Clinical Practice and Post-Operative Rehabilitation After Knee Arthroscopy: Comparison Between Polish Experts and Non-Experts.

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Research article

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Abstract

**Background:** The purpose of this study was to compare the clinical practices between polish expert and non-expert arthroscopy knee surgeons.

**Methods:** 205 registered orthopedic surgeons took part in surveys. The survey included 35 questions regarding general arthroscopy and postoperative management, including physician's level of expertise, arthroscopy anesthesia, postoperative treatment, rehabilitation and procedures performed. Comparisons were made between knee arthroscopy experts (> 100 arthroscopies performed per year) and non-experts (≤ 100 cases) on aspects of patient care.

**Results:** The most important finding of this study is an agreement in almost all aspects of knee arthroscopy approach. A consensus between polish surgeons was noticed in choosing regional anesthesia for knee arthroscopy, no need for knee braces nor knee medications, using LMW heparin as thromboprophylaxis, 1-2 days hospitalization, recommendation of rehabilitation and magnetic resonance as a diagnostic test for meniscus damage. Surgical expertise was significantly associated with the performance of meniscus sewing procedures (p = 0.009). Experts recommended starting rehabilitation already on the day of surgery (p=0.007) and more likely used objective physical tests (p=0.003). Nonexpert surgeons recommended longer period from meniscus suture to a full range knee motion (p=0.001) and admitted that patient's age does matter for meniscus repair qualification (0.002).

**Conclusions:** Clinical practice varies among orthopeadists performing knee arthroscopy procedures, based on their level of expertise. Polish knee arthroscopy experts agreed with non-experts in the type of anesthesia during knee arthroscopy and numerous aspects of postoperative treatment. Surgical expertise was associated with the performance of advanced meniscus suturing techniques.

**Background**

The knee joint is one of the most common joints subjected to injuries. Due to its localization and function, it is of vital importance to working ability, daily tasks and recreational and professional sports. For many in the young and active population who injure their knee, this commonly involves injury to the menisci [1].

Due to its hypovascularity and hypocellularity a meniscus tear does not heal spontaneously [2–4]. Moreover, a prolonged untreated damage may lead to the development of osteoarthritis [5–7]. Therefore, a proper treatment of damaged meniscus is of crucial importance for the patients. The main treatment options for damaged meniscus are surgical arthroscopic partial meniscectomy (meniscus removal) or meniscus repair. Many advances have been made in tissue engineering strategies recently and they gain more attention [8, 9].

Current orthopaedic practice aims to preserve meniscal integrity and restore function through a variety of different methods. Therefore studying and analyzing of the existing therapeutic methods to find a
Results

205 participants were questioned by 5 hostesses. All survey forms were used for the analysis. Table 1 presents the educational background of the participating surgeons in the field of knee arthroscopy. 169 of 205 (82%) orthopaedists participated in a knee arthroscopy at early stages of their career (residency, specialization) more than 30 times. Only 8 participants (4%) had no contact with knee arthroscopy during their residency or specialization. 55 orthopaedists (28%) performed more than 100 knee arthroscopies per year independently and were classified as experts for this study. The remaining 150 orthopaedists (72%) performed up to 100 knee arthroscopies per year and therefore were classified as non-experts.

Methods

For this study, a questionnaire was presented to 205 orthopaedists with various levels of clinical expertise in arthroscopy during Polish Arthroscopy Society Congress, which was held on 24–26 October 2019 in Katowice, Poland. The questionnaire contained six sections with a total of 35 questions regarding general arthroscopy and postoperative management. The six sections of the questionnaire (see Additional file 1) included: (A) physician's level of experience (4 questions), (B) anesthesia during arthroscopy (1 question), (C) postoperative treatment (3 questions), (D) hospital stay (3 questions), (E) post-arthroscopy rehabilitation (11 questions) and (F) arthroscopy procedures (13 questions).

A pilot survey was conducted before the meeting. The questionnaire was distributed to 10 orthopedic surgeons and a biostatistician to ensure that it was scientifically sound and the question stems were easy to understand. We defined experts as any participating orthopaedist who had performed > 100 knee arthroscopies per year. Orthopaedists who had performed 100 or fewer knee arthroscopies per year were classified as non-experts for this study.

Statistical analysis

Statistics were conducted using GraphPad Prism software (Graphpad Software, Inc.). Power analysis was conducted to identify the minimum number of participants required in each group to detect statistical significance. A total of 43 participants were necessary. To test proportional differences in categorical variables, a Chi square test was performed. Fisher exact tests were used when cells contained less than five subjects. Statistical significance was determined as p < 0.05.

