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# ACL surgical trends evolve in the last five years for young European surgeons: results of the survey among the U45 ESSKA members

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## Abstract

**Purpose** Although the outcomes of ACL reconstruction are generally satisfying, there are several patients who do not regain their pre-injury sporting level and suffer persistent symptoms. Orthopaedic practice has evolved significantly over the last five years to address these drawbacks. The aim of the present survey was to analyze the changes in the approach to ACL reconstruction among a population of young ESSKA surgeons dedicated to ACL surgery.

**Methods** The survey was uploaded on the ESSKA website and was accessible to members under the age of 45. The ESSKA society has 1035 U45 members involved in multiple aspects of Orthopaedic practice. One hundred and forty questionnaires were returned. Several aspects of ACL surgery were investigated at baseline and 5 years prior. They included general details such as the volume of ACL reconstructions per surgeon per year, the graft choice in cases of low and high demanding patients, the technique for femoral tunnel drilling and the preferred device for femoral fixation. The approach to the management of damage to peripheral structures, as well as meniscal ramp and root tears were also investigated.

**Results** Hamstrings and quadrupled semitendinosus were the preferred graft choice in low-demanding patients (92.9%) while quadriceps tendon is gaining popularity in contact sport practitioners (from 4.3 to 10.7%). The percentage of surgeons using femoral screws had decreased from 37.9 to 29.3 while the percentage of those who used buttons increased from 52.9 to 69.3%. Extra-articular procedures (antero-lateral ligament (ALL) or lateral tenodesis have become popular. The percentage of surgeons who perform an additional peripheral reconstruction rose from 28.5 to 71.5%. Of those who perform the meniscal repair more than 50% of patients rose from 14.3 to 27.9%. Similarly, the percentage of surgeons who performed a medial meniscus ramp lesion repair rose from 29.4 to 54.7%. While the percentage of those who choose to perform a transtibial pull-out repair of lateral meniscus root tears significantly rose from 17.9 to 59.3%.

**Conclusions** The present survey among under 45 years old ESSKA surgeons yields some notable findings. The new evidence on the impact of injuries on peripheral structures and menisci is stimulating surgeons towards a more anatomic approach if identified at the time of ACL reconstruction. This evidence will probably influence future research and decision-making.

**Level of evidence** IV.

**Keywords** Anterior cruciate ligament · Graft choice · Fixation device · Ramp lesion · Root lesion

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## Introduction

Residual instability and return to sports are a major problem after ACL reconstruction. Where 90% of patients report a satisfactory outcome, this percentage drops to 82% of patients being able to return to sport, 63% regaining their preinjury level of participation, 44% returning to competitive sport and 11–30% claiming a residual rotatory instability [3, 23]. However, several surgical evolutions have emerged over the past decade to address these problems including graft choice, the management of new meniscal lesions and reconstruction of peripheral capsuloligamentous structures. All of these factors remain the subject of debate [5, 15, 16, 20].

Recent updates on the biomechanical and clinical understanding of ACL-associated injuries have influenced surgeons' general decision making, thus leading to a change which seems to be especially relevant amongst young knee surgeons. For these reasons, a survey was designed among young ESSKA knee surgeons to confirm and eventually quantify this trend over the last five years. It was hypothesized that this approach had widely changed according to the new evidence in the literature.

If the hypothesis was confirmed, the new evidence may lead young surgeons in changing their approach toward specific aspects of ACL reconstruction surgery.

## Material and methods

In August 2021 a survey on the trends in ACL reconstruction was uploaded on the ESSKA website. The survey was available for all the members of the ESSKA "U45 committee" and was based on 27 questions on general trends in ACL reconstruction (https://docs.google.com/forms/d/1Sxqhow3rlrTFm-OnromekI2UpyLo6WQDwyRzzN3sp_0/edit). The first 6 questions considered general demographics for each surgeon (country, age, gender, work, number of ACL reconstructions at baseline and 5 years ago). The next 7 questions (7–14) investigated crucial surgical aspects at baseline and 5 years prior (graft choice in low and high-demanding patients, options for femoral tunnel drilling, femoral and tibial fixation). The last questions (15–26) investigated general trends at baseline and 5 years prior for associated surgical steps (antero-lateral ligament reconstruction, lateral tenodesis, meniscal repair, surgical management of ramp and root tears). Participants were asked to answer a total of 26 questions. Five of these questions consisted of multiple choices and for the other 21, participants were also asked to describe their actual practice and propose an answer reflecting their habit five years ago.

