injuries with a concomitant PCL injury. They reported no neurovascular complications and no difference

between the 2 groups. The arthroscopic LaPrade technique did take significantly longer than the Arciero technique, and the maximum flexion angle at 12 months was significantly greater in the Arciero group compared with the LaPrade group. In 2018, Krause et al.<sup>44</sup> performed a magnetic resonance imaging study to determine a number of quantifiable parameters for location of the exit point for the tibial tunnel in an (arthroscopic) popliteus tendon reconstruction. The tunnel should be located on the crossing of a tangent to the tip of the fibular head and the medial edge of the fibular head. In 2023 Krause et al.<sup>3</sup> studied the placement of a fibular tunnel for posterolateral corner reconstruction in an arthroscopic technique compared with an open technique. The arthroscopic techniques were more accurate than the open technique for positioning of the tunnel. Feng et al.<sup>25</sup> mentioned that at the time of publication they had already performed an arthroscopic popliteus bypass clinically in 6 cases with good results, which they define as a restoration of external rotational stability. In 2016, Frosch et al.<sup>45</sup> mentioned in a follow-up study using their popliteus bypass technique in 35 patients with good and excellent clinical results and low complications. They do not further specify what entails good to excellent clinical outcome. They performed an additional LCL reconstruction in 3 patients but did not mention whether this was open or arthroscopic. In 2016, Razi et al.<sup>38</sup> described using either an isolated popliteus bypass procedure or in combination with a modified Larson in patients depending on the grading of the posterolateral corner injury. They used this approach in 39 patients, with a mean follow-up of  $58 \pm 1$  months. The results at latest follow-up were good for International Knee Documentation Committee scores and clinical testing. In 2019, Babu et al.<sup>37</sup> reported their results of the arthroscopic popliteus bypass procedure in 12 patients. The authors used the technique described by Kodkani.<sup>26</sup> No complications were reported, and all patients did well clinically. There was no objective measurement of the posterolateral instability pre- or postoperatively. Mean follow-up was 6-36 months. In 2022, Drenck et al.<sup>4</sup> retrospectively evaluated 23 patients with a minimum of 2-year follow-up after arthroscopic popliteus bypass procedure and concomitant posterior cruciate ligament reconstruction. The arthroscopic popliteal bypass graft technique provided good-to-excellent clinical results in the midterm follow-up in patients with type A posterolateral corner instability and concomitant PCL injury.

## Discussion

This systematic review shows that most studies addressing arthroscopic posterolateral corner reconstruction techniques are of low-level evidence, mainly due to the small number of patients and the

retrospective nature of the study design. No neurovascular injuries have been reported to date in arthroscopic posterolateral corner reconstruction of the knee. Most surgeons perform open reconstructive techniques for treatment of this injury. Recently, some studies have been reported that describe the arthroscopic execution of these techniques.<sup>4,6,9,13,19-21,25-27,30,32,34,37,42,43,45</sup> There remains large heterogeneity in the treatment of these injuries, with the option of using a fibular-based, tibial-based, or tibiofibular-based reconstruction technique.<sup>1</sup> A meta-analysis has shown comparable clinical outcomes with open fibular-based and tibiofibular-based reconstruction techniques.<sup>16</sup> Approximately one half of knee surgeons choose a fibular-based reconstruction technique, probably due to the fact that it is less technically demanding and less invasive.<sup>1,16</sup> A more injured structure specific reconstruction technique is another option, hereby shying away from a more one-size-fits-all solution for posterolateral corner injuries of the knee.<sup>46</sup> Arthroscopic techniques for posterolateral corner reconstruction have the advantage of being even less invasive and can target specific structures but are generally regarded as technically demanding with a greater risk of neurovascular injury.<sup>10,11</sup> In an editorial commentary in 2018, LaPrade and Engebretsen<sup>10</sup> commented that small incisions can lead to big mistakes, cautioning fellow knee surgeons to know and learn the intricate anatomy of the posterolateral corner and to underline the importance of anatomic reconstructions. The authors mentioned the frequency of malpositioned femoral and fibular tunnels in revision cases. In another editorial commentary in 2019, LaPrade<sup>12</sup> cautioned more inexperienced knee surgeons for the risks involving arthroscopic or minimally invasive popliteus tendon reconstructions. In 2020, Chahla et al.<sup>11</sup> cautioned against the use of a minimally invasive or arthroscopic approach for drilling the tibial tunnel in a popliteus tendon reconstruction due to proximity of the popliteal artery. The authors noted the steep learning curve that is often described and the limited clinical outcome studies of these arthroscopic techniques. They also underlined the risks of these arthroscopic techniques, such as malpositioning of tunnels due to poor visualization and the increased risk of neurovascular injury. In the hands of experienced surgeons, however, arthroscopic techniques can provide the benefits of being less invasive and more accurate than open techniques, as described by Krause et al.<sup>3</sup> A systematic review in 2020 was performed by Weiss et al.<sup>13</sup> concerning arthroscopic reconstruction of the posterolateral corner of the knee. At that point in time, most reports on this subject were technical notes, and few clinical data were available. Their systematic review therefore mainly focused on the comparison of the technical aspects of these techniques. They also did not include repair techniques

