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Original Research

Current trends in anterior cruciate ligament surgery. A worldwide benchmark study

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ABSTRACT

Objectives: To benchmark current trends on anterior cruciate ligament reconstruction (ACLR) surgery.
Methods: The largest worldwide ACLR survey to date was performed during May 2020, targeted to reach representation of all continents. It was submitted electronically to all International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports surgeons (n = 3,026), asking those who perform ACLR to respond.
Results: With a final sample size of 2,107, the overall response rate was 69.6%. Median years of practice as orthopaedic surgeon was 15 (range 1–52) and 49.6% of all respondents were defined as high-volume surgeons (>50 ACLR annually). Hamstrings tendon autograft was the preferred graft for primary ACLR (80.3%) and the medial portal femoral drilling was the most frequently used technique (78.5%). Cortical buttons (82.7%) and bioabsorbable screws (62.7%) were the preferred fixation methods for hamstring tendon autograft ACLR in femur and tibia, respectively. Metallic screws (45.2%) were the preferred fixation methods for bone patellar tendon bone autograft in femur and tibia. Most of the respondents routinely used pre-tensioning techniques for their graft preparation (63.8%), but less than half of surgeons preferred antibiotic soaking of the grafts (45.3%). The preferred knee position for graft fixation was 10–30° of knee flexion and neutral rotation (57.0%). The addition of anterolateral augmentation (or extra-articular tenodesis) was infrequent in primary and isolated ACLR (10.0%), but a statistically significant raise was seen for revision surgeries (20.0%). Most used brace in the initial postoperative rehabilitation (54.9%) and the time to allow patients to fully resume sports was at an average of 8.9 ± 2.0 months. Treatment algorithm of paediatric ACL injuries exhibited a low consensus among the respondents.
Conclusion: This worldwide survey benchmarks the current trends in ACL reconstruction, achieving the largest participation of surgeons to date. Among the great variety of options available for ACL reconstructions, surgeons' preferences showed some differences according to their location and expertise. Reporting trends in practice, and not only the evidence, is important to medical education and providing patients the safest care possible.
This is a Level V, expert opinion study.

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What are the new findings?

- There is a high level of expertise in the field between peer, according to their dedication and years as knee surgeons as well as to their annually performed anterior cruciate ligament reconstruction surgeries.
- Hamstring tendon autograft (HT) was by far the preferred graft for primary anterior cruciate ligament reconstruction and medial portal femoral drilling the most frequently used technique, confirming this worldwide trend.
- The addition of any type of anterolateral augmentation (or extra-articular tenodesis) was infrequent in primary and isolated anterior cruciate ligament reconstruction, but a statistically significant raise was seen for revision surgeries.
- The time to allow patients to fully resume sports showed an average of 8.9 ± 2.0 months.

Introduction

Anterior cruciate ligament reconstruction (ACLR) is one of the most frequently performed knee surgeries with an extensive amount of literature dedicated to ACL anatomy, surgical reconstruction techniques and patient outcomes. ACLR surgery has proven to be a successful procedure, aiming to restore knee stability, prevent further articular damage and improve functional outcomes [1]. Nevertheless, to date, there is no consensus as regards the 'gold standard' method for ACLR. The constant search for optimising outcomes has led to a permanent evolution of the technique, providing the surgeons with a variety of graft options, fixation devices and surgical techniques, leading to a considerable variation in ACLR surgeries around the world.

Surgeons plan their ACLR based on personal training, available evidence, peer's preferences and local trends. To date, several local surveys have summarised the current trends and common practices for ACLR in different countries [1–8]. Grassi et al. [1] in 2018 published a systematic review of the national surveys of the last 5 years, including questionnaires from 8 different countries, ranging from 45 to 824 responses, with an overall number of 1,495 respondents and response rates that fluctuated from 19 to 76%. Previously, an international survey conducted in 2013 was answered by surgeons from 57 countries, but with only 261 responses [2].

Our aim is to conduct a worldwide survey benchmarking current trends on ACLR surgery, summarising the updated peer's opinion in an organised and comprehensive manner, targeted to reach a greater representation of all continents. We hypothesise that the ACLR practice patterns are influenced by the expertise of the surgeons, location of their practice and the evidence-based consensus published to date.

Methods

An anonymous, unpublished, encrypted online survey was conducted during May 2020, comprising 1 free response question and 17 forced choice questions (Appendix). The questionnaire was submitted electronically to all the ISAKOS sports surgeons database (n = 3.026), asking those who perform ACLR to respond. The response to the questionnaire was kept anonymous so that the content did not include direct links to the participating physicians or their clinics.

The exclusion criteria were answers with outlier values, defined as values higher than the mean ± 3 standard deviations, which were excluded assuming typing errors.

For better understanding and comparison, literature-based decision of dichotomising variables was made: years of practice as an orthopaedic surgeon (>15 years/≤15 years), percentage of current practice dedicated to knee surgery (>50%/≤50%) and number of ACLR performed annually ("high-volume surgeons" defined as those who perform ≥50/"low-volume surgeons" defined as those who perform <50) [4,8]. Also, in some specific items, comparison between "very high-volume surgeons" (defined as those who perform >75 ACLR annually) and "very low-volume surgeons" (defined as those who perform <25 ACLR annually) was made.