Answers were estimated using percentages and differences between answers provided for different time points (5 years ago vs today for example) and compared using Pearson chi-2 tests.

## Results

One hundred and forty people completed the questionnaire.

### General aspects

Surgeons from 26 countries answered the survey. France ($n = 20$), Italy ($n = 16$) and Spain ($n = 11$) had the highest number of responders. Surgeons from Europe represented the largest group, however, there were participants from outside Europe also. Average age of the participants was 38 years (28–45). One-hundred thirty-nine surgeons were male (99.3%). Fifty-six participants (40%) worked in Academic hospitals, 30 (21.4%) in non-Academic hospitals and 52 (37.1%) in private practice (Fig. 1).

With regards to the volume of surgeries performed every year, the comparison between baseline and five years before (Table 1A) clearly indicated the percentage of high-volume surgeons (those who perform more than 50 cases per year) increased from 38.2 to 57.2% ($p < 0.001$).

### Surgical options

In the case of low demand patients, the percentage of surgeons using both hamstrings and quadrupled semitendinosus remined stable over five years at 92.9% as well as the combined percentage of BTB and quadriceps tendon (from 5.7 to 5%) (n.s.). (Table 1B). Low-demand patients were defined as

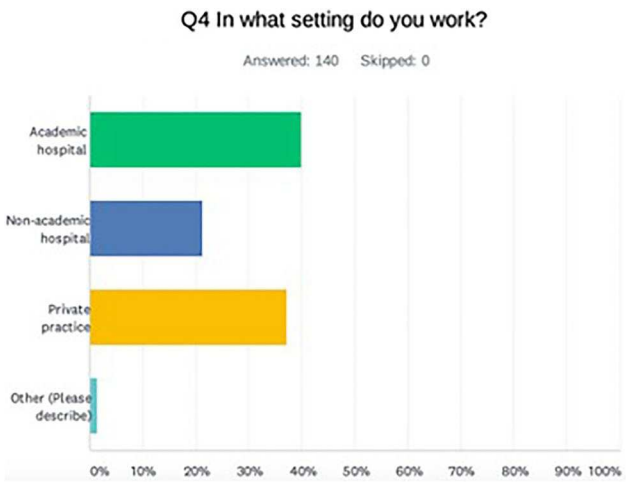


**Fig. 1** Work setting distribution among participants

**Table 1** **A** How many ACL reconstructions do you perform each year? 0 < 10, 1 = 10–30, 2 = 30–50, 3 = 50–75, 4 = 75–100, 5 > 100. **B** Which is your graft of choice for low demanding patients? 0 = hamstrings, 1 = ST4, 2 = Fascia Lata, 3 = btb, 4 = Quad, 5 = Allograft. **C** Which is your graft of choice for contact sport practitioners? 0 = hamstrings, 1 = ST4, 2 = Fascia Lata, 3 = btb, 4 = Quad, 5 = Allograft. **D** Which is your choice for femoral tunnel? 0 = Transtibial, 1 = AM inside-outside, 2 = AM outside-inside, 3 = AM all inside. **E** Which is your choice for femoral fixation? 0 = Screws, 1 = Buttons, 2 = Pins, 3 = Press fit. **F** Do you perform any peripheral reconstruction (ALL or lateral tenodesis) during ACL reconstruction? 0 = Always, 1 = Sometimes, 2 = Rarely, 3 = Never. **G** What is your rate of meniscus repair during your ACL reconstruction? 0 = 10%, 1 = 20%, 2 = 30%, 3 = 50%, 4 > 50%. **H** How do you make the diagnosis of medial meniscus ramp lesion? 0 = MRI, 1 = AM probing, 2 = PM viewing, 3 = PM testing. **L** What is your treatment of choice in case of posterolateral meniscus root tears? 0 = leave it, 1 = Partial meniscectomy, 2 = All-inside repair, 2 = Transtibial pullout repair