in their assessment. Since then, more clinical and biomechanical data have been published concerning arthroscopic treatment of posterolateral corner injuries. We therefore felt there was a need for an updated systematic review on this subject. The most important finding of our systematic review was the limited clinical and biomechanical evidence on arthroscopic techniques for posterolateral corner reconstruction. There is inconsistency in the structures that are repaired in the repair studies, ranging from an arcuate fracture repair, posterolateral capsule repair to repair of a femorally avulsed popliteus tendon. Clinical outcomes are reported for 3 patients for these repair techniques with a follow-up time from 1 to 2 years. There is also large heterogeneity in the techniques used in arthroscopic posterolateral corner reconstruction. Twenty-one percent of studies describe a tibiofibular-based technique, 41% describe a tibial-based technique, 22% describe a fibular-based technique, and 16% describe a repair technique. The testing methods in the biomechanical studies varied substantially. Only 3 studies reported a comparison between an arthroscopic or open technique for posterolateral corner reconstruction.<sup>7-9</sup> The results were comparable in these 2 studies. The mean CMS score of all studies with exception of the biomechanical and cadaveric studies was  $43 \pm 11.4$ , which is rated as poor. The low score, however, is mainly due to the limited number of patients and the retrospective nature of the studies and not because of study set-up. The level of evidence for arthroscopic posterolateral corner reconstruction is therefore currently low with only 4 Level III evidence studies. Despite the low level of evidence, there are multiple studies showing promising results for arthroscopic treatment of posterolateral corner injuries of the knee. A study shows more accurate placement of the fibular tunnel arthroscopically compared with open for posterolateral corner reconstruction techniques.<sup>3</sup> In 2016, Frosch et al.<sup>45</sup> mentioned in a follow-up study using their popliteus bypass technique in 35 patients with good and excellent clinical results and low complications. In 2016, Razi et al.<sup>38</sup> described using an either an isolated popliteus bypass procedure or in combination with a modified Larson in patients depending on the grading of the posterolateral corner injury. The results at latest follow-up were good for International Knee Documentation Committee scores and clinical testing. In 2019, Babu et al.<sup>37</sup> reported their results of the arthroscopic popliteus bypass procedure in 12 patients. They are the first to describe a learning curve for the procedure, but due to the additional procedures, the learning curve cannot be objectively defined. No complications were reported, and all patients did well clinically. No neurovascular complications are reported in the literature for arthroscopic posterolateral corner reconstruction or repair

techniques. These results seem to confirm the statements of some authors that arthroscopic techniques to reconstruct the posterolateral corner are safe and accurate<sup>3</sup>. It should be noted though that many of these techniques are being performed by high-volume knee surgeons extremely skilled in arthroscopic reconstructive techniques and these results should be interpreted with caution.<sup>10-12</sup> More studies are needed that compare arthroscopic techniques with open techniques regarding clinical outcomes and complications. Only 2 outcome studies, with low levels of evidence, were available for comparison with open techniques, thereby limiting recommendations at this point. Future studies should focus on a comparison of arthroscopic techniques with open techniques concerning outcomes, complications, and learning curve.

### Limitations

We acknowledge limitations to this systematic review. The heterogeneity of the biomechanical and clinical studies, more specifically for technique (fibular- or tibial- or tibiofibular-based) and graft selection limits direct comparisons when evaluating biomechanical and clinical results. There are only 3 studies in the literature comparing results of these arthroscopic reconstructive techniques with open techniques. Although results at this point seem to match the results of the open techniques, due to the limited number of studies, it is impossible to make clinical recommendations at this point. No neurovascular injuries have been reported with the use of arthroscopic techniques to reconstruct the posterolateral corner of the knee; however, most studies come from the same scientific groups, and the surgeries are performed by high-volume knee surgeons.

### Conclusions

Most studies addressing arthroscopic posterolateral corner reconstruction of the knee are of low level of evidence and provide limited information about the best treatment options.

### Disclosure

All authors (S.H., P.D., M.K., P.V., J.M.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. Full ICMJE author disclosure forms are available for this article online, as [supplementary material](#).

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