A descriptive statistical analysis of the data was performed. To study associations between variables, Chi-square test and Mann–Whitney–Wilcoxon test were used. The data were previously checked for normality (Shapiro Wilks test), but to account for the heterogeneous distribution of it, non-parametric statistical tests were applied. An alpha level of 0.05 was considered statistically significant. Statistical analysis was performed using STATA software, version 14 (STATA Corp LLC, CS, TX, USA).

Results

The survey was answered by 2,130 surgeons, of which 6 were excluded in the question about years of practice as an orthopaedic surgeon, and 17 in the one regarding the months to allow patients to fully resume sports; in both cases because of outlier answers. With a final sample size of 2,107, the overall response rate was 69.6%.

The location of the respondents was mainly from Asia and Oceania, followed by South America and Europe (Table 1).

The median year of practice as an orthopedic surgeon was 15, with a range from 1 to 52 and a mode of 10 years (7.9% of the sample). When dichotomising the variable, 45.6% of the respondents had >15 years of practice as an orthopaedic surgeon and 54.4% of the respondents had ≤15 years.

Most of the respondents dedicated >50% of their practice to knee surgery, with 32.5% of them dedicating 50–75% and 34.0% of them >75% of their practice. Nearly half of the respondents (49.6%) were categorised as "high-volume surgeons", 29.9% as "very high-volume surgeons" and 18.8% as "very low-volume surgeons."

In isolated primary ACLR, the preferred graft was HT with 80.3%, followed by 16.1% for bone patellar tendon bone autograft (BPTB), 2.4% for quadriceps tendon autograft (QT), 1.0% for allograft (ALLO) and 0.2% for augmented autograft with allograft (HYBRID) (Fig. 1).

When categorised by location, North America stands out with BPTB as the first graft choice with 45.5%, followed by HT with 40.9% (Fig. 2).

The graft preference order (HT > BPTB > others) remained the same when analysing it by the dichotomised comparison of years of practice, percentage of knee surgery and annual volume of surgeries.

A statistically significant higher use of BPTB was observed in the less experienced groups ($p < 0.01$), even though the preference order remained constant.

Interestingly, 91.8% of respondents declared never to use HYBRID, 75.2% never to use ALLO and 70.8% never to use QT.

In clinical practice, we are exposed to different clinical presentations in patients who require an isolated primary ACL reconstruction. Opinions regarding these representative clinical presentations were obtained for graft choices.

- 25 year old male, professional rugby player: HT (31.4%), BPTB (59.3%), QT (7.7%), ALLO (1.0%) and HYBRID (0.6%).
- 28 year old woman, recreational volleyball player, recurvatum: HT (60.6%), BPTB (27.7%), QT (8.3%), ALLO (2.4%) and HYBRID (1.0%).
- 35 year old male, sedentary: HT (84.5%), BPTB (7.9%), QT (2.4%), ALLO (5.1%) and HYBRID (0.1%).
- 55 year old man, runner and skier: HT (72.7%), BPTB (12.9%), QT (3.1%), ALLO (10.4%) and HYBRID (0.9%).
- 16 year old boy, closed growth plates, amateur soccer player: HT (64.7%), BPTB (27.7%), QT (6.0%), ALLO (1.0%) and HYBRID (0.6%).
- 18 year old female soccer player: HT (54.1%), BPTB (36.8%), QT (7.2%), ALLO (1.1%) and HYBRID (0.8%).

HT was the preferred option for all scenarios except for ACLR in a professional rugby player. In this scenario, the BPTB was the preferred

Table 1
Demographic characteristics of ISAKOS members 2020.

	Asia and Oceania	South America	Europe	North America	Africa	Total members
Respondents	934	506	382	257	28	2,107
Total members	1,019	689	644	618	56	3,026
Response rate	91.7%	73.4%	59.3%	41.6%	50.0%	69.6%
Years of practice (median, range)	12 (1–50)	16 (1–48)	20 (1–52)	15 (1–45)	16 (1–45)	16 (1–52)
Dedication to knee surgery (mean)	50–75%	50–75%	50–75%	50–75%	25–50%	50–75%
Volume of annual ACLR (mean)	25–50	25–50	50–75	25–50	25–50	25–50

ACLR, anterior cruciate ligament reconstruction.

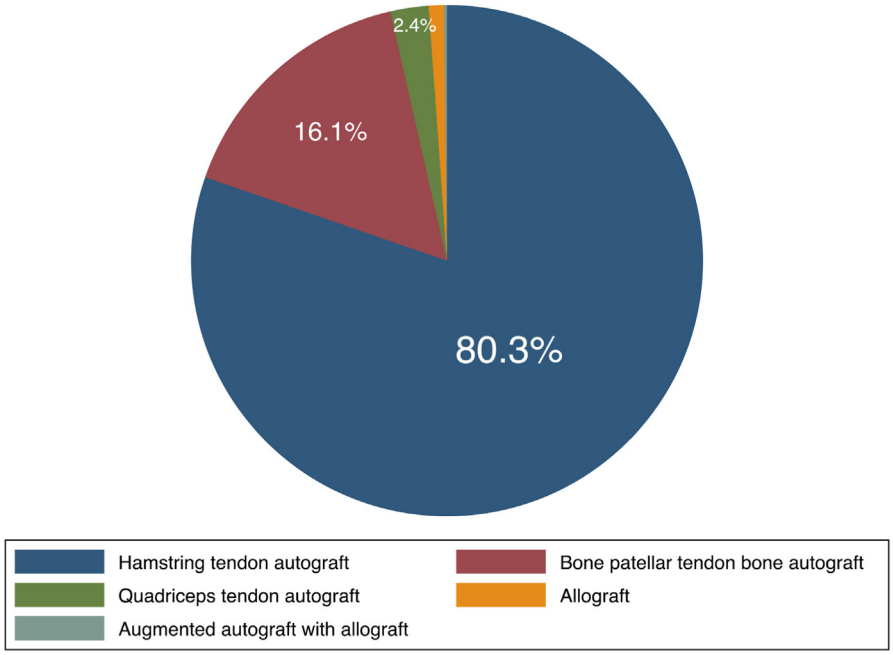

Fig. 1. First choice of graft according to the percentage of respondents' choice.

