The Use of the Ligament Augmentation and Reconstruction System (LARS) for Posterior Cruciate Reconstruction

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Purpose: To systematically review and assess the use of the Ligament Advanced Reinforcement System (LARS; Surgical Implants and Devices, Arc-sur-Tille, France) for posterior cruciate ligament (PCL) reconstruction. Methods: A search of multiple databases was conducted using the following terms: (LARS[All Fields] AND posterior[All Fields]) OR (LARS[All Fields] AND PCL[All Fields]). The methodologic quality of each article was assessed by use of abridged Downs and Black criteria. Results: Fifty-four studies were found from the database search, of which 5 were included in the final review (4 case series and 1 case-control study). One hundred twenty-nine PCL reconstructions with LARS were performed. The mean patient age was 32.2 years, with 89 male and 40 female patients included. The mean follow-up time ranged from 10.5 to 44 months. Lysholm scores improved from a mean of 64.8 preoperatively to 89.8 postoperatively. No patients had International Knee Documentation Committee grade 1 or 2 preoperatively, with 93.0% achieving this postoperatively. Only 1 case of synovitis and 1 case of graft rupture were reported. Conclusions: There is little evidence on the effectiveness of PCL reconstructions using LARS ligaments. What data there are show great promise, with short- and medium-term outcome data appearing favorable to autograft reconstruction. Complication rates are encouragingly low. Clinical Relevance: LARS has great potential for PCL reconstruction. Further studies are needed regarding the use of LARS ligaments during PCL reconstruction, including longer follow-up periods and investigation into the optimal timing for reconstruction. This may be best achieved by way of a multicenter study.

Posterior cruciate ligament (PCL) injury accounts for up to 20% of all ligamentous knee injuries.\(^1,2\) There is mixed evidence as to whether PCL reconstruction is adequate to significantly alter the natural history of PCL deficiency and prevent articular degeneration.\(^2,3\) The primary uncertainty is the ability of a reconstruction to maintain the long-term stability and function of the knee.\(^2,3\) The anatomic structure of the PCL makes reconstruction less reliable compared with anterior cruciate ligament (ACL) reconstruction.\(^7\) The PCL is considered an intra-articular ligament, although it is extrasynovial. Recent anatomic descriptions have divided the ligament into anterolateral and posteromedial bundles,\(^7\) based on its functional assessment and differential tensioning in flexion and extension. Many studies have investigated variables that affect the outcome of PCL reconstructive surgery,\(^8\) including graft choice,\(^9,10\) femoral tunnel placement,\(^6,11\) and tibial tunnel placement.\(^12,13\) Because of higher rates of instability and resulting poorer outcomes compared with ACL reconstruction, protection of the PCL graft is paramount during the early phase of postoperative rehabilitation.\(^5\)

Artificial ligaments have been used for knee ligament reconstruction as far back as the 1970s,\(^14\) although most of the research has focused on ACL reconstruction. The first generation involved Teflon, carbon fiber, and polypropylene ligaments, but they were withdrawn because of high failure rates.\(^15\) In the 1980s expanded polytetrafluoroethylene (PTFE) was used. It was thought to have a good biomechanical profile, but complication
rates of up to 76% have been reported. The complications include PTFE deposits in the distant lymph nodes. PTFE soon fell into disuse thereafter. Woven Dacron ligaments were used in the 1990s. Although complication rates with Dacron were lower than those with previous synthetic ligaments, they were still high, and this product was withdrawn in 1994. Table 1 summarizes some of the more common artificial ligaments that have been previously used.

The Ligament Advanced Reinforcement System (LARS; Surgical Implants and Devices, Arc-sur-Tille, France) was first implanted in 1992. LARS ligaments are made from polyethylene terephthalate with a varying intra- and extra-articular structure (Figs 1 and 2). The intrasosseous section is formed from longitudinal fibers bound together by a knitted structure, and the intra-articular portion is made of purely unlinked longitudinal fibers orientated in a 90° spiral (Fig 3). The intra-articular structure resembles the normal anatomy of the ACL compared with earlier attempts, helping to avoid shearing forces. The polyethylene terephthalate fibers allow tissue ingrowth, reducing friction and theoretically avoiding tunnel enlargement.