Results

205 participants were questioned by 5 hostesses. All survey forms were used for the analysis. Table 1 presents the educational background of the participating surgeons in the field of knee arthroscopy. 169 of 205 (82%) orthopaedists participated in a knee arthroscopy at early stages of their career (residency, specialization) more than 30 times. Only 8 participants (4%) had no contact with knee arthroscopy during their residency or specialization. 55 orthopaedists (28%) performed more than 100 knee arthroscopies per year independently and were classified as experts for this study. The remaining 150 orthopaedists (72%) performed up to 100 knee arthroscopies per year and therefore were classified as non-experts.
Table 1
Physician’s level of education and experience.

| Participation in knee arthroscopy during residency or specialization | 0 cases: 4% (8/205) |
|---------------------------------------------------------------------|---------------------|
|                                                                     | 1–30 cases: 14% (28/205) |
|                                                                     | > 30 cases: 82% (169/205) |
| Independent knee arthroscopies performed per year                   | 0–50 cases: 47% (98/205) |
|                                                                     | 50–100 cases: 25% (52/205) |
|                                                                     | > 100 cases: 28% (55/205) |
| Independent knee arthroscopies performed during career              | 0-500 cases: 62% (127/205) |
|                                                                     | > 500 cases: 38% (78/205) |
| Joints currently subjected to arthroscopy procedures                | shoulder: 41% (83/205) |
|                                                                     | elbow: 14% (28/205) |
|                                                                     | wrist: 4% (9/205) |
|                                                                     | spine: 0.5% (1/205) |
|                                                                     | hip: 20% (41/205) |
|                                                                     | knee: 98% (200/205) |
|                                                                     | ankle: 40% (82/205) |

Most participating in the study orthopaedists were best trained in a knee arthroscopy (200 of 205, 98%), but a prominent number of them had additional expertise in shoulder (83 of 205, 41%) and ankle (82 of 205, 40%) arthroscopy.

In total, we have examined 55 expert orthopaedist who had performed > 100 knee arthroscopies per year and 150 non-expert orthopaedists who had performed 100 or fewer knee arthroscopies per year.

Considering anesthesia during arthroscopy, general anesthesia was reported by 12 (6%) orthopaedists in patients undergoing knee arthroscopy, a combined version of both, general and regional - by 21 (10%). The use of regional anesthesia (spinal/epidural) was favored and reported by 172 orthopaedists (84%, n.s.), of which 48 were experts (87% of experts) and 98 were non-experts (65% of non-experts). General anesthesia was used by 2 of 55 (3%) expert surgeons and 10 of 150 (6%) non-expert surgeons (n.s.). 5 experts (9%) and 14 (9%) non-experts reported combined anesthesia (n.s.).

The comparison between post-operative treatment is shown in Table 2. Only 13% orthopaedists recommended using an orthosis to their patients immediately after knee arthroscopy: 4 of 55 experts (7%) and 23 of 150 non-experts (15%).
Table 2
Postoperative treatment and hospital stay.

|                                | All (n = 205) | Experts (n = 55) | Non-experts (n = 150) | p value |
|--------------------------------|---------------|------------------|-----------------------|---------|
| Orthosis                       |               |                  |                       |         |
| Yes                             | 27 (13%)      | 4 (7%)           | 23 (15%)              | n.s.    |
| No                              | 178 (87%)     | 51 (93%)         | 127 (85%)             |         |
| Knee drain                      |               |                  |                       |         |
| Yes                             | 189 (92%)     | 50 (91%)         | 139 (72%)             | 0.012   |
| No                              | 16 (8%)       | 5 (9%)           | 11 (28%)              |         |
| Knee medications               |               |                  |                       |         |
| Yes                             | 22 (10%)      | 8 (15%)          | 10 (7%)               | n.s.    |
| No                              | 183 (90%)     | 47 (85%)         | 140 (93%)             |         |
| Anti-thrombotic prophylaxis     |               |                  |                       |         |
| Aspirin                         | 1 (1%)        | 0                | 1 (1%)                | n.s.    |
| Heparin                         | 8 (3%)        | 0                | 8 (5%)                |         |
| LMW heparin                     | 181 (88%)     | 51 (94%)         | 130 (87%)             |         |
| Other                           | 3 (2%)        | 0                | 3 (2%)                |         |
|                                 | 12 (6%)       | 4 (6%)           | 8 (5%)                |         |
| Hospitalization after non-reconstructive arthroscopy |     |                  |                       |         |
| Hours                           | 8 (4%)        | 4 (7%)           | 4 (3%)                | n.s.    |
| 1 day                           | 160 (77%)     | 47 (85%)         | 113 (75%)             |         |
| 2 days                          | 28 (14%)      | 4 (7%)           | 24 (15%)              |         |
| ≥3 days                         | 9 (5%)        | 0                | 9 (7%)                |         |
| Hospitalization after reconstructive arthroscopy |     |                  |                       |         |
| Hours                           | 3 (2%)        | 1 (1%)           | 2 (1%)                | n.s.    |
| 1 day                           | 81 (39%)      | 29 (52%)         | 52 (35%)              |         |
| 2 days                          | 90 (44%)      | 17 (31%)         | 73 (49%)              |         |
| ≥3 day                          | 22 (15%)      | 0                | 22 (14%)              |         |

p value is presented to establish statistical significance between expert and non-expert treatment. n.s. – not significant, LMW heparin – low molecular weight heparin.