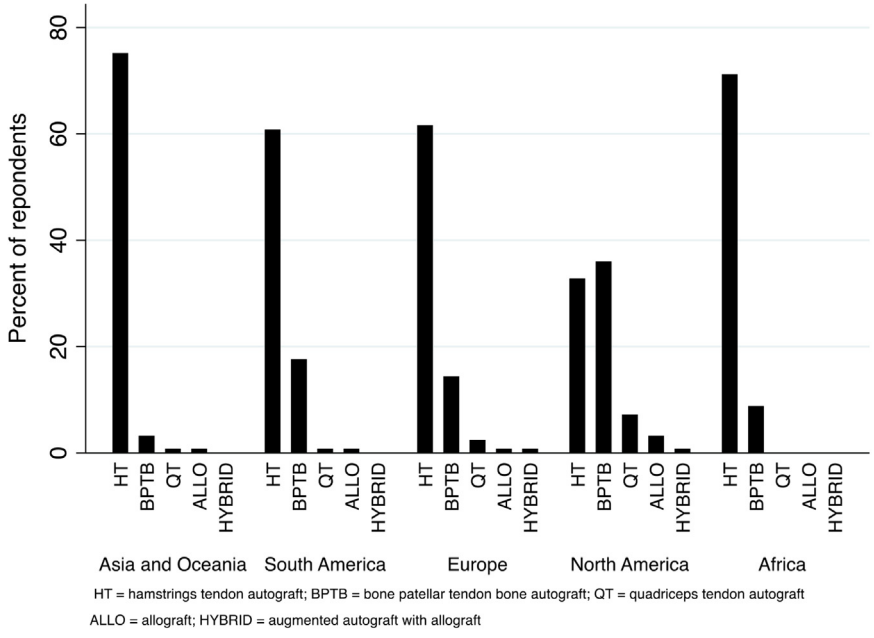

Fig. 2. Percent of the respondents first choice of graft preferences by their location.

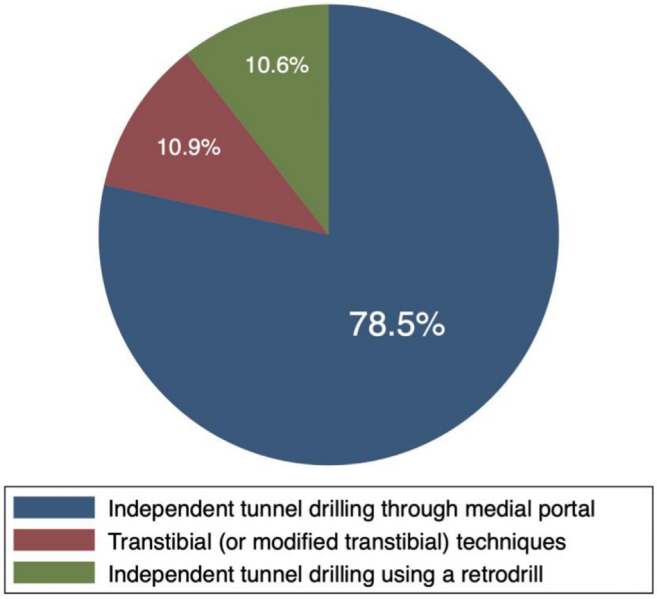

Fig. 3. Surgeons preferred technique for femoral tunnel drilling.

graft choice. In all the other scenarios, HT had more than 50% of the preferences, followed always by BPTB. In all of them, HYBRID was the least selected graft option.

Most of the surgeons (78.5%) preferred medial portal approach for femoral tunnel drilling (Fig. 3).

When evaluating preferences by location, in all the continents medial portal approach was by far their first choice. The transtibial (or modified transtibial) technique was next preferred for Asia and Oceania and in South America, whereas retrodrill technique was next preferred in Europe, North America and Africa (Fig. 4).

When analysing the technique of choice stratified by the volume of annual ACLR, high-volume surgeons showed a 12.1% of preference for retrodrill approach, which was significantly higher than the 9.1% presented in the low-volume surgeons ($p = 0.03$).

Regarding the percentage of practice dedicated to knee surgery, those with >50% showed a 12.4% of preference for retrodrill approach, which was significantly higher than the 6.9% presented in those with ≤50% ($p < 0.01$).

When analysing the technique of choice stratified by years of practice, surgeons with >15 years showed a significantly higher preference than those with <15 years for transtibial approach, with 16.0% versus 6.6%, respectively ($p < 0.01$). There was no statistically significant difference for retrodrill approach preference between both groups.

Regarding fixation method for the different grafts, cortical button was the system of choice for femoral fixation of HT in 82.7% of the cases, followed by bioabsorbable screw (8.4%), metallic screw (4.2%), transverse pin fixation (2.8%), press-fix (1.0%), sheath screw (0.7%) and staple (0.2%). High-volume surgeons had 84.8% of preference for cortical button fixation, which was significantly higher than the 80.6% of preference of low-volume surgeons ($p = 0.01$).