There have been numerous investigations into the use of LARS ligaments during ACL reconstruction. There are 3 systematic reviews regarding the use of polyethylene terephthalate or LARS synthetic ligament systems. Machotka et al. performed a systematic review including 4 studies, 2 of which compared LARS with autograft. They concluded that the short-term results for LARS appear promising, with faster recovery times, high patient satisfaction levels, lack of donor-site morbidity, and similar outcome and complication profiles compared with autografts. However, the studies included had relatively short follow-up periods (range, 2 to 62 months), and their methodology was arguably suboptimal. Machotka et al. specifically commented on the lack of rehabilitation protocols included in the studies.

Mulford and Chen published a systematic review based on the use of polyethylene terephthalate ligaments and separately analyzed 12 studies using LARS, 4 of which compared LARS with various autografts. Again, it was concluded that the results appeared promising but that there were no long-term results (mean follow-up, 28 months; follow-up range, 4 to 60 months).

The most recent systematic review is that of Newman et al., published in 2013. They reviewed 9 studies, 1 of which compared LARS with various autografts. Again, it was concluded that the results appeared promising but that there were no long-term results (mean follow-up, 28 months; follow-up range, 4 to 60 months).

Table 1. Details, Including Complications Resulting in Withdrawal or Disuse, of Previous Artificial Ligaments Used in Reconstruction of Cruciate Ligaments

<table>
<thead>
<tr>
<th>Ligament</th>
<th>Years of Use</th>
<th>Examples</th>
<th>Mechanism of Action</th>
<th>Structure</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon fiber</td>
<td>1977</td>
<td>Intergraft</td>
<td>Thought to be tenogenic, allowing ingrowth of fibrous tissue</td>
<td>Flexible implant, coated with absorbable polymers and collagen</td>
<td>Poor torsional resistance. Deposits in joint and regional lymph nodes. Excessive laxity and rupture rate</td>
</tr>
<tr>
<td>Polyester composites</td>
<td>1980</td>
<td>Prolflex, Trevira, Pro-pivot</td>
<td>High ultimate tensile strength, low stiffness, reduced water adsorption</td>
<td>Varying</td>
<td>Tunnel widening, synovitis, high rupture rate</td>
</tr>
<tr>
<td></td>
<td>1982</td>
<td>Leeds-Keio</td>
<td>Augment used to promote soft-tissue ingrowth</td>
<td>Mesh-like structure</td>
<td>Deterioration of knee stability after 1 yr. High rates of long-term rupture Poor long-term stability. High failure rates</td>
</tr>
<tr>
<td></td>
<td>1989-1994</td>
<td>Dacron</td>
<td>Scaffold for ingrowth of fibrous tissue</td>
<td>4 tightly woven strips sheathed in loosely woven velour</td>
<td></td>
</tr>
<tr>
<td>Expanded PTFE</td>
<td>1986-1993</td>
<td>Gore-Tex, Telfon</td>
<td>High ultimate tensile strength, low levels of creep and fatigue</td>
<td>Single long fiber arranged into loops</td>
<td>Good early results but rapid deterioration due to mechanical fatigue and loosening. High failure rate within 3 yr</td>
</tr>
</tbody>
</table>

NOTE. Manufacturer information is as follows: Intergraft, Osteonics Biomaterials, Livermore, CA; Prolflex, Protek Ltd, Bern, Switzerland; Trevira, Telos, SARL, Marburg, Germany; Pro-Pivot, Istituto Ortopedico Gaetano Pini, Milan, Italy; Leeds-Keio, Neoligaments Ltd, Leeds, UK; Dacron ligament, Meadox Medicals, Oakland, NJ; Stryker Corp, Kalamazoo, MI; Kennedy Ligament, 3M, St. Paul, MN; Gore-Tex, W.L.Gore, Flagstaff, AR.