There was a statistically significant difference observed in knee drain usage between experts and non-experts: 9% of experts and 28% of non-experts did not recommend using a knee drain (p = 0.012).

Only 10% of orthopaedists admitted that they administer knee medications immediately after arthroscopy: 15% of experts and 7% of non-experts. The most commonly reported pain medications used in the first 24 h after surgery were local anaesthetic drugs belonging to the amino amide group (8),
hyaluronic acid (7 cases), platelet rich plasma (1 case), steroids (1 case), antibiotics (1 case), pain killers (1 case), levonor (1) or morphine (2 cases).

Experts and non-experts answered almost equally when asked about anti-thrombotic prophylaxis administered to the patients. Low molecular weight heparin was recommended by 88% of surgeons after the patient was discharged: 94% of experts and 87% of non-experts.

Both, knee arthroscopy experts (85%) and non-experts (75%) recommended one day of hospitalization after non-reconstructive arthroscopy, rather than shorter (few hours) or longer period (more than one day). However, 1 or 2 days of hospitalization were most frequently recommended after reconstructive arthroscopy: 52% of experts and 32% of non-experts recommended 1 day, 31% of experts and 49% of non-experts recommended 2 day-long hospitalization.

Comparisons of rehabilitation recommendations are shown in Table 3. 135 surgeons (64%) reported that they always recommend rehabilitation (excluding physical therapy) and 99% (203) discuss with the patient about the importance of rehabilitation. There was a statistically significant difference noticed (p = 0.032) when surgeons were asked about their patients' compliance with the rehabilitation program. 85% of experts and 75% of non-experts admitted their patients being compliant with the protocol.
|                               | All (n = 205) | Experts (n = 55) | Non-experts (n = 150) | p value |
|-------------------------------|--------------|-----------------|-----------------------|---------|
| **Rehabilitation recommendation** |              |                 |                       |         |
| Never                         | 1 (1%)       | 0               | 1 (1%)                | n.s.    |
| Rarely                        | 7 (4%)       | 0               | 7 (5%)                |         |
| Sometimes                     | 10 (5%)      | 0               | 10 (7%)               |         |
| Mostly                        | 43 (21%)     | 8 (14%)         | 35 (23%)              |         |
| Always                        | 135 (64%)    | 41 (75%)        | 94 (63%)              |         |
| Depends                       | 9 (5%)       | 6 (11%)         | 3 (1%)                |         |
| **Patient compliance**        |              |                 |                       |         |
| Rarely                        | 48 (23%)     | 11 (20%)        | 37 (25%)              | 0.032   |
| Sometimes                     | 122 (60%)    | 30 (55%)        | 92 (61%)              |         |
| Mostly                        | 28 (14%)     | 12 (22%)        | 16 (14%)              |         |
| Always                        | 6 (3%)       | 6 (11%)         | 0                     |         |
| **Talk about the need for rehabilitation** | Yes | 203 (99%) | 55 (100%) | 148 (99%) | n.s. |
|                               | No           | 2 (1%)          | 0                     | 2 (1%)  |
| **Beginning of rehabilitation** | Day of surgery | 22 (11%) | 14 (25%) | 8 (5%) | 0.007 |
|                               | 1 day after  | 124 (60%) | 33 (60%) | 91 (61%) |
|                               | 2 days after | 14 (7%)  | 3 (6%)  | 11 (8%) |
|                               | 3d-1 week after | 22 (11%) | 2 (3%)  | 20 (14%) |
|                               | 1-2 weeks after | 18 (9%)  | 3 (6%)  | 15 (10%) |
|                               | > 2 weeks after | 4 (2%)   | 0       | 4 (2%)  |
| **Standardized rehabilitation** | Yes         | 84 (42%)     | 21 (38%)  | 63 (43%) | n.s. |
|                               | No           | 120 (58%)    | 34 (62%)  | 86 (57%) |

*p value is presented to establish statistical significance between expert and non-expert treatment. n.s. – not significant.*
|                                    | All (n = 205) | Experts (n = 55) | Non-experts (n = 150) | p value |
|------------------------------------|--------------|------------------|-----------------------|---------|
| Dependence of rehabilitation program on performed procedure | Yes | 176 (86%) | 47 (85%) | 129 (63%) | n.s. |
|                                    | No  | 28 (14%) | 8 (15%) | 75 (37%) |         |
| Physiotherapist | Yes | 189 (92%) | 49 (89%) | 140 (93%) | n.s. |
|                                    | No  | 16 (8%) | 6 (11%) | 10 (7%) |         |
| Cryotherapy | Yes | 158 (77%) | 45 (82%) | 113 (75%) | n.s. |
|                                    | No  | 46 (23%) | 10 (8%) | 91 (25%) |         |
| Physical therapy                  | Yes | 133 (65%) | 29 (53%) | 104 (69%) | n.s. |
| *multiple answers allowed          | No  | 72 (35%) | 26 (47%) | 46 (31%) |         |
| Lasertherapy                      | Yes | 69 (34%) | 16 (29%) | 53 (35%) |         |
|                                    | No  | 71 (34%) | 18 (32%) | 53 (35%) |         |
| Magnetotherapy                    | Yes | 58 (28%) | 7 (13%) | 51 (34%) |         |
|                                    | No  | 7 (3%) | 0 | 7 (5%) |         |
| Ultrasound                        | Yes | 39 (19%) | 8 (14%) | 31 (20%) |         |
|                                    | No  | 0 | 0 | 0 |         |
| Solux lamps                       | Yes | 0 | 0 | 0 |         |
|                                    | No  | 0 | 0 | 0 |         |
| Ionophoresis                      | Yes | 38 (19%) | 7 (13%) | 31 (20%) |         |
|                                    | No  | 7 (3%) | 0 | 7 (5%) |         |