Bioabsorbable screw was the fixation of choice for tibial fixation of HT with 62.7% of the responses, followed by metallic screw (14.6%), cortical button (12.9%), sheath screw (7.2%), staple (1.6%), press-fix (0.8%) and transverse fixation (0.3%). There was no statistically significant difference for bioabsorbable screw preferences between high- and low-volume surgeons.

Femoral fixation of BPTB responses were much similar, with 45.2% for metallic screw, followed by 37.5% for bioabsorbable screw, cortical button (13.6%), press-fix (2.0%), transverse fixation (1.3%), sheath screw (0.5%) and staple (<0.1%). No statistically significant differences were found for metallic screw and bioabsorbable screw preferences between high- and low-volume surgeons.

For tibial fixation of BPTB, the most preferred choice was metallic screw and bioabsorbable screw, both with a 47.7% of the preferences, followed by cortical button (2.4%), sheath screw (1.0%), press-fix (0.5%), staple (0.5%) and transverse fixation (0.2%). There were no statistically significant differences for fixation method preferences between high- and low-volume surgeons. Surgeons who dedicated >50% of their current practice to knee surgery had a 50.5% of preference for

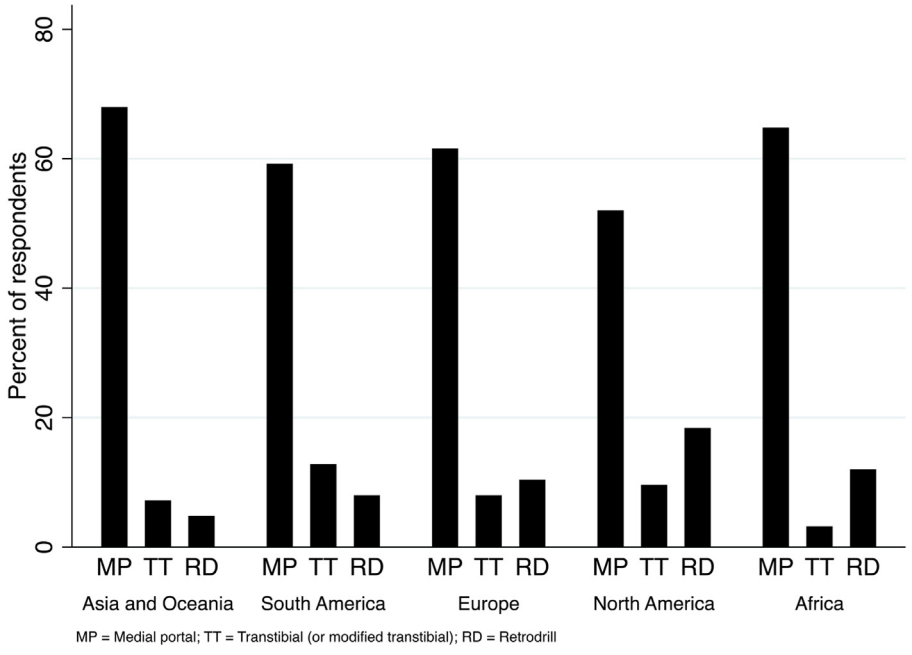

Fig. 4. Preferred technique for femoral tunnel drilling by respondents' location.

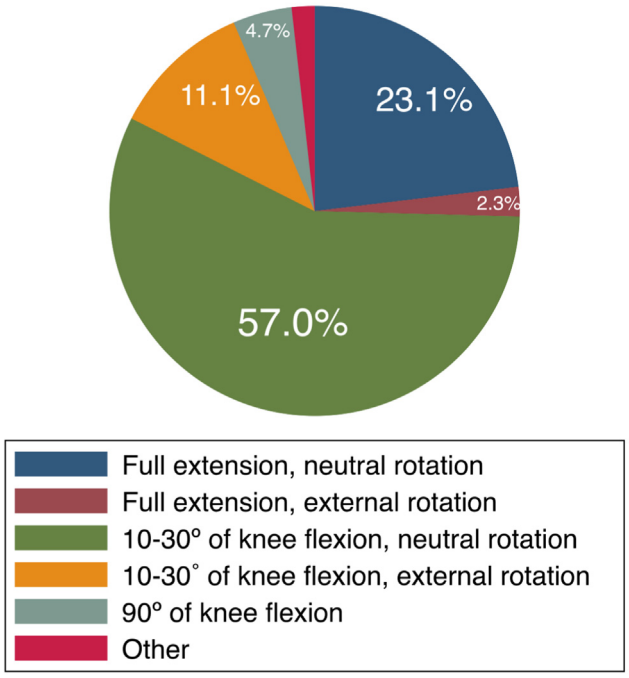

Fig. 5. Respondents preferred knee position for graft fixation.

metallic screw, which was significantly higher than the 42.1% preference of those who dedicated ≤50% ($p < 0.01$). Also, those who dedicated >50% had a 44.7% of preference for bioabsorbable screw, which was significantly lower than the 53.7% of preference of the ones who dedicated ≤50% ($p < 0.01$).