BTB, bone-tendon-bone.
which used LARS as an augment to a thin hamstring autograft. The mean follow-up period was slightly greater than that in the previous systematic reviews, ranging from 18 to 60 months. Again, this article concluded that the methodology of the included studies was generally poor; the early results were promising, but longer-term results were needed. This systematic review included much more data on patient return to sport, ranging from 2 to 6 months, much sooner than would be expected for autograft patients. Machotka et al.20 were unable to offer any firm recommendation with regard to return to sport from the data they analyzed.

The LARS ligament was developed by J. P. Laboureau and was originally designed for PCL reconstruction.21 Given the higher incidence of ACL injuries, it is obvious why most investigations have focused on LARS as a tool for ACL reconstruction. The 3 systematic reviews on ACL reconstruction using LARS all came to a similar conclusion: early results are very promising, but there are no long-term data.

The aim of this systematic review was to assess whether there is evidence to support the use of LARS in PCL reconstruction, the indication for which it was originally intended.

Methods

Search Strategy
A search was conducted using the online Cochrane Library, Medline, and PubMed databases, using the following terms: (LARS[All Fields] AND posterior[All Fields]) OR (LARS[All Fields] AND PCL[All Fields]). No limitations were placed on sex, age, date, or language. The bibliographies of all articles were reviewed to identify possible further relevant articles (Fig 4 shows the PRISMA [Preferred Reporting Items for Systematic Reviews and Meta-Analyses] flowchart).

All articles were assessed against the following inclusion criteria:
- PCL reconstruction using LARS.
- Prospective study or retrospective study.

The exclusion criteria were as follows:
- Multiple ligament reconstruction.
- Use of earlier generations of synthetic ligaments (i.e., not LARS).
- Review articles or case reports.
- No full text in the English language or available in a readily translatable format.

Data Extraction
All articles included underwent detailed review with the following dataset assessed: number of LARS ligaments implanted, mean age of patients, sex of patients, mean follow-up period, mean time to surgery, laterality of reconstruction, use of postoperative braces, postoperative weight-bearing status, preoperative assessment of the injured knee, postoperative assessment of the reconstructed knee, complications, and time period until return to sport occurred.

Assessment of Methodologic Quality
In a similar manner to Newman et al.,22 we assessed the methodologic quality of the articles using abridged Downs and Black criteria.23 Fifteen criteria are used to score a study, with a positive criterion result scoring 1 mark and a negative criterion result scoring 0. The assessment was performed independently by 2 of the authors. Any possible disagreement was resolved by the senior author. The level of evidence was also determined.

Results

Search Results
Fifty-four articles were identified by the database search. Reviewing the bibliographies of the articles
identified by the search found 1 relevant article. Removing duplicates and applying the inclusion criteria resulted in 8 eligible articles. Three studies were removed based on the exclusion criteria (no full text or translation in the English language in 2 studies and multiple ligament reconstruction in 1 study), resulting in 5 studies included for final review. The details of the 5 studies are shown in Table 2.

**Methodologic Quality**

Table 3 summarizes the results of the Downs and Black abridged criteria for the 5 studies. Of the studies, 2 scored 12 of 15 (80%), 2 scored 11 of 15 (73.3%), 1 scored 10 of 15 (66.6%), and 1 scored 0 of 15. All studies described their sample population without any justification of their sample size or performance of a power calculation. Three studies did not attempt to account for any confounders in their results, and 2 of these studies failed to clarify any exclusion criteria. Two of the five studies were guilty of data dredging, possibly creating spurious or misleading implications from the analysis of their data.