p value is presented to establish statistical significance between expert and non-expert treatment. n.s. – not significant.

124 (60%) of the physicians, experts and non-experts, recommended beginning rehabilitation within one day after the surgery. However, knee arthroscopy experts frequently recommended the beginning of the rehabilitation procedure at the day of surgery (14 of 55 experts, 25%, p = 0.007). In contrast, only 8 out of 149 non-expert were choosing this option (5%).

A standardized rehabilitation protocol was recommended by 84 surgeons (42%). 176 surgeons (86%) reported that the rehabilitation protocol was dependent on procedures performed. 189 surgeons (92%) reported that the physical therapist was the key person responsible for patient rehabilitation. Cryotherapy was a preferred option of rehabilitation by 77% orthopaedists (42 experts and 113 non-experts) and
physical therapy – by 65% (133 orthopaedists). Within this group, lasertherapy and magnetotherapy were most frequently used.

Table 4 shows the factors considered when recommending return to sport by patients which underwent knee arthroscopy procedure. In most cases either surgeon or surgeon together with a physical therapist were responsible for the decision whether a patient is ready to return to sport. The most important factor in a decision process was a functional state of the patient (93% of experts and 74% non-experts, p = 0.002). Objective measurements were used to aid in the decision to return to sport by 159 (78%) surgeons. Objective physical tests were reported to be significantly more involved in the decision about the patient’s return to activity in the case of experts compared to non-expert surgeons (p = 0.003). Among them, functional tests were significantly preferred by experts than non-experts (p = 0.006).
Table 4
Return to sport.

| Decision making | All (n = 205) | Experts (n = 55) | Non-experts (n = 150) | p value |
|------------------|---------------|------------------|-----------------------|---------|
|                  | Surgeon       |                  |                       |         |
| *multiple answers allowed | 77 (37%) | 23 (45%) | 54 (36%) | n.s. |
| Physical therapist | 3 (2%) | 1 (1%) | 2 (1%) | |
| Surgeon and physical therapist | 87 (42%) | 30 (54%) | 57 (38%) | |
| Patient          | 7 (3%) | 1 (1%) | 6 (4%) | |
| Criteria of decision | Time | 72 (35%) | 24 (44%) | 48 (32%) | 0.002 |
| *multiple answers allowed | 86 (42%) | 19 (34%) | 67 (45%) | |
| Functional state | 162 (80%) | 51 (93%) | 111 (74%) | |
| Correct image in examination | 39 (19%) | 12 (22%) | 27 (18%) | |
| Objective physical tests | Yes | 159 (78%) | 50 (91%) | 109 (66%) | 0.003 |
| *multiple answers allowed | 56 (22%) | 5 (9%) | 51 (34%) | 0.006 |
| Dynamometer | 58 (28%) | 22 (40%) | 36 (24%) | |
| Functional tests | 119 (58%) | 44 (80%) | 75 (50%) | |
| Survey          | 35 (17%) | 11 (20%) | 24 (16%) | |

*p value is presented to establish statistical significance between expert and non-expert treatment. n.s. – not significant.

The arthroscopic procedures used by experts were as follows (Table 5 and Fig. 1): ACL reconstruction (100%), meniscus suturing all inside (96%) and meniscus removal (93%). Non-experts had significantly less experience with these procedures: ACL reconstruction was reported by 81% non-experts, meniscus suturing all inside by 79% and meniscus removal by 81% (p < 0.0001).
| Procedures used *multiple answers allowed | All (n = 205) | Experts (n = 55) | Non-experts (n = 150) | p value |
|-----------------------------------------|--------------|-----------------|-----------------------|---------|
| Diagnostic arthroscopy                  | 119 (58%)    | 25 (45%)        | 94 (63%)              | < 0.0001|
| Synovial folds removal                  | 164 (80%)    | 40 (73%)        | 124 (83%)             |         |
| Meniscus removal                        | 171 (83%)    | 53 (96%)        | 118 (79%)             |         |
| Meniscus suturing all inside            | 161 (79%)    | 48 (87%)        | 113 (75%)             |         |
| Meniscus suturing inside-out/outside-in | 99 (48%)     | 41 (75%)        | 58 (39%)              |         |
| Meniscus transplant                     | 66 (32%)     | 32 (58%)        | 34 (23%)              |         |
| Ramp lesion repair                      | 76 (37%)     | 33 (60%)        | 43 (29%)              |         |
| Microfractures                          | 36 (18%)     | 18 (33%)        | 18 (12%)              |         |
| Cartilage reconstruction               | 49 (24%)     | 36 (66%)        | 13 (8%)               |         |
| ACL reconstruction                      | 45 (22%)     | 20 (45%)        | 25 (17%)              |         |
| PCL reconstruction                      | 54 (27%)     | 23 (45%)        | 31 (21%)              |         |
| Simultaneous multi-ligament reconstruction | 21 (10%)    | 11 (20%)        | 10 (7%)               |         |
| Pediatric multi-                        |              |                 |                       |         |

