Latin American formal consensus on the appropriate indications of extra-articular lateral procedures in primary anterior cruciate ligament reconstruction

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ABSTRACT

Objectives: To create a practice guideline for the appropriate indications of an extra-articular procedure in primary anterior cruciate ligament reconstruction (ACLR).

Methods: The formal consensus method described by the Haute Autorité de Santé was used. The Latin American Society of Arthroscopy, Articular Replacement, and Sports Injuries (SLARD) recruited three groups of experts on ACLR. Initially, the steering group, consisting of eight surgeons, performed a systematic review of the literature and elaborated on 192 scenarios for primary ACLR. The rating group, composed of 23 surgeons, rated each scenario in two rounds, with an in-between in-person meeting for discussion. Median scores and agreement levels were estimated to classify each scenario as inappropriate, uncertain or appropriate for adding anterolateral reconstruction. Finally, the lecture group, consisting of 10 surgeons, revised each stage of the method, results and interpretation.

Results: Of the scenarios, 11.97% were rated as appropriate for adding an extra-articular lateral procedure, 7.81% as inappropriate and 80.21% as uncertain. The key recommendations for the addition of extra-articular lateral techniques were as follows: it is appropriate when the patient is under 25 years of age, has high-grade physical examination findings, practises a pivoting sport and has hyperlaxity; meanwhile, it is inappropriate when the patient has low-grade physical examination findings, has normal laxity and does not practise a pivoting sport.

Conclusions: The appropriate indications of extra-articular lateral procedures in primary ACLR were determined on the basis of the best available evidence and expert opinion following a formal consensus method.

Level of evidence: V.
Introduction  
Anatomic arthroscopic-assisted anterior cruciate ligament reconstruction (ACLR) is currently the gold standard treatment for restoring knee stability, assisting in return to sports and avoiding meniscal or cartilage injuries [1]. Although the rates of return to sports and satisfactory functional results are high [2], the proportion of patients with residual instability and early failure reaches 10% at 10 years after surgery [3]. A graft tear is a catastrophic event for patients and their families, sports clubs and medical teams. Moreover, functional results after ACL revision are deficient compared with those after the first surgery [4,5].

Various strategies have been proposed to decrease the rates of residual laxity and early failure (graft tear). There is a constant search to improve the surgical technique, including evaluation of more details of the morphology and attachment of the ACL, discussion on the appropriate graft to use and performance of the double-bundle procedure [6-8]. Recently, alignment has been highlighted, specifically in varus and tibial slopes. Finally, in the last decade, there has been a return to the use of extra-articular anterolateral techniques, which were widely used as isolated techniques in the ‘70s [9]. Adding an extra-articular procedure to ACLR aims to reduce the anterolateral rotary instability and the rate of ACL retear [10,11]. The indication is most agreed upon in cases of ACL revision; thus, the discussion has switched to primary ACLR being the target to screen for patients at a greater risk for graft failure [12].

Currently, evidence-based medicine is the most accepted practice; however, questions regarding daily medical practice still remain. Several meta-analyses have been conducted but were limited by the quality of the original studies, heterogeneity of anterolateral techniques and patient characteristics [13-16]. Good clinical practice guidelines based on the experience of a specific group and better available evidence are essential to fill this gap [17]. The formal consensus method described by the Haute Autorité de Santé (HAS) is a consensus and guideline method [18]. As a consensus method, it aims to formalise the degree of agreement among experts using iteratively rated scenarios with feedback. As a practice guideline method, it seeks to draft a few brief and unambiguous statements regarding the matter in question.

The appropriate indications of primary ACLR are controversial, and it is necessary to formulate guidelines that could help in the daily practice of knee surgeons. The purpose of this study was to obtain a formal consensus and create a practice guideline for the appropriate indications of an extra-articular lateral procedure in primary ACLR.

Methods  
The formal consensus method described by the HAS was carefully followed as previously described [18]. The Latin American Society of Arthroscopy, Articular Replacement, and Sports Injuries (SLARD) sequentially recruited three groups of experts on ACLR. These groups were independent, and no members belonged to more than one group.