| 1A | 0 | 1 | 2 | 3 | 4 | 5 | *p* value |
|---|---|---|---|---|---|---|---|
| (5 years ago) | 37 (26.6%) | 31 (22.3%) | 18 (13%) | 20 (14.4%) | 13 (9.4%) | 20 (14.4%) | |
| (Now) | 10 (7.1%) | 20 (14.3%) | 30 (21.4%) | 25 (17.9%) | 19 (13.6%) | 36 (25.7%) | |
| Total | 47 (16.8%) | 51 (18.2%) | 48 (17.1%) | 45 (16.1%) | 32 (11.4%) | 56 (20%) | < 0.0001 |
| 1B | 0 | 1 | 2 | 3 | 4 | 5 | *p* value |
| (5 years ago) | 112 (80%) | 18 (12.9%) | 0 (0%) | 8 (5.7%) | 0 (0%) | 2 (1.4%) | |
| (Now) | 95 (67.9%) | 35 (25%) | 1 (0.7%) | 6 (4.3%) | 1 (0.7%) | 2 (1.4%) | |
| Total | 207 (73.9%) | 53 (18.9%) | 1 (0.4%) | 14 (5%) | 1 (0.4%) | 1 (0.4%) | n.s |
| 1C | 0 | 1 | 2 | 3 | 4 | 5 | *p* value |
| (5 years ago) | 67 (47.9%) | 16 (11.4%) | 2 (1.4%) | 48 (34.3%) | 6 (4.3%) | 1 (0.7%) | |
| (Now) | 53 (37.9%) | 26 (18.6%) | 1 (0.7%) | 44 (31.4%) | 15 (0.7%) | 1 (0.7%) | |
| Total | 120 (42.9%) | 42 (15%) | 3 (1.1%) | 92 (32.9%) | 12 (4.3%) | 2 (0.7%) | n.s |
| 1D | 0 | 1 | 2 | 3 | | | *p* value |
| (5 years ago) | 20 (14.3%) | 77 (55%) | 36 (25.7%) | 7 (5%) | | | |
| 1 (now) | 5 (3.6%) | 87 (62.1%) | 37 (26.4%) | 11 (7.9%) | | | |
| Total | 25 (8.9%) | 164 (58.6%) | 73 (18.2%) | 18 (16.7%) | | | 0.0067 |
| 1E | 0 | 1 | 2 | 3 | | | *p* value |
| (5 years ago) | 53 (37.9%) | 74 (52.9%) | 12 (8.6%) | 1 (0.7%) | | | |
| (now) | 41 (29.3%) | 97 (69.3%) | 2 (1.4%) | 0 (0%) | | | |
| Total | 94 (33.6%) | 171 (61.7%) | 14 (5%) | 1 (0.4%) | | | 0.0019 |
| 1F | 0 | 1 | 2 | 3 | | | *p* value |
| (5 years ago) | 9 (6.4%) | 31 (22.1%) | 44 (31.4%) | 56 (40%) | | | |
| (Now) | 18 (12.9%) | 82 (58.6%) | 29 (20.7%) | 11 (7.9%) | | | |
| Total | 27 (9.7%) | 113 (40.4%) | 73 (26.1%) | 67 (23.9%) | | | < 0.0001 |
| 1G | 0 | 1 | 2 | 3 | 4 | | *p* value |
| (5 years ago) | 38 (27.1%) | 44 (31.4%) | 28 (20%) | 10 (7.1%) | 20 (14.3%) | | |
| (now) | 12 (8.6%) | 30 (21.4%) | 43 (30.7%) | 16 (11.4%) | 39 (27.9%) | | |
| Total | 50 (17.9%) | 74 (26.4%) | 71 (25.4%) | 26 (9.3%) | 59 (21.1%) | | < 0.0001 |
| 1H | 0 | 1 | 2 | 3 | | | *p* value |
| (5 years ago) | 64 (45.7%) | 43 (30.7%) | 17 (12.1%) | 16 (11.4%) | | | |
| (now) | 14 (10%) | 39 (27.9%) | 38 (27.1%) | 49 (35%) | | | |
| Total | 78 (27.9%) | 82 (29.3%) | 55 (19.6%) | 65 (23.2%) | | | < 0.0001 |
| 1I | 0 | 1 | 2 | 3 | | | *p* value |
| (5 years ago) | 62 (44.6%) | 15 (10.8%) | 35 (25.2%) | 27 (19.4%) | | | |
| 1 (now) | 10 (7.2%) | 6 (4.3%) | 47 (33.8%) | 76 (54.7%) | | | |
| Total | 72 (25.7%) | 21 (7.5%) | 82 (29.3%) | 93 (33.2%) | | | < 0.0001 |
| 1J | 0 | 1 | 2 | 3 | | | *p* value |
| (5 years ago) | 51 (36.4%) | 36 (25.7%) | 28 (20%) | 25 (17.9%) | | | |

**Table 1** (continued)

| 1J | 0 | 1 | 2 | 3 | *p* value |
|---|---|---|---|---|---|
| 1 (now) | 13 (9.3%) | 9 (6.4%) | 35 (25%) | 83 (54.7%) | |
| Total | 64 (22.9%) | 45 (16.1%) | 63 (22.5%) | 108 (38.6%) | < 0.0001 |

those who either did not play sports or played non-pivoting or non-contact sports with a frequency of once per week.