*p value is presented to establish statistical significance between expert and non-expert treatment. n.s. – not significant. PRP – platelet rich plasma, BMC – bone marrow cells, AAT – autologous adipose tissue.*
| Procedures performed most frequently | All (n = 205) | Experts (n = 55) | Non-experts (n = 150) | p value |
|--------------------------------------|--------------|-----------------|-----------------------|---------|
| Diagnostic arthroscopy               | 24 (12%)     | 3 (5%)          | 21 (14%)              | 0.009   |
| Synovial folds removal               | 15 (7%)      | 2 (4%)          | 13 (9%)               |         |
| Meniscus removal                     | 47 (23%)     | 10 (18%)        | 37 (25%)              |         |
| Meniscus suturing                    | 45 (22%)     | 21 (38%)        | 25 (17%)              |         |
| Meniscus transplant                  | 1 (1%)       | 0               | 1 (1%)                |         |
| Microfractures                        | 4 (21%)      | 2 (4%)          | 2 (1%)                |         |
| Cartilage reconstruction             | 3 (1%)       | 2 (4%)          | 1 (1%)                |         |
| ACL reconstruction                   |              |                 |                       |         |
| Simultaneous multi-ligament reconstru...|          |                 |                       |         |
| Pediatric multi-ligament reconstructi...|          |                 |                       |         |

*p value is presented to establish statistical significance between expert and non-expert treatment. n.s. – not significant. PRP – platelet rich plasma, BMC – bone marrow cells, AAT – autologous adipose tissue.*
|                      | All (n = 205) | Experts (n = 55) | Non-experts (n = 150) | p value |
|----------------------|-------------|----------------|----------------------|--------|
| **Meniscus repair**  |             |                |                      |        |
| methods              |             |                |                      |        |
| Suturing all inside  | 164 (80%)  | 47 (85%)       | 117 (78%)            | 0.001  |
| Suturing inside-out  | 132 (64%)  | 44 (80%)       | 88 (59%)             |        |
| Suturing outside-out | 105 (51%)  | 34 (62%)       | 71 (47%)             |        |
| ***multiple answers**|             |                |                      |        |
| Scarification         | 68 (33%)   | 21 (38%)       | 47 (31%)             |        |
| PRP                  | 48 (23%)   | 19 (35%)       | 29 (19%)             |        |
| BMC                  | 13 (6%)    | 11 (20%)       | 2 (1%)               |        |
| AAT                  | 6 (3%)     | 4 (7%)         | 2 (1%)               |        |
| Biomaterials         | 12 (6%)    | 7 (13%)        | 5 (3%)               |        |

|                          |            |                |                      |        |
| **Diagnostic methods**   |            |                |                      |        |
| methods                |            |                |                      |        |
| None                   | 1 (1%)     | 1 (2%)         | 0                    | n.s.   |
| X-ray                  | 28 (14%)   | 7 (13%)        | 21 (14%)             |        |
| USG                    | 101 (49%)  | 28 (51%)       | 73 (49%)             |        |
| MR                     | 200 (98%)  | 54 (98%)       | 146 (97%)            |        |
| Other                  | 2 (1%)     | 1 (2%)         | 1 (1%)               |        |

*p value is presented to establish statistical significance between expert and non-expert treatment. n.s. – not significant. PRP – platelet rich plasma, BMC – bone marrow cells, AAT – autologous adipose tissue.*

Experts mostly performed meniscus suturing (38%), non-experts – meniscus removal (25%), p = 0.009 (Table 5 and Fig. 2).

When it comes to meniscus repair methods (Table 5 and Fig. 3), experts were performing significantly more suturing methods than non-experts (p = 0.001). Bone marrow cells were used almost mostly by experts (11 out of 55 experts, 20%) and only 1 non-expert. Similar trend was observed in biomaterials usage (7 experts – 13% and 5 non-experts – 3%) and autologous adipose tissue usage (4 experts – 7% and only 2 non-experts – 1%).