The first group was the steering group, whose objective was to review the literature, write a systematic review and select the variables for the construction of scenarios. The scenarios represent all the possible combinations of each variable. The group consisted of eight surgeons. Thereafter, 25 Latin American surgeons were recruited for the rating group to rate all scenarios. Two of them declined the invitation. All members received the systematic review performed by the steering group and instructions to respond to the scenarios and learn how to perform the ratings. All members rated all the scenarios in two rounds on a scale of 1–9, in which ‘1’ indicated completely inappropriate; ‘5’, uncertain; and ‘9’, completely appropriate. Because the group had more than 15 members, two outlier values could be omitted from each scenario. A scenario was considered appropriate when the median value was 7 or higher and all ratings were 5 or higher. Meanwhile, a scenario was deemed inappropriate when the median value was 3 or lower and the ratings ranged from 1 to 5. All other results were considered uncertain.

After the first round, a meeting was conducted for feedback; all members received the condensed results and the anonymous answers of the 23 members and were allowed to discuss each rating to reach agreements. After this meeting, all members were allowed to maintain or change the rating of all scenarios.

After the second round, the median value and range were calculated. Ordinal regression was used to determine which variables had more weight for the raters. The median value of each scenario was the dependent variable. For this purpose, it was re-coded as ‘0’ when the median value was 3 or lower; ‘1’, between 4 and 6 and ‘2’, 7 or higher. The odds ratio (OR) and 95% confidence interval were estimated. The parallel assumption was tested using the brand test; a p-value above 0.15 considered that the null hypothesis of parallelism was valid. In addition, quantile regression was used to generate an equation to predict the median value of the ratings in the rating group that could be used to decide whether to add an extra-articular technique.

Later, the recommendations and final text were presented to a lecture group consisting of 10 surgeons. The purpose of this group was to rate each recommendation from ‘1’ (completely disagree) to ‘9’ (completely agree). When the recommendation achieved a median rating above ‘6’ and all ratings were above ‘5’, it was retained. Other results indicate that the statement is vetoed and requires a revision by the steering and rating group. Additionally, the lecture group had to supervise that each stage was conducted appropriately according to the HAS. Comments and criticisms on the final text were welcomed.

Results  
The 41 knee surgeons involved in this consensus study had a mean experience performing ACLR of 19.44 years (standard deviation, ±8.07), mean number of 114 ACLRs performed in the last 12 months (standard deviation, ±78.04) and mean rate of adding an extra-articular technique to primary ACLR of 0.24 (standard deviation, ±0.16). The preferred extra-articular technique was tenodesis in 72%, while anterolateral ligament reconstruction was favoured by 28% of the surgeons (Table 1).

The steering group selected seven variables that created 192 scenarios (Table 2). After the first round of ratings, there were 55 scenarios (28.65%) with a median value of 3 or lower, 43 scenarios (22.40%) with a median value of 4–6 and 94 scenarios (48.96%) with a median value of 7 or higher (Figs. 1 and 2). An agreement was reached for a total of 38 scenarios (19.79%), of which 23 (11.97%) were rated appropriate for the median value was 3 or lower; ‘1’, between 4 and 6 and ‘2’, 7 or higher. The odds ratio (OR) and 95% confidence interval were estimated. The parallel assumption was tested using the brand test; a p-value above 0.15 considered that the null hypothesis of parallelism was valid. In addition, quantile regression was used to generate an equation to predict the median value of the ratings in the rating group that could be used to decide whether to add an extra-articular technique.

(i) Combination of normal laxity, low-grade physical examination findings, absence of radiological findings and non-participation in pivoting sports, regardless of the age, temporality or meniscal status: The median rating by the lecture group was 9 (range, 8–9).

(ii) High-grade physical examination findings, >25 years of age, normal laxity and acute lesions without meniscal injury or radiological risk factors: The median rating by the lecture group was 8 (range, 7–9).

What are the new findings?  
- A Formal consensus was performed on the appropriate indications of anterolateral procedures in primary anterior cruciate ligament reconstruction.
- Age, laxity, physical examination and pivoting sports were the four variables that most significantly impacted the ratings.
- The appropriateness of adding an anterolateral procedure lies in the combination of factors and not in one variable alone.
Table 1
Summary of the characteristics related to the expertise of the surgeons who participated in the consensus study according to each group.