**Study Characteristics**

The 5 studies consisted of 4 case series and 1 retrospective case-control study. Two studies only included acute injuries (defined as <3 months from injury to surgery), 1 study included only chronic PCL ruptures, 1 study included a mixture of acute and chronic ruptures, and 1 study did not specify how old the injuries treated were. The age of the patients

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**Table 2. Summary of Studies Obtained From Search Term and Included in Systematic Review After Application of Inclusion and Exclusion Criteria**

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Journal</th>
<th>Type of Study</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chen et al.</td>
<td>2012</td>
<td>Orthopedics</td>
<td>Retrospective case series</td>
<td>IV</td>
</tr>
<tr>
<td>Li et al.</td>
<td>2009</td>
<td>International Orthopaedics</td>
<td>Retrospective case-control study</td>
<td>IIIB</td>
</tr>
<tr>
<td>Huang et al.</td>
<td>2010</td>
<td>The Chinese Medical Journal</td>
<td>Prospective case series</td>
<td>IV</td>
</tr>
<tr>
<td>Xu et al.</td>
<td>2008</td>
<td>Chinese Journal of Reparative and Reconstructive Surgery</td>
<td>Retrospective case series</td>
<td>IV</td>
</tr>
<tr>
<td>Shen et al.</td>
<td>2012</td>
<td>The Journal of Surgical Research</td>
<td>Prospective case series</td>
<td>IV</td>
</tr>
</tbody>
</table>
ranged from 17 to 59 years, with a mean of 32.2 years. There were over twice as many male patients undergoing reconstructions as female patients (89 male and 40 female patients). The mean follow-up period ranged from 10.5 to 44 months.

The 5 studies include 129 PCL reconstructions utilizing LARS. Two types of LARS ligaments exist, with different numbers of fibers in the intra-articular portion, PC60 and PC80, the latter containing more fibers. Only 2 articles stated which LARS ligament was used (PC80 by Shen et al.28 and Xu et al.27); the other 3 did not mention this fact. All articles described the operative technique in fair detail. All articles commented on rehabilitation regimens. With the exception of 1 study using a postoperative brace,25 there was a large degree of homogeneity in these regimens.

With respect to clinical outcome scoring, all studies used Lysholm and International Knee Documentation Committee (IKDC) scores. The Tegner score was also used by Chen et al.24 and Li et al.25 and KT-1000 arthrometer (MEDmetric, San Diego, CA) testing was used by Shen et al.28 and Li et al. The Lysholm score improved from a mean of 64.8 preoperatively to 89.8 postoperatively at the final follow-up. The IKDC scores also improved: 0 patients had grade 1 or 2 scores preoperatively, whereas 93.0% had grade 1 or 2 scores postoperatively. The only control group included in the studies (PCL reconstruction with 4-strand hamstring autograft) had a Lysholm score increase from a mean of 71 to 85, with 73.3% of postoperative knees being classified as grade 1 or 2 based on the IKDC score.25 The results of all the studies are summarized in Table 4.

Three patients in 2 studies had complications of infection,24,28 1 of which resulted in a deep infection and was associated with graft rupture. Synovitis was only reported in 1 patient,24 and 3 patients in 2 studies had long-term pain postoperatively.25,28 All the complications listed in the studies are presented in Table 5.

Discussion

The aim of this systematic review was to assess whether there is evidence to support the use of LARS in PCL reconstruction. This review identified 5 studies (4 case series and 1 case-control study) with moderate methodologic quality. In general, the results appear encouraging for the use of LARS in PCL injuries.

Improvements in outcome scores were consistent among studies, with Lysholm scores increasing by 25.0 points on average and 93.0% of patients achieving IKDC grade 1 or 2 postoperatively; this is in comparison to the only control group included in the studies, in which the Lysholm score increased by 14 points and 73.3% achieved IKDC grade 1 or 2. Authors have reported successful return to sport as early as 4 months after LARS PCL reconstruction, significantly earlier than most would contemplate after autograft reconstruction.29,30
Table 4. Summary of Details Taken From Results Sections of 5 Included Studies