Diagnostic tests used by experts when meniscus tear was suspected in their patients were the same as chosen by non-experts (Table 5 and Fig. 4). Both, experts and non-experts agreed that magnetic resonance was their preferred diagnostic method. Ultrasounds were used by ~ 50% of experts and non-experts. X-ray method was the least frequently used.
Both, experts and non-experts recommended similar time of using elbow crutches after meniscus removal (2 weeks) or orthosis after meniscus suture (6 weeks). The answers were however different when surgeons were asked about how soon after meniscus sewing they recommend a full range of knee motion (Table 6 and Fig. 5). Experts recommendation was 4 weeks and non-experts – 6 weeks (p = 0.001).
|                    | All (n = 205) | Experts (n = 55) | Non-experts (n = 150) | p value |
|--------------------|--------------|-----------------|-----------------------|---------|
| **Elbow crutches** |              |                 |                       |         |
| usage after        |              |                 |                       |         |
| meniscus removal   |              |                 |                       |         |
| No                 | 20 (10%)     | 9 (16%)         | 11 (7%)               | n.s.    |
| 1–6 days           | 34 (17%)     | 11 (20%)        | 23 (15%)              |         |
| 1 week             | 23 (11%)     | 7 (13%)         | 16 (11%)              |         |
| 2 weeks            | 57 (28%)     | 13 (24%)        | 54 (36%)              |         |
| 3 weeks            | 5 (2%)       | 2 (3%)          | 3 (2%)                |         |
| 4 weeks            | 22 (11%)     | 4 (7%)          | 18 (11%)              |         |
| 6 weeks            | 17 (8%)      | 4 (7%)          | 13 (8%)               |         |
| Other              | 17 (8%)      | 5 (10%)         | 12 (7%)               |         |
| **Orthosis**       |              |                 |                       |         |
| usage after        |              |                 |                       |         |
| meniscal repair    |              |                 |                       |         |
| No                 | 24 (12%)     | 6 (10%)         | 18 (11%)              | n.s.    |
| 1–6 days           | 3 (2%)       | 0               | 3 (2%)                |         |
| 1 week             | 4 (2%)       | 0               | 4 (2%)                |         |
| 2 weeks            | 19 (10%)     | 3 (5%)          | 16 (10%)              |         |
| 3 weeks            | 14 (7%)      | 5 (10%)         | 9 (6%)                |         |
| 4 weeks            | 43 (21%)     | 15 (27%)        | 28 (19%)              |         |
| 5 weeks            | 6 (4%)       | 0               | 6 (3%)                |         |
| 6 weeks            | 70 (34%)     | 19 (35%)        | 51 (30%)              |         |
| 8 weeks            | 3 (2%)       | 1 (2%)          | 3 (2%)                |         |
| Other              | 13 (6%)      | 6 (10%)         | 12 (8%)               |         |

*p value is presented to establish statistical significance between expert and non-expert treatment. n.s. – not significant.*
| Time since meniscus suture to recommendation of a full range knee motion | All (n = 205) | Experts (n = 55) | Non-experts (n = 150) | p value |
|---|---|---|---|---|
| 1–6 days | 11 (5%) | 1 (2%) | 10 (7%) | 0.001 |
| 1 week | 5 (2%) | 1 (2%) | 4 (3%) | |
| 2 weeks | 14 (7%) | 4 (7%) | 10 (7%) | |
| 3 weeks | 14 (7%) | 2 (4%) | 12 (8%) | |
| 4 weeks | 48 (24%) | 18 (33%) | 30 (20%) | |
| 5 weeks | 5 (2%) | 1 (2%) | 4 (3%) | |
| 6 weeks | 79 (39%) | 19 (34%) | 60 (40%) | |
| 7 weeks | 1 (1%) | 1 (2%) | 1 (1%) | |
| 8 weeks | 15 (7%) | 3 (5%) | 12 (8%) | |
| Other | 12 (6%) | 5 (9%) | 7 (3%) | |

| Consideration whether to remove or repair meniscus | Patient's age | Time since injury | Physical activity | Damage type | Damage zone | Damage MR | Accompanying damage |
|---|---|---|---|---|---|---|---|
| All (n = 205) | 151 (74%) | 118 (58%) | 105 (51%) | 175 (85%) | 44 (23%) | 75 (36%) | |
| Experts (n = 55) | 37 (67%) | 30 (54%) | 24 (44%) | 50 (91%) | 14 (25%) | 22 (40%) | |
| Non-experts (n = 150) | 114 (76%) | 88 (59%) | 81 (54%) | 125 (83%) | 101 (68%) | 53 (35%) | |

| Patient's age for meniscus repair qualification | < 20 y.o. | < 30 y.o. | < 40 y.o. | < 50 y.o. | < 60 y.o. | < 70 y.o. | Does not matter |
|---|---|---|---|---|---|---|---|
| All (n = 205) | 3 (2%) | 14 (7%) | 34 (16%) | 45 (22%) | 23 (11%) | 0 | 86 (42%) |
| Experts (n = 55) | 0 | 2 (4%) | 10 (18%) | 10 (18%) | 2 (4%) | 0 | 31 (56%) |
| Non-experts (n = 150) | 3 (2%) | 12 (8%) | 24 (16%) | 35 (23%) | 21 (14%) | 0 | 55 (36%) |

*p value is presented to establish statistical significance between expert and non-expert treatment. n.s. – not significant.*
Both, experts and non-experts named similar factors when they considered whether to remove or to repair meniscus - damage type and zone. They also selected patient's age, however experts stated that age does not matter when they consider for meniscus repair qualifications significantly more frequently than non-experts (Table 6 and Fig. 6, p = 0.002).