<table>
<thead>
<tr>
<th>Variable Options</th>
<th>N</th>
<th>Y ACLR&lt;sup&gt;3&lt;/sup&gt;</th>
<th>N 12 month&lt;sup&gt;3&lt;/sup&gt;</th>
<th>Rate EA ACLR&lt;sup&gt;3&lt;/sup&gt;</th>
<th>Preferred EA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>&lt;25 years</td>
<td>8</td>
<td>15.0</td>
<td>126.1</td>
<td>0.26</td>
</tr>
<tr>
<td></td>
<td>&gt;25 years</td>
<td>(±8.77)</td>
<td>(±85.43)</td>
<td>(±0.19)</td>
<td>56%</td>
</tr>
<tr>
<td>Physical examination findings</td>
<td>Low grade</td>
<td>23</td>
<td>21.1</td>
<td>113</td>
<td>0.24</td>
</tr>
<tr>
<td></td>
<td>High grade</td>
<td>(±7.47)</td>
<td>(±79.30)</td>
<td>(±0.15)</td>
<td>75%</td>
</tr>
<tr>
<td>Radiological risk factor</td>
<td>Present</td>
<td>10</td>
<td>20.6</td>
<td>100</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>Absent</td>
<td>(±7.79)</td>
<td>(±73.71)</td>
<td>(±0.15)</td>
<td>86%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>41</td>
<td>19.4</td>
<td>113</td>
<td>0.24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(±8.07)</td>
<td>(±78.04)</td>
<td>(±0.15)</td>
<td>73%</td>
</tr>
</tbody>
</table>

Abbreviations: N, Number of participants; Y ACLR, Years performing ACLR; N 12 month, Number of ACLRs performed in the last 12 month; R EA ACLR, Rate of extra-articular technique in primary ACLR; Preferred EA, Preferred extra-articular technique.

* Mean (standard deviation).

(iii) Desire to return to pivoting sports, ≥25 years of age, low-grade physical examination findings, normal laxity and no meniscal injury or radiological risk factors: The median rating by the lecture group was 8 (range, 6–9).

The agreements for appropriate indications were as follows:

(i) Combination of <25 years of age, high-grade physical examination findings, desire to practise a pivoting sport and hyperlaxity, along with the meniscal status, temporality and presence of radiological risk factors: The median rating by the lecture group was 9 (range, 7–9).

(ii) Combination of high-grade physical examination findings, practice of a pivoting sport, presence of radiological risk factors and hyperlaxity, along with the meniscal status, temporality and age: The median rating by the lecture group was 9 (range, 7–9).

(iv) Low-grade physical examination findings, chronic lesions, need for meniscectomy or meniscal repair, <25 years of age, hyperlaxity, desire to practise a pivoting sport and presence of radiological risk factors: The median rating by the lecture group was 9 (range, 7–9).

The lecture group approved all the statements. Also, it was found that when radiological risk factors and hyperlaxity were combined, no scenario reached inappropriate agreement. Meanwhile, appropriateness was not achieved in any scenario that combined >25 years of age with normal laxity or low-grade physical examination findings with normal laxity.

Ordinal regression showed that age, laxity, physical examination findings and pivoting sports were the four variables that significantly impacted the ratings (Table 3). The radiological risk factors had a significant OR; nevertheless, the brand test violated the parallel assumption of the ordinal model, making it difficult to interpret the importance of this variable.

The semiparametric model estimated a pseudo-R² value of 0.56. The equation for calculating the median rating by the rating group was as follows:

\[
\text{Median} = 1 + (0.91 \times \text{Age} < 25) + (1.91 \times \text{Hyperlaxity}) + (2.27 \times \text{high-grade physical exam}) + (2.36 \times \text{Radiological risk factor}) + (2.36 \times \text{Pivotsport}) + (0.36 \times \text{Meniscal injury}) + (0.45 \times \text{Chronic lesion})
\]

(Table 4).

**Discussion**

This study combined the best available scientific evidence with expert opinions to create a guideline for the appropriate indications of an extra-articular procedure in primary ACLR. The main finding of this study was that the appropriateness of adding an anterolateral procedure lies in a combination of factors and not in one variable alone. However, this study also showed that there is still a significant area of uncertainty regarding this topic, which is why it is imperative to promote the conduct of clinical trials.