<table>
<thead>
<tr>
<th>Author</th>
<th>Graft</th>
<th>No. of Patients in Study</th>
<th>M:F</th>
<th>Mean Age (yr)</th>
<th>Mean FU (mo)</th>
<th>Time to Surgery</th>
<th>R:L</th>
<th>Brace</th>
<th>WB</th>
<th>Preoperative Knee Assessment</th>
<th>Postoperative Knee Assessment</th>
<th>Complication</th>
<th>Return to Sport</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chen et al., 2012</td>
<td>LARS</td>
<td>38</td>
<td>23:15</td>
<td>32.6 (19-59)</td>
<td>37</td>
<td>6 mo (1-48 mo)</td>
<td>22:16</td>
<td>No</td>
<td>PWB, 2 wk</td>
<td>L, 70.0 T, 3.4 IKDC, 0%</td>
<td>L, 91.7 T, 6.0 IKDC, 89.5%</td>
<td>Synovitis, n = 1</td>
<td>6 mo</td>
</tr>
<tr>
<td>Shen et al., 2012</td>
<td>LARS</td>
<td>41</td>
<td>25:16</td>
<td>34 (23-57)</td>
<td>44</td>
<td>21 d, 90% 3 mo, 10%</td>
<td>22:19</td>
<td>No</td>
<td>NWB, 4 d PWB, 4 wk</td>
<td>L, 64.9 IKDC, 0% S IKDC, 0% O KT, 0%</td>
<td>L, 92.1 IKDC, 95% S IKDC, 93% O KT, 93%</td>
<td>Superficial infection, n = 1</td>
<td>Not stated</td>
</tr>
<tr>
<td>Huang et al., 2010</td>
<td>LARS</td>
<td>20</td>
<td>16:4</td>
<td>27.5 (17-48)</td>
<td>29.4</td>
<td>Not stated</td>
<td>11:9</td>
<td>No</td>
<td>NWB, 2 wk PWB, 4 wk</td>
<td>L, 46.6 IKDC, 0</td>
<td>L, 80.8 IKDC, 95%</td>
<td>Tibial screw pain, n = 2 Stitch sinus, n = 1</td>
<td>4 mo</td>
</tr>
<tr>
<td>Li et al., 2009</td>
<td>4SHG</td>
<td>15</td>
<td>13:2</td>
<td>20-43</td>
<td>28</td>
<td>5-32 mo</td>
<td>3 wk, locked 2 mo, 0°-90°</td>
<td>3 wk, locked 2 mo, 0°-90°</td>
<td>3 wk, locked 2 mo, 0°-90°</td>
<td>L, 71 T, 2 IKDC, 0</td>
<td>L, 70 T, 2 IKDC, 0</td>
<td>L, 85 T, 6 IKDC, 93%</td>
<td>Anterior knee pain, n = 1 Arthrofibrosis, n = 1</td>
</tr>
<tr>
<td>Xu et al., 2008</td>
<td>LARS</td>
<td>9</td>
<td>8:1</td>
<td>23-49</td>
<td>10.5</td>
<td>13.6 d</td>
<td>6:3</td>
<td>No</td>
<td>PWB, 3 wk</td>
<td>L, 70 T, 2 IKDC, 0</td>
<td>L, 70 T, 2 IKDC, 0</td>
<td>L, 85 T, 6 IKDC, 93%</td>
<td>Anterior knee pain, n = 1</td>
</tr>
</tbody>
</table>

NOTE. All values are given as mean values with ranges in parentheses when appropriate.