Surgeons were also asked about patient’s sport discipline influence on to repair or to remove decision. 103 orthopaedist: 23 experts (42%) and 80 non-experts (54%) admitted taking into consideration a discipline.

At the end of the first part of the survey participating orthopaedist were asked about their preferred procedure in case of traumatic meniscus tear in an 18-year-old or 30-year-old professional football player. 179 orthopaedists decided to repair the damaged part of the meniscus in an 18-year-old patient: 53 experts (97%) and 126 non-experts (84%). Similarly, 166 surgeons decided to repair the damaged part of the meniscus in an 30-year-old patient: 44 experts (80%) and 122 non-experts (81%).

Summarizing the results from the survey, we have noticed a consensus in the following areas of knee arthroscopy:

- regional anesthesia used for knee arthroscopy - reported by 84% orthopaedists,
- no need for using a knee orthosis – reported by 87% orthopaedists,
- no need for knee medications immediately after arthroscopy – by 89% orthopaedists,
- low molecular weight heparine as thromboprophylaxis after knee arthroscopy – 90% orthopaedists,
- 1 day duration of hospital stay after non-reconstructive knee arthroscopy – 78% orthopaedists,
- 1–2 days duration of hospital stay after reconstructive knee arthroscopy – 87% orthopaedists,
- recommendation of rehabilitation – 85% of surgeons,
- talking with the patient about the need of postoperative rehabilitation – 99% orthopaedists,
- dependence of rehabilitation program on procedures performed – 86% orthopaedists,
- recommendation of rehabilitation with a physiotherapist- 92% orthopaedists,
- magnetic resonance as a diagnostic test for meniscus damage – 97% orthopaedists,
- repair as preferred procedure in case of meniscus damage in an 18-year-old professional footballer – 87% orthopaedists,
- repair as preferred procedure in case of meniscus damage in an 30-year-old professional footballer – 81% orthopaedists.

**Discussion**

The most important finding of this study is an agreement in almost all aspects of knee arthroscopy approach. A consensus between polish surgeons was noticed when it comes to anesthesia during knee arthroscopy as well as numerous aspects of postoperative treatment, hospital stay and rehabilitation.
A consensus between polish orthopaedists was reached in choosing of the regional anesthesia for knee arthroscopy. This is with an agreement with world standards. Regional anesthesia, in contrast to the general one, is a simple, safe technique, well accepted by patients and reducing hospital stay. Therefore, both experts and non-experts also agreed on short duration of hospital stay after knee arthroscopy (1–2 days). Polish surgeons also agreed on no need for routine recommendation of using a knee orthosis, which is in agreement with previous studies showing no beneficial effect of bracing after knee arthroscopy [14, 15] or even indirect prevention of ACL reruptures in case of rehabilitation without a knee brace [16].

The presentation of pain after arthroscopic surgery is determined by the procedure of surgery. In this survey, all surgeons agreed that there is no need for intraarticular knee medications immediately after arthroscopy. This is in agreement with studies where it was found that a significant proportion of patients have only very mild or mild pain after knee arthroscopic procedures [17].

Current guidelines for thromboprophylaxis recommend the use of vitamin K antagonists (e.g. warfarin), low-molecular-weight heparins (LMW heparin) or aspirin [18, 19]. LMW heparine has a long half-life with good bioavailability [20] and is administered once daily subcutaneous dose without laboratory monitoring or dose adjustment. Experts and non-experts in this survey agreed that the efficacy and safety of LMW heparin is well established and is a good choice for knee arthroscopy.

There is a wide range of rehabilitation protocols after knee arthroscopic procedures, mainly based on specialist exercises. The goal of the postoperative rehabilitation period is to reduce knee pain and regain good knee control, range of motion, strength and knee function. The surgeon plays a key role in educating the patient about the importance of post-surgical rehabilitation. Polish surgeons taking part in this survey agreed that proper post-operative rehabilitation of the knee is essential, especially for a return to active lifestyle. In our survey, 99% of the surgeons reported that they discussed the importance of compliance with the rehabilitation protocol with the patient. However, there is still a room for an improvement, since this study showed that 1% of surgeons never recommends rehabilitation, 5% - rarely and 7% - sometimes. Most of the surgeons recommended a rehabilitation with a physiotherapist, which is now considered as a gold standard in the field, as its effectiveness has been proved by a number of control studies [21–24].