Two randomised controlled trials showed no advantage in the addition of anterolateral surgery to primary ACL. In both studies, the inclusion criteria were broad, not selecting any specific characteristics of patients; this indicates that not every patient required anterolateral reconstruction [19,20]. Nevertheless, recent randomised controlled studies reported significantly better outcomes in a specific population: Getgood et al. [21] included patients under 25 years old with two of the following: high pivot shift, desire to practise pivot sport, hyperlaxity and genu recurvatum. They reported in this specific population that the number needed to treat to avoid one ACL revision was 14 anterolateral tenodesis. Efforts to identify subpopulations with a higher risk for ACL retear are necessary to reach adequate indications of anterolateral procedures.

Age, pivoting sports, laxity and physical examination findings were the four variables that had more weight on the ratings. These variables were repeatedly found in the reviewed literature and in the randomised controlled trial by Getgood et al. [21,22]. Youth has been consistently associated with a higher risk for ACL retear, and the MOON group reported that the risk for retear increased by 9% each year in younger patients [4]. Moreover, Schulemberg et al. [23] demonstrated that patients aged <25 years had a six-fold higher risk for ACL re-injury than patients aged >25 years.

The type of sports practised also plays an essential role in the risk for ACL retear. A study conducted with National Collegiate Athletic
Association data showed different risks among the types of sports practised [24]. In addition, using the Marx scale, the MOON group identified an association between ACLR and the volume and intensity of the sports [4].

Hyperlaxity and genu recurvatum have a high prevalence among patients aged between 18 and 25 years, reaching 26.8% and 18.6%, respectively [25]. In a level III study, Helito et al. [26] demonstrated that adding anterolateral reconstruction in patients with hyperlaxity reduced the risk of revision. A recent study showed a strong correlation between knee hyperlaxity and high pivot grade [27].

Regarding pivot shift, it has been well documented that it takes more than just an ACL tear to have a high-grade pivot shift. Injury to the anterolateral knee corner is strongly associated with anterolateral rotary instability. Other factors have been linked to a high pivot shift, such as an increased tibial slope, a smaller tibial plateau volume and a lateral meniscus tear [28].

Unlike the four previous variables, the imaging risk factor did not reach the necessary probability to validate the parallel assumption of the ordinal regression model despite obtaining a significant OR. This variable included the presence of a Segond fracture or Ferreti grade /C21 on magnetic resonance imaging (MRI), subchondral sinking of the femoral condyle or tibial slope of above 12 /C14. Controversial evidence on this topic has been reported in literature. Some studies have shown a direct correlation between the severity of anterolateral injuries on MRI and the grade of the pivot shift [29]; however, other studies have not found the same results [30]. Two reasons can explain these findings. First, a low interobserver agreement for evaluating anterolateral injuries on MRI has been reported [31]. Second, the time elapsed between the injury and the date of MRI has been shown to change the incidence of complex anterolateral injuries [32]. Segond fractures have been identified as avulsion lesions of the anterolateral capsule [9]. However, to our knowledge, no study has evaluated knee instability in patients with this fracture after ACLR by comparing it alone or with anterolateral reconstruction. Finally, it has been established that a tibial slope greater than 12° increases the risk of ACL retear [33]. The use of osteotomy to correct the tibial slope in primary ACLR has shown good outcomes [34]; nevertheless, it is a challenging surgery with a rate of complications higher than that of extra-articular techniques [35]. The use of extra-articular lateral tenodesis in the study performed by the Stability group showed that it maintained a protective effect on ACL retear in the multivariate logistic model that included the tibial slope [36]; however, more evidence is needed to determine the role of extra-articular techniques in patients with an increased slope.

Another critical issue is that most trials comparing the addition of anterolateral reconstruction in a primary ACL tear have less than 2 years of follow-up [19,21,37–43]. Zaffagnini et al. [44] published a study with

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**Fig. 1.** The 96 scenarios for acute lesions are presented. Red highlights the scenarios of agreement where an extra-articular lateral technique was considered inappropriate; meanwhile, blue highlights the scenarios of agreement where an extra-articular lateral technique was considered appropriate. Green presents the scenarios with a median rating between 4 and 6; thus, they were considered uncertain. Ecru highlights the scenarios with a median rating of <3 and >7, but which did not reach the criteria for agreement; thus, they were considered uncertain. Low grade: Low-grade physical examination, High grade: High-grade physical examination, Red: Inappropriate to perform an extra-articular lateral procedure, Green: Uncertain, Blue: Appropriate to perform an extra-articular lateral procedure, Ecru: Median rating of <3 and >7, but the scenario did not meet the criteria for agreement.