When dealing with high-demand patients, the percentage of surgeons choosing a quadriceps tendon graft more than doubled in five years (from 4.3 to 10.7%). the combined percentage of hamstrings and quadrupled semitendinosus had slightly decreased (56.4% at baseline and 59.3% five years before) and the percentage of combined BTB and quadriceps tendon had slightly increased (42.1% at baseline and 38.6% 5 years before) (n.s) (Table 1C). High-demand patients were defined as those who played pivoting or contact sports with a frequency of twice or more per week.

Regarding the choice of femoral tunnel drilling, over the last five years, there has been a significant drop in the percentage of transtibial drilling (from 14.3 to 3.6%). Outside-in technique has remained stable (25.7% 5 years ago and 26.4% at baseline) and there has been an increase in use of the anteromedial inside-out technique (55% 5 years ago and 62.1% at present) and all-inside technique (5% five years ago and 7.9% at baseline) ($p < 0.007$) (Table 1D).

Regarding femoral fixation, in 5 years there has been a clear trend toward a reduction in the percentage of surgeons using femoral screws (37.9% 5 years ago and 29.3% at baseline) and pins (8.6% five years ago and 1.4% at baseline); conversely there was a significant increase in the percentage of those who use extracortical buttons (52.9% 5 years ago and 69.3% at baseline) ($p < 0.002$) (Table 1E).

### Extra articular procedures and menisci

Extra-articular procedures including the antero-lateral ligament (ALL) reconstruction and lateral tenodesis have become popular; In 5 years, a significant drop in the percentage of surgeons who never perform extra-articular procedures (40% five years ago and 7.9% at baseline) has been observed ($p < 0.001$) Table 1F).

Similarly, the role of menisci and their impact on knee biomechanics has become more evident and resulted in a clear trend towards a more aggressive approach to meniscal repair in the last 5 years (meniscal repair in more than 50% of patients increased from 14.3 to 27.9%) ($p < 0.001$) (Table 1G).

The routine inspection of the postero-medial aspect of the knee to detect ramp lesions has become standard practice. The percentage of those who rely on MRI has dropped from 45.7% to 10% and the percentage of those who perform an accurate postero-medial inspection and/or probing has increased from 23.5 to 62.5% over the 5 years ($p < 0.001$) (Table 1H). As a result, the percentage of surgeons who find a ramp lesion in at least 30% of their ACL reconstructions is now around 15% Fig. 2. The treatment of medial meniscus ramp lesions has evolved as well: the percentage of those who routinely tend to manage them non-operatively has dropped from 44.6 to 7.2% while the percentage of those who perform a postero-medial anatomic all-inside repair using a suture hook has increased from 29.4 to 54.7% ($p < 0.001$) (Table 1I). Root tears of the lateral meniscus are uncommon; the percentage of surgeons who encounter them in at least 30% of their ACL reconstructions is still around 6.5% Fig. 3. Similar to the trends encountered when considering ramp tears, in five years the percentage of surgeons who manage a root tear of the lateral meniscus non-operatively has dropped from 36.4 to 9.3%, while those who choose to perform a transtibial pull-out repair significantly rose from 17.9 to 59.3% in the last 5 years ($p < 0.001$) (Table 1L).

## Discussion

The present survey among young surgeons of the ESSKA society yielded some notable findings. First, in the last 5 years the percentage of high-volume ACL reconstruction