When using an ALLO for a primary ACLR, preferences were distributed as follows: patellar tendon ALLO (27.5%), achilles (25.1%), tibialis (21.1%), hamstrings (16.7%) and peroneus (9.6%). While patellar ALLO was the first choice in South America (26.9%), Europe (32.5%) and North America (38.5%), achilles ALLO was the preferred choice in Asia and Oceania (28.8%) and Africa (35.7%).

Most of the respondents (63.8%) routinely use pre-tensioning techniques for their graft preparation. Analysed by location, less than half of the surgeons from South America and Europe used pre-tensioning (48.6% and 47.6%, respectively). When analysed by experience, either by work volume, dedication to knee surgery or years as a surgeon, the routine use of pre-tensioning techniques was always the preferred practice. Nevertheless, very high-volume surgeons showed a 62.2% of use, which was significantly lower than the 68.8% of very low-volume surgeons ($p < 0.01$). Similarly, those with >50% dedication to knee surgery showed a 60.6% of use, which was significantly lower than the 70.1% of use of those with ≤50% of dedication ($p < 0.01$). Those with >15 years of practice showed a 61.3% of use, which was also significantly lower than the 65.9% of use of those with ≤15 years ($p = 0.03$).

Only 45.3% of the respondents routinely pre-soak the graft in a prophylactic antibiotic solution. By location, only in Asia and Oceania, more than half of the respondents (51.5%) used antibiotics for the graft. A 51.0% of high-volume surgeons pre-soak the graft in antibiotics, which was significantly higher than the 39.6% of low-volume surgeons ($p < 0.01$). A 46.9% of surgeons who dedicated >50% of their practice to knee surgery pre-soak it, which was significantly higher than the 42.1% of the ones with less dedication ($p = 0.04$). A 47.5% of the ones with ≤15 years of practice pre-soak it, which was significantly higher than the 42.5% of the ones with less years ($p = 0.02$).

The preferred knee position for graft fixation was 10–30° of knee flexion and neutral rotation (57.0%, followed by full extension with neutral rotation (23.1%) (Fig. 5)).

Even though with varying percentages, the first and second choice of preference were the same in all locations, except for Asia and Oceania where the first and second choices were inverted. Distinctively, in North America, the first choice of preference was very close between 10 and 30° of knee flexion and neutral rotation (44.4%) and full extension and neutral rotation (42.0%). The first choice of high-volume surgeons for knee fixation was between 10 and 30° of knee flexion and neutral rotation with 54.7%. Nevertheless, this percentage was significantly lower than the 59.2% preference of low-volume surgeon ($p = 0.04$). And it was

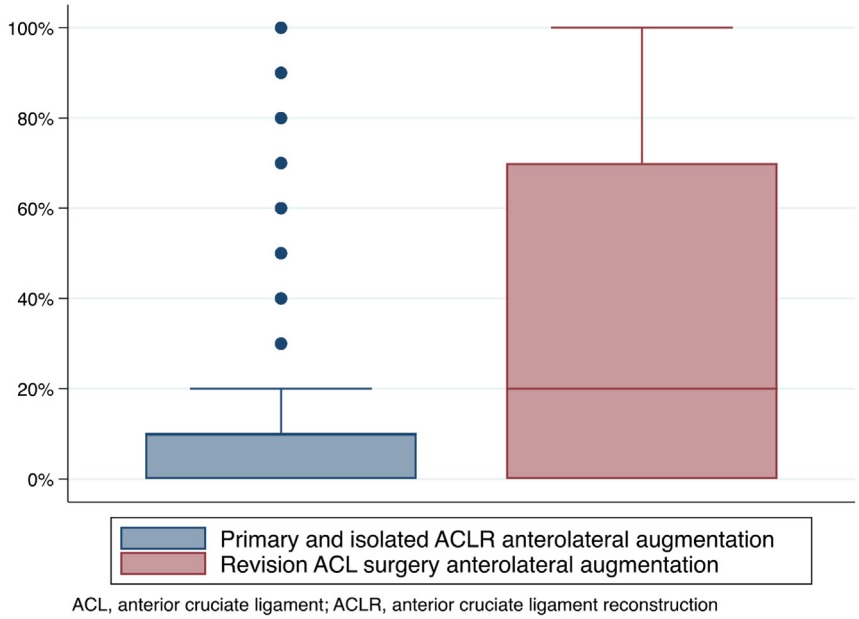

Fig. 6. Percentage of primary and isolated ACLR and revision ACL surgery in which respondents add any type of anterolateral augmentation (or extra-articular tenodesis), with its median (central horizontal line), interquartile range (coloured box), whisker (upper horizontal lines) and outliers (dots). ACLR, anterior cruciate ligament reconstruction.

mainly at the expense of a significantly higher preference for fixation in full extension and neutral rotation by high-volume surgeons than low-volume surgeons, with 25.8% versus 20.4%, respectively ($p < 0.01$).

Regarding the addition of any type of anterolateral augmentation (or extra-articular tenodesis) in a primary and isolated ACLR, 10.0% was the median percentage of use (Fig. 6), less than 3% add them ≥50% of their surgeries, and 45.4% claimed to never use it in a primary and isolated ACLR. By location, Africa had the highest median of augmentation addition with 15.0% (range 0.0–60.0%) and Asia and Oceania and North America the lowest, both with <0.1% (range 0.0–100% and 0.0–70.0%, respectively). Both, high-volume surgeons and the ones who dedicated >50% of their practice to knee surgery had a median of use of 10.0%, which was significantly higher than 0.0% of us by low-volume surgeons and by the ones who dedicated ≤50% to knee surgery ($p < 0.01$). Furthermore, both more experienced groups had a significantly lower percentage of no use at all, with 36.4% versus 54.2% and 43.9% versus a 60.0%, respectively ($p < 0.01$).