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**Fig. 2.** The 96 scenarios for chronic lesions are presented. Red highlights the scenarios of agreement where an extra-articular lateral technique was considered inappropriate; meanwhile, blue highlights the scenarios of agreement where an extra-articular lateral technique was considered appropriate. Green presents the scenarios with a median rating between 4 and 6; thus, they were considered uncertain. Ecru highlights the scenarios with a median rating of <3 and >7, but which did not reach the criteria for agreement; thus, they were considered uncertain. Red: Inappropriate to perform an extra-articular lateral procedure, Green: Uncertain, Blue: Appropriate to perform an extra-articular lateral procedure, Ecru: Median rating of <3 and >7, but the scenario did not meet the criteria for agreement.
process [47]. Second, it is the
could express their ideas, as well as to ensure the transparency of the
consensus study has several strengths. First, it used a formal method in
fi
Lyon in 2015 [46]. The discussion included anatomy, biomechanics,
2017 using the modi-
methods have been shown to lead to a less biased and more
image diagnosis and indications using an informal method. Formal
published. The
fi
lower the revision rate.
the method allowed the estimation of a formula to help in daily
allowed the objective determination of variables of more weight instead
of simply subjectively selecting the major or minor criteria. Furthermore,
the method allowed the formulation of a help in daily decision-making of knee surgeons. Also, our consensus study findings
could be used to promote the conduct of trials, as they identify areas of
uncertainty. Moreover, they could be used to evaluate over/underuse in a
retrospective cohort of patients and determine whether they correlate with the functional outcome and revision rate.

One limitation of this consensus study is that the number of variables included was limited. The scenarios combined all of them; therefore, if too many variables are selected, the number of scenarios increases exponentially. The steering group identified 21 potential candidate variables to include, indicating that 2,097,152 scenarios would have had to be rated. After the review of the literature and meetings, options, such as high-grade physical examination findings (Lachman test and pivot shift) and imagological risk factors, were grouped. Further, only one cut-point point was used for chronic ACL injuries, based on the findings by Abdelrazek et al. [37], Ibrahim et al. [39] and Batty et al. [27].

On the other hand, sex and contralateral ACL injury were variables excluded. The MOON group and Norwegian and Swedish registries showed that women do not have an increased risk for ACL tears compared with men [4,49]. The reports that found differences may be related to confounding factors, such as age and level of sports activity [4, 50], which are variables included in our consensus study. Regarding contralateral ACL lesions, the risk for contralateral lesions is 15 times greater than that in patients without a history of a knee injury. However, this consensus study focused on primary ACL tears [50].

Conclusions
The appropriateness of the indication of extra-articular lateral procedures in primary ACLR was determined on the basis of the best available evidence and expert opinion. This Latin American consensus study on the proper indication of an anterolateral procedure in primary ACLR can help in better informed clinical decision-making. An anterolateral procedure is not required for every patient with a primary ACL injury. The appropriateness of adding an anterolateral procedure lies in the combination of factors and not in one variable alone.

Declarations
All authors had approved the final form.

Conflict of interest
The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Maximiliano Barahona reports administrative support and article publishing charges were provided by Latin-American Society of Arthroscopy, Articular replacement, and Sports Injuries.

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Ethical approval
N/A.

Informed consent
N/A.

Authors contribution
MB: Project leader. MM: Contributed the original idea and supervised the study. VDP: coordinated literature review and member of the steering group. HG: supervised the draft of literature review and member of the
steering group. JDC: Supervised the final draft of the consensus and member of the steering group. SM: Perform critical review of the manuscript and member of the steering group. FBB: coordinator of the steering group. OA: Perform critical review of the manuscript and member of the steering group. AK: Chair of the steering group.

Availability of data

The datasets used or analysed during the current study are available from the corresponding author on reasonable request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jsiskos.2022.08.007.

References