ADL, activities of daily living; 4SHG, 4-strand hamstring graft; IKDC, International Knee Documentation Committee rating (grades 1 and 2 only); KT, KT-1000 score; L, Lysholm score; LARS, ligament augmentation and reinforcement system; M:F, ratio of male to female patients in study; mean FU, mean follow-up period for patients in individual studies; NWB, full weight bearing; PWB, partial weight bearing; R:L, ratio of right to left knees operated on in each study; T, Tegner score; WB, weight-bearing status postoperatively.
Two of the studies could be deemed guilty of data dredging, as mentioned earlier. Chen et al.\textsuperscript{24} performed a univariate and multivariate analysis on the effect of certain demographic and preoperative variables on the outcome of the Tegner, Lysholm, and KT-1000 scores. The variables were age, sex, laterality of injury, preoperative outcome score, whether the injury was sustained in a traffic accident, and whether there were other associated injuries. Only 1 variable, associated injuries, was found to have a significant effect on all outcome scores. There was not any consistent significant effect from any other variable across all outcomes. Given the small sample sizes, lack of power calculation, and multiple variables, the validity of the significance of the associations needs to be questioned. Shen et al.\textsuperscript{28} compared their postoperative incidence of osteoarthritic changes with other, unreferenced “numerous studies.” They claim that the “numerous studies” show that PCL injury is associated with degenerative changes, yet only 10% of the patients in their study showed osteoarthritic changes by use of the Ahlbäck classification. Their study had a minimum of 3 years’ follow-up (<4 years on average). They did not comment on the period taken for osteoarthritic changes to become apparent in the unreferenced “numerous studies.” A recent study by Shelbourne et al.\textsuperscript{4} examined outcomes of conservatively treated PCL ruptures. They concluded that only 11% of patients showed moderate to severe osteoarthritic changes after a minimum of 10 years’ follow-up.

The LARS ligament is the first generation of artificial ligament without a woven cross-linked structure in its intra-articular portion. It is thought that this design reduces friction because the cross-linking fibers were believed to rub against the longitudinal fibers during movement, weakening the ligament and causing debris, ultimately contributing to graft rupture or synovitis. The intra-articular segment of the LARS ligament is said to act as a scaffold for ingrowth of the ruptured ligament stump, further reducing shear forces acting on it. This scaffold action is supported by the work of Trieb et al.,\textsuperscript{31} who showed fibroblast ingrowth into biopsied LARS ligaments 6 months after implantation in vivo and in vitro. They also found osteoblast-like cells growing into in vitro specimens. Work by Lessim et al.\textsuperscript{32} looked to improve the biocompatibility of the LARS ligament, showing greater organization of collagen fiber ingrowth on specially bioactive grafted LARS ligaments.

The overall failure rate of the LARS ligament appears encouraging, with only 1 reported rupture among the 129 reconstructions (0.78%). These figures appear more favorable than the failure rates of ACL reconstruction associated with LARS use (2.5%)\textsuperscript{22} and autologous hamstring graft reconstruction (1.8% to 10.1%).\textsuperscript{33-40} It is important to note that the failure rates associated with hamstring autografts are from studies with a much longer follow-up; therefore direct comparison is not appropriate without further research over a greater period. It is also interesting to note that the rupture of the LARS graft was due to a deep infection. The infection is believed to have been due to contiguous spread from an upper respiratory tract infection. The patient refused to undergo any further operations on the knee, so this infection was treated purely with intravenous antibiotics. The graft later developed excessive laxity before rupturing.

Only 1 case of synovitis was reported (0.78%), which required arthroscopic synovectomy.\textsuperscript{24} The incidence of synovitis after LARS ligament ACL reconstruction appears comparable to this, with only 2 cases found in the systematic review by Newman et al.\textsuperscript{22} in over 600 patients (0.2%); poor femoral tunnel positions were believed to be responsible. LARS ligaments have been

### Table 5. Summary of Complications Occurring in 129 PCL Reconstructions Using LARS and Their Outcome

<table>
<thead>
<tr>
<th>Complication</th>
<th>Incidence</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep infection after hemotologic spread from upper respiratory tract infection</td>
<td>1 (0.78%)</td>
<td>The patient refused any form of operative intervention; therefore it was treated with intravenous antibiotics only. The graft later ruptured.</td>
</tr>
<tr>
<td>Synovitis*</td>
<td>1 (0.78%)</td>
<td>Required arthroscopic debridement</td>
</tr>
<tr>
<td>Anterior knee pain</td>
<td>1 (0.78%)</td>
<td>Outcome not recorded</td>
</tr>
<tr>
<td>Loosening of tibial screw*</td>
<td>1 (0.78%)</td>
<td>Required operative revision to larger screw</td>
</tr>
<tr>
<td>Mild swelling over anterior tibia</td>
<td>2 (1.6%)</td>
<td>Resolved after conservative treatment</td>
</tr>
<tr>
<td>Pain from tibial screw*</td>
<td>2 (1.6%)</td>
<td>Required operative removal of screws</td>
</tr>
<tr>
<td>Superficial infection</td>
<td>2 (1.6%)</td>
<td>Managed nonoperatively with oral antibiotics</td>
</tr>
</tbody>
</table>

\*Complications required operative intervention.