As for the addition of any type of anterolateral augmentation (or extra-articular tenodesis) in revision ACL surgery, 20.0% was the median percentage of use (Fig. 6), 28.7% add them in ≥50% of their surgeries and 27.0% claimed to never use it. By location, Africa had the highest median of augmentation addition with 90.0%, while Asia and Oceania and North America had the lowest with 20.0% each. Again, both, high-volume surgeons and the ones who dedicated >50% of their current to knee surgery had a median of use of 30.0%, which was significantly higher than 10.0% of their counterpart groups ($p < 0.01$). Also, both more experienced groups had a significantly lower percentage of no use at all, with 21.1% versus 38.5% and 17.4% versus 36.4%, respectively ($p < 0.01$).

Most of the respondents (54.9%) declared the use of some kind of brace during postoperative rehabilitation following primary isolated ACLR. By location, whereas most of the respondents of Asia and Oceania and North America did use brace (71.6% and 67.3%, respectively), in South America, Europe and Africa most of the respondents did not (40.1%, 26.7% and 35.7%, respectively). A 64.6% of the respondents who dedicated >50% of their current practice to knee surgery did use brace, which was significantly higher than the 50.0% of those with ≤50% ($p < 0.01$).

The time after a primary, isolated ACLR that surgeons allow their patients to fully resume sports was on average 8.9 ± 2.0 months, with a mode of 9 months (32.7%), a minimum of 3 months and a maximum of 14 months (Fig. 7).

By location, South America was the one with the longest time on average in allowing their patients to fully resume sport with 9.2 ± 1.9 months. The shortest one was Africa with 8.2 ± 1.8 months.

There was no statistically significant difference in the months on average that surgeons allow their patients to fully resume sports when comparing high- versus low-volume surgeons, very high- versus very low-volume surgeons or surgeons with >15 years of practice versus ≤15 years. However, surgeons who dedicate >50% of their practice to knee surgery average waiting time of 9.0 ± 2.0 days was significantly higher the 8.5 ± 2.1 days of those who dedicate ≤50% ($p < 0.01$).

In a 12 year old male with more than 3 years remaining of open growth plates, amateur soccer player, who had an isolated ACL rupture that failed conservative treatment, the preferred treatment option was all epiphyseal or hybrid (all-epiphyseal femur + trans-physeal tibia) ACLR (Fig. 8).

By location, all epiphyseal or hybrid (all-epiphyseal femur + trans-physeal tibia) ACLR was the preferred first line of treatment in all continents. High-volume surgeons preferred all epiphyseal or hybrid (all-epiphyseal femur + trans-physeal tibia) ACLR in a 41.8%, which was significantly higher than 29.9% of low-volume surgeons ($p < 0.01$), even though in both cases it was the first line of treatment.

Discussion

To our knowledge, this is the largest ACL survey published to date. Respondents from every region of the world answered the questionnaire, exhibiting a high level of expertise in the field since most surgeons dedicated more than half of their practice to knee surgery, had a median of 15 years as knee surgeons and almost half of them performed >50 ACLR annually. The most striking findings of this survey are that HT was by far the preferred graft for primary ACLR and medial portal the most frequently used technique. Cortical buttons and bioabsorbable screws were the preferred fixation methods for HT in femur and tibia, respectively. Metallic screws were the preferred fixation methods for BPTB graft in femur and tibia. Most of the respondents routinely used pre-tensioning techniques for their graft preparation, but less than half of the surgeons applied antibiotic solutions to their grafts. The preferred knee position for graft fixation was 10–30° of knee flexion and neutral rotation. The

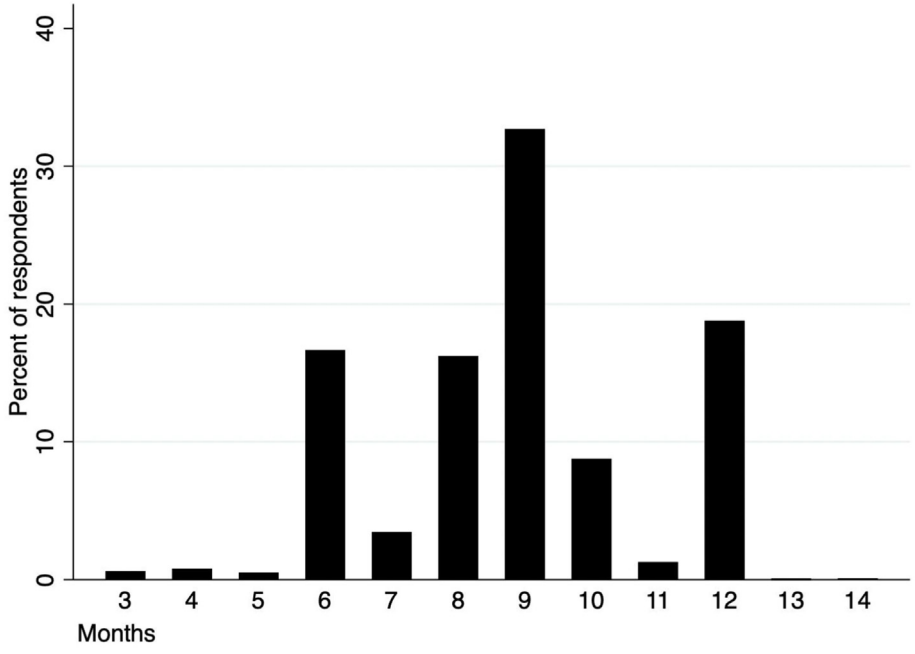

Fig. 7. Months after a primary, isolated ACLR that surgeons allow their patients to fully resume sports. ACLR, anterior cruciate ligament reconstruction.