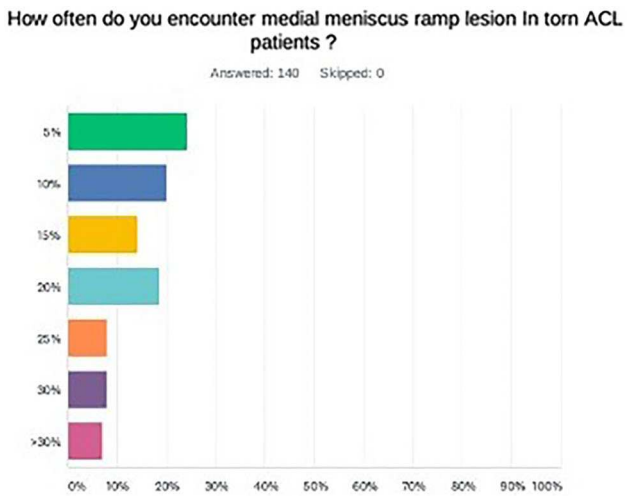


**Fig. 2** Rate of surgeons who encounter ramp lesions of the medial meniscus during ALC reconstruction surgery

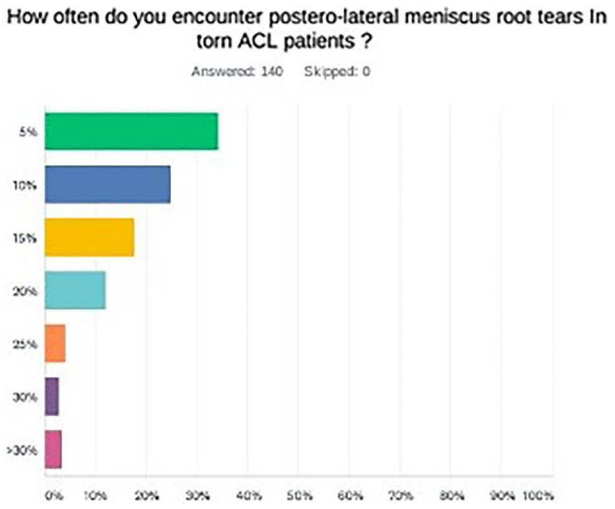


**Fig. 3** Rate of surgeons who encounter postero-lateral root tears during ACL reconstruction surgery

surgeons (those who perform more than 50 ACL reconstructions per year) has increased. The treatment of ACL ruptures, meniscal tears and peripheral ligaments tears is technically demanding, and high-volume surgeons are more trained to face all the possible scenarios associated with ACL injuries.

Second, in the case of low-demand patients, hamstrings and quadrupled semitendinosus have remained the gold standard. In five years, in situations of athletes performing intensive contact or pivoting sports, the percentage of surgeons choosing the quadriceps tendon has more than doubled, the combined percentage of hamstrings and quadrupled semitendinosus has slightly decreased and the combined percentage of BTB and quadriceps tendon have slightly increased. The debate on which is the ideal graft is still subject to much debate. BPTB autografts are utilized in approximately 23% of ACL reconstructions [13, 27]. BTB graft has the advantage of the bone-to-bone interface in the tunnels and has a higher maximum load to failure than the native ACL, shown by Cooper et al. [7]. Hamstring autografts account for 33%-53% of all ACL reconstructions [13, 27]: it has a maximum load to failure of approximately 4590 N [13]. Regardless of the chosen fixation method, soft tissue grafts can take up to 6 weeks longer to incorporate into the host bone when compared to BTB autograft [19]**.** The percentage of surgeons using the quadriceps tendon has increased from 2.5% in 2010 to 11% in 2014 [13, 28]. It has a maximum load to failure of between 2185 and 2352 N, which is comparable with the native ACL [21, 25].

Recent meta-analyses on autografts in over 47,000 patients showed a slight increase percentage of hamstring graft tears compared with BTB (2.84 vs 2.80%, respectively) [20] and less donor site pain for QT compared to BTB [12, 15]. Donor site morbidity is the generally less relevant for HT than BTB [13, 29]. Similarly, The recent survey among the ACL study group members showed that the preference for HT autograft increased over time [4].

According to this evidence, it is reasonable to conclude that graft choice should be decided on surgeon comfort and experience and individual patient characteristics, while allografts should be reserved for revision cases and those aged 35 years and older.

The third interesting aspect of the present survey is the change that occurred in the approach to femoral drilling and fixation. Over time, there has been a significant drop in the percentage of transtibial drilling, the outside-in technique has remained stable, while an increase of anteromedial inside-out users was observed.

A recent systematic review and meta-analysis compared transtibial (TT) drilling method and independent methods in terms of outcomes and complications [8]. Independent femoral tunnel drilling provided better results than the TT approach, although the difference was not clinically significant Amongst the independent drilling options, the anteromedial portal technique seemed to provide the most favorable outcomes. However, the AM portal technique has complications such as a short femoral socket, and posterior wall blowout of the femoral socket. The outside-in technique allows more freedom with the positioning of the femoral tunnel and can be performed in a retrograde fashion [19].