### Table 6. Summary of Salient Points of Study

- There are only 5 studies investigating the use of LARS for PCL reconstruction.
- PCL reconstruction using LARS appears to have comparable results and complication rates to the use of autograft, albeit with short- and medium-term findings.
- More studies are required with larger sample sizes and longer follow-up periods to ascertain the viability of LARS as a reliable alternative to autograft and allograft in PCL reconstruction.
developed to reduce potential wear particle production and improve their biocompatibility. Compared with previous synthetic grafts, it appears that the results thus far are encouraging. It is important to reiterate that PCL reconstruction, independent of graft choice, is a technically demanding operation and accuracy of graft tunnel placement is still believed to be 1 of the most important factors of success.

Ideally, the reconstruction should take place in an acute setting because this prevents scarring of the ligament stump, reducing the potential for ingrowth. Two studies stated that they used the LARS ligament purely in the acute setting. The improvements exhibited by their patients were the greatest compared with the other studies (Lysholm score difference of 27.2 in the larger series and 35.0 in the smaller series). Despite this, the other studies all reported greater improvements in outcome measures compared with the control group, which underwent 4-strand hamstring autograft reconstruction.

An often-underappreciated factor in ACL reconstruction surgery is that of donor-site morbidity, the most common problem being pain from the donor site, which can impair postoperative rehabilitation. A recent meta-analysis by Kraeutler et al. examined outcomes of ACL reconstruction using autograft. They quoted donor-site pain as a complication with an incidence of 38.5% in 76 studies involving over 5,000 patients. One of the obvious benefits of synthetic grafts is the lack of donor-site morbidity, as well as the increased immediate rehabilitation potential as a result of this.

More high-quality comparative studies, ideally multicenter studies, are required before one can advocate LARS ligaments as being the standard for PCL reconstruction. Although the time to return to sport seems very favorable compared with autografts, there was no information on the number of patients who were not able to return to their preinjury level of sports participation despite achieving a good outcome. Most of the studies treated patients with chronic PCL injuries or a combination of acute and chronic injuries. The 2 articles that treated purely acute PCL injuries seemed to have better outcomes than the other studies. It would be of great benefit to analyze acute and chronic injuries as individual subgroups to determine whether there is any benefit to expediting any contemplated intervention.

Limitations

This study was limited by the paucity of high-level, high-quality evidence. All but 1 study failed to include any kind of control group. All studies had fairly small sample sizes, and there were no follow-up data beyond 4 years; therefore long-term results and reliability of the procedure cannot be commented on. Given that the LARS ligament has been available for nearly 20 years, it is fairly surprising that there is so little long-term evidence. This sentiment is shared by the systematic reviews investigating LARS use in ACL reconstruction. However, given the catastrophic failures associated with previous synthetic ligaments, the use and study of LARS have clearly suffered because of the negativity within the orthopaedic community regarding synthetic ligaments.

Conclusions

We have presented the first systematic review of PCL reconstruction using LARS (Table 6 shows the salient points of this study). There is little evidence present within the literature regarding the effectiveness of this technique. What data there are show promise, with short- and medium-term outcome data appearing comparable, if not favorable, to autograft reconstruction. Complication rates in the data found are encouragingly low, with loss of many of the stigmata associated with previous generations of synthetic grafts. Further studies are needed including longer follow-up periods and investigation into the optimal timing for reconstruction. This may best be achieved by way of a multicenter study.

References