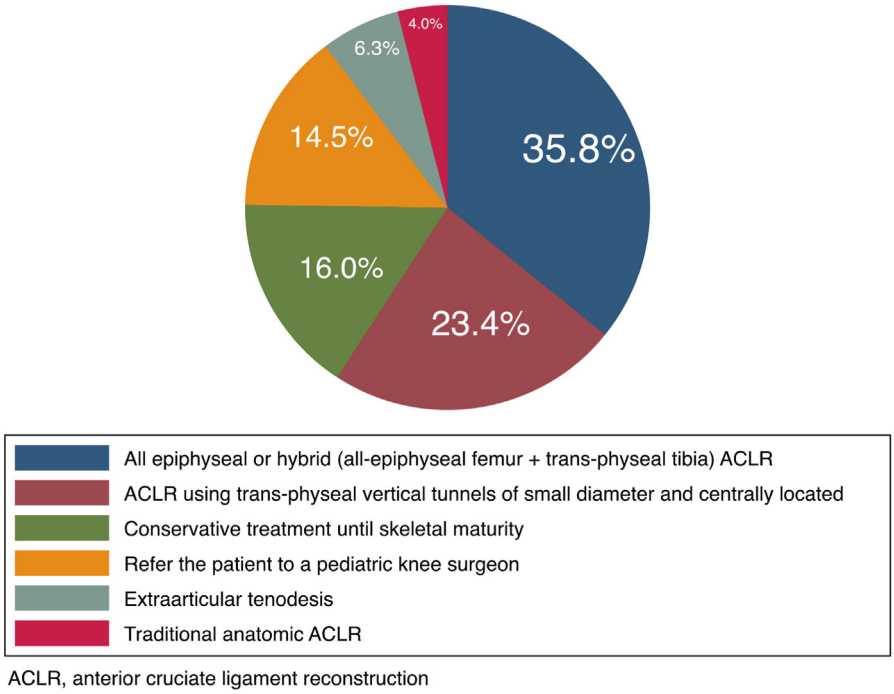

Fig. 8. Percentage preferences of first line of treatment in a scenario of a 12 year old male with open growth plates (>3 years of growth remaining), amateur soccer player, with an isolated ACL rupture that failed conservative treatment. ACL, anterior cruciate ligament.

addition of any type of anterolateral augmentation (or extra-articular tenodesis) was infrequent in primary and isolated ACLR, but a statistically significant raise was seen for revision surgeries. Most used a brace in the initial postoperative rehabilitation and the time to allow patients to fully resume sports showed a mode of 9 months. Treatment algorithm of paediatric ACL injuries exhibited a low consensus among the respondents of this survey.

Previous surveys had studied similar topics, but this is the first one to achieve a worldwide representation, with a statistically significant sample size from each continent. The achievement of an overall response rate of 69.6% and a final sample size of 2,107 is substantial. Other ACL surveys have had a comparatively lower sample size (United States of America: 824 [3]; Brazil 191 [8]; United Kingdom: 192 [5]; Germany: 155 [4]; Italy: 131 [6]; Chile: 103 [7]).

This survey proposed six different scenarios for graft selection, and in 5 out of 6, HT was the preferred graft. Only in the scenario of a young professional contact sport player, BPTB was chosen as the first option (59.3%). This predominance may have been influenced by studies suggesting the benefits of BPTB particularly for patients at a higher risk of graft failure [9]. BPTB has also been associated with lesser postoperative anterior knee laxity and less surgical failures than HT in certain patients [10]. Also, surgery involving HT can result in somewhat weaker flexion in the knee, which could significantly affect the overall performance in this kind of athlete [11]. All of these data might have shifted the preferences in this particular scenario for BPTB. For the other five scenarios, HT would be the preferred graft choice, with more than 50% of the preferences, followed by BPTB in all cases. This is in accordance with current trends worldwide since the preference for HT was confirmed by all of the most of the relevant surveys reviewed, with 93.1% preference in Brazil [8], over 80.0% in Italy [1], 45.0% in United States of America [3], 76.7% in Chile [7] and 89.0% in Sweden [12]. Whereas only in the survey by United Kingdom [5], a higher preference of BPTB was reported (58.0%).

Interesting and statistically significant differences were seen all along the survey when comparison by surgeon's experience was carried out. Most experienced surgeons tend to use in a greater proportion the retrodrill approach, prophylactic antibiotic solution, postoperative brace and anterolateral augmentation in both, primary and revision ACL surgery. As for the retrodrill approach, even though it is a documented excellent technique compared to others [13–17], there is still a low preference between surgeons. It is possible that the reasons why surgeons still do not use it in a greater proportion may be related to comparative higher costs, being technically demanding, longer operative time requirements and limited fixation options [18]. Pre-soaking the graft in prophylactic antibiotic solution has been a gaining popularity during the past decade, with promising reports indicating it would be an effective measure for reducing the incidence of septic arthritis following ACLR [19]. Adding an anterolateral procedure is also a rising trend, with growing evidence backing up its benefit in selected patients to reduce graft failure and control rotatory instability [20]. These findings suggest that more experienced surgeons are more prone to incorporate novel surgical strategies and technique modifications that might enhance their results.