Similarly, in five years there has been a clear trend towards a reduction in the percentage of surgeons using femoral screws and pins while there has been a significant increase in the percentage of those who use extra-cortical buttons. This is in keeping with the ACL study group survey by Sherman et al. [22]. Several biomechanical studies reported controversial results. Eysturoy et al. compared four different femoral fixation devices for hamstrings grafts [9]. They showed that cortical suspensory fixation had a significantly increased risk of revision, while intratunnel transfixation exhibited a lower risk of revision. In addition, it has been shown that HS autograft appears to have the lowest risk of aseptic revision when crosspin or interference fixation is used on the femoral side and is coupled with an interference screw on the tibial side [24].

Moreover, an increased interest in the peripheral stabilizers of the knee has been observed. A significant drop in the percentage of surgeons who never perform extra-articular procedures has been observed. All recent biomechanics studies have clearly shown the role of the lateral structures of the knee in controlling the pivot shift phenomenon. Monaco et al., on a cadaveric study, evaluated the anterior tibial translation (ATT) and internal rotation (IR) in intact knees and after selectively transecting both the ACL anteromedial bundle (AM) and posterolateral bundle (PL), and then the ALL [14]. A significant increase

in ATT at 60° and IR at 30°, 45°, and 60° was observed after ALL section, supporting the conclusion that concomitant injury of ALL increases the pivot shift phenomenon. Parsons et al. showed that the antero-lateral ligament (ALL) is an important stabilizer of internal rotation at flexion angles greater than 35°, while the ACL is the primary restraint to ATT at all flexion angles and to IR at flexion angles less than 35° [16]**.** It is, therefore, reasonable to add a lateral tenodesis/ALL reconstruction in patients with major pivot shift and healthy medial meniscus and medial collateral ligament, in young patients (age < 25 years), in cases of genu recurvatum greater than 10°, in patients playing contact sports, in patients with generalized ligamentous laxity or in cases of revision ACL reconstruction without a clear reason for failure [5].

Finally, the percentage of surgeons performing routine meniscal repair has clearly increased, as well as the percentage of those who attempt an anatomic repair of both medial meniscus ramp lesions and root tears of the lateral meniscus. It is now evident that ramp and root tears have a crucial impact on knee biomechanics especially in case of ACL deficiency. Ramp lesions induce anterior instability in ACL-deficient cadaveric knees on [1, 17] as well as internal [17] and external [17, 26] rotation laxity at all knee flexion angles. Similarly, anterior or posterior root tears of the medial meniscus reduce translational and rotational stability of the knee in both ACL-intact and ACL-deficient states [6] and increase tibiofemoral contact pressures equal to those following a total meniscectomy. Whereas their repair restored contact pressure to that of the uninjured knee [2]. Forkel et al. confirmed the findings of increased contact pressure in association with meniscal root injuries on the medial side but demonstrated that tibiofemoral contact pressure was not significantly increased in association with lateral root injury ($p < 0.05$) unless the meniscofemoral ligament was sectioned. He concluded that an isolated lateral root injury without damage to the meniscofemoral ligament might have a better prognosis than its medial counterpart [10]. The present survey clearly shows an increasing interest toward menisci and peripheral ligamentous structures in the setting of ACL reconstruction. The restoration of their anatomy and function is essential to improve outcomes. This requires trained surgeons and more open-minded approach.

This may turn into an economical problem, especially in those countries where the reimbursement for surgery is focused on ACL alone [18]. The present survey yields some clear findings: according to the answers clearly emerges an increased necessity for more anatomic ACL reconstruction (antero-medial portal rather than transtibial for femoral tunnel drilling). In addition, new evidence on the impact and influence of injuries of peripheral structures and menisci is driving surgeons towards a more anatomic approach in case of their involvement during ACL reconstruction.

## Conclusions

The present survey among U45 ESSKA surgeons yields some notable findings: the percentage of high-volume surgeons is increasing. Hamstrings and quadrupled semitendinosus are still the references in low-demanding patients (used by 92.9% of surgeons), while quadriceps tendon has become more common in contact sport practitioners (10.7%). Anteromedial inside-out technique has become the reference for femoral tunnel drilling (55% 5 years ago and 62.1% at present) as well as a cortical button for femoral fixation (52.9% 5 years ago and 69.3% at baseline).

Extra-articular procedures (antero-lateral ligament (ALL) or lateral tenodesis have become popular for 71.5% of surgeons. Finally, the percentage of those who perform meniscal suture repair, posteromedial all-inside (hook) ramp repair and transtibial pull-out repair of a lateral meniscus root tear has dramatically increased. These data indicate that the treatment of meniscal and peripheral lesions will be at the forefront of surgical practice in the future.

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**Declaration**

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** Ethical approval is not applicable to a survey.

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