Differential analysis by geographic location was a highlight of this study. Interesting findings were found in North America, regarding the first choice graft. It was the only area in which the first choice was not HT, but BPTB with 45.5%, followed closely by HT with 40.9%. North America was also the one with the higher preference of use for the retrodrill approach, patellar ALLO and the lowest median of anterolateral augmentation in both primary and revision ACLR surgery. As for the use of prophylactic antibiotic solution, Asia and Oceania were the only locations with more than half of the surgeons applying it routinely in their ACLR. As previously mentioned, despite recent evidence showing positive effects of pre-soaking the graft in prophylactic antibiotic solution for preventing septic arthritis [19], the lack of Level 1 studies does not allow to recommend a universal application for all ACLR patients. Nevertheless, this survey showed that a statistically significant percentage of surgeons have incorporated antibiotic pre-soaking to their practice.

It is well known that good quality evidence influences surgeons' decision-making. A great example of this is the preferred knee position for graft fixation. Even though there is still some debate, there is a relative consensus that a range between full extension and 30° of knee

flexion should get the best results. Evidence, though scarce, shows slightly superior stability and biomechanical outcomes for fixation in 30° angle of knee flexion when compared to full extension [21,22]. This is consistent with the respondents preferred knee position for graft fixation shown in this survey. Similar conduct was seen for anterolateral procedures, where the growing evidence supporting its use for rotatory stability and avoiding graft failure [20,23] was reflected in the survey, with a higher rate of addition in revision surgeries and by those more experienced surgeons.

On the other hand, the results of the survey also reflected those topics where there is lacking consensus in the literature. For example, regarding paediatric ACLR, there was no majority answer among the respondents, and preferences were divided. Despite growing interest in this topic, compared with adult ACLR, we are still lacking high quality evidence in paediatrics. Olympic Committee proposed a consensus in 2018 for the treatment of paediatric ACLR acknowledging there are several valid treatment options without clear superiority of any [24]. Hopefully, ongoing prospective trials and registries will provide evidence-based answers for these patients [25,26].

This survey had several limitations. First, as the questionnaire was delivered only to ISAKOS members, this expert opinion cannot be generalised to all knee surgeons worldwide, though there is a substantial contribution of surgeons from most areas in this survey. Moreover, only a relatively small number of surgeons were surveyed from Africa, which jeopardised an unbiased comparison with the other geographic location.

Self-reported surveys are inherently biased from a recall standpoint, as the respondents may not completely remember their own experience on the question's subject. Also, some respondents made mistakes answering questions, and in some cases, they had to be excluded from the final sample (1.1% excluded from 2,130 respondents for outlier values interpreted as typing errors). Also, some questions headlines lead to misunderstandings, specifically the question regarding the percentage of each graft used in the current surgeons practice (0%–100%). In this question, 20.0% of the respondents answered a sum over 100%, so it was decided to change the analysis of the question to the first choice of graft according to the one that got more percentage of the five given options.

The response rate of 69.6% was considered a reasonable sample of the population surveyed. As the non-respondents were not in any known way different from the respondents, this was considered as strength of the study. Compared to other published ACL surveys, the response rate was much higher in this study (Germany: 22.0% [4]; Italy: 17.0% [6]; United States of America: 19.2% [3]; United Kingdom: 60.0% [5]). However, as the survey was distributed via link that could be shared, an unknown proportion of respondents may not be an ISAKOS member, which could have biased the response rate. Another strength of the study was that almost half of the respondents annually performed more than 50 ACLR, which speaks highly of the members' experience. In most other similar studies, this percentage was lower (Germany: 40.7% [4]; Italy: 17.0% [6]; Chile: 30.0% [7]; Croatia: 25.0% [27]; Belgium: 43.0% [28]; Brazil: 46.8% [8]; Australia: 46.0% [29]; India: 46.0%).

A huge amount of information was obtained from this survey, exceeding the capacity of analysis in a single article, thus, only the most relevant elements were prioritised. Upcoming reports will further discuss the multiple subtopics that can be analysed.

The issues raised by this survey could serve as guidance to future research and randomised controlled trials. Moreover, the collected data may be useful in Delphi studies to reach international consensus on best practices for ACLR.

Conclusion

This worldwide survey benchmarks the current trends in ACL reconstruction, achieving the largest participation of surgeons to date. Overall, dominance for the use of hamstring autograft and medial portal femoral drilling was observed for primary ACL reconstructions. The addition of lateral extra-articular procedures increased significantly for revision ACL surgeries versus primary procedures. Among the great variety of options available for ACL reconstructions, surgeons' preferences showed some differences according to the location of their practice and expertise. Reporting trends in practice, and not only the evidence, is important to medical education and providing patients the safest care possible.

Declaration of competing interest

The authors declare the following interests/personal relationships which may be considered as potential conflict of interest:

María Tuca is a paid consultant for Johnson & Johnson Medical and a member of ISAKOS Knee: Sports & Preservation Committee 2019/2023.

Sachin Tapasvi is a paid consultant for Smith & Nephew and an associate editor of JISAKOS.

Karl Eriksson is a paid consultant for Arthrex and member of the editorial board of KSSTA.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jisako.2022.08.009.

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