Different treatment requires a different rehabilitation approach, which is why individual cooperation between the physiotherapist and the patient is so important [25]. On the other hand, there are no direct evidences for good results with physical therapy, as Evidence Based Medicine (EBM) does not exist in physical therapy field, in contrary to physiotherapy. In our survey, both, experts and non-experts recommended physical therapy less frequently (65%) than rehabilitation with physiotherapist (92%). The results of this survey suggest a need for a broad discussion in the polish environment if physical therapy should be advisable and recommended by polish National Health Fund.

Magnetic resonance imaging (MRI) is considered to be the most accurate method of imaging of the internal knee joint structure, with sensitivity in detecting medial meniscus lesions ranging from 83–94% [26–28]. Moreover, the ESSKA European meniscus consensus group recommended using MRI when
arthroscopy would be considered to identify concomitant pathologies [11]. Magnetic resonance as a diagnostic test for meniscus damage was recommended by 97% orthopaedists in this study. However, 50% of surgeons recommended ultrasounds as a diagnostic method and this should not be practiced since ESSKA European meniscus consensus group does not recommend ultrasounds for traumatic nor degenerative damage.

On the other hand, surgical expertise was significantly associated with the performance of reconstructive procedures, in comparison to diagnostic arthroscopy performed more often by non-experts (p = 0.009). Experts were significantly more likely to perform meniscus sewing procedures than non-experts, which are considered advanced and challenging techniques with significant biomechanical consequences. Moreover, the clinical experience of participating in this survey orthopaedists was correlated with the using of newly established methods. Experts were deciding to use bone marrow cells, biomaterials or autologous adipose tissue as meniscus repair methods. All of these approaches that involve the use of cells and biomaterial scaffolds have gained an increasing attention as potential regenerative therapies in the field of musculoskeletal medicine very recently [4, 9]. Therefore the observation than non-experts are less frequently choosing these options could be explained with their less experience with new therapeutic options for patients, as they still gain experience with traditional meniscus treatment methods.

Experts admitted that they patients comply with the rehabilitation protocol to high extend (p = 0.032), in contrast to non-experts. This might be explained by greater authority of more experienced surgeons. Polish experts recommended starting rehabilitation already on the day of surgery (p = 0.007). Surgeons from all over the world have increasingly emphasized early mobilization, which may produce favorable post-operative outcomes [29–31].

Nonexpert surgeons less likely used objective physical tests (p = 0.003), recommended longer period from meniscus suture to a full range knee motion (p = 0.001) and admitted that patient’s age does matter for meniscus repair qualification (0.002). All of these issues might be correlated with less experience of this group of surgeons.

Both expert and non-expert preferred to perform meniscus suturing rather than meniscus removal in both traumatic meniscus tears in 18-yeral old and 30-year old football player. That proves the willingness of meniscal repair and awareness of its role in knee arthritis prevention.

**Conclusions**

Clinical practice varies among orthopaedists performing knee arthroscopy procedures, based on their level of expertise. Polish knee arthroscopy experts agreed with non-experts in the type of anesthesia during knee arthroscopy and numerous aspects of postoperative treatment. Surgical expertise was associated with the performance of advanced meniscus suturing techniques.

This study had limitations. The questionnaire included 35 questions, which is a prominent number and could cause a potential weariness and careless or ill-considered answers. However, during the pilot study
the average time for competition did not exceed 10 minutes and it would be difficult to collect detailed information about the post-operative aspects of care with fewer questions. Defining the level of expertise at a cutoff of more than 100 arthroscopies performed per year could be considered a biased decision for this study.

List Of Abbreviations

AAT – autologous adipose tissue
BMC – bone marrow cells
EBM - Evidence Based Medicine
ESSKA - European Society for Sports Traumatology, Knee Surgery and Arthroscopy
LMW heparin - low-molecular-weight heparine
MRI - Magnetic resonance imaging
PRP – platelet rich plasma

Declarations

Ethics approval and consent to participate: According to the Bioethical Commitee of Karol Marcinkowski Medical University in Poznań, the consent of the bioethics commission is not required for "surveys involving the use of standardized surveys - used for their intended purpose, and the study will develop statistically selected elements of the survey" (ordinance No. 113/17 of the Rector of Karol Marcinkowski Medical University in Poznań, October 2nd, 2017).

Verbal informed consent was obtained from study participants before completing the survey (based on the opinion of Rehasport Clinic Scientific Council).

Consent to publish: Not applicable

Availability of data and materials: The datasets used during the current study are available from the corresponding author on reasonable request.

Competing interests: Not applicable

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Authors' Contributions: PB conceived and designed the study. PB and TP participated in the setup of the study, participants recruitment, and data collection. KBŻ conducted the analysis. KBŻ drafted the first version of the manuscript. All authors helped in revising the manuscript and gave their final approval of
the submitted version. All authors had full access to the data and take responsibility for the integrity of
the data and the accuracy of the data analysis.

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Figures
Figure 1

Procedures performed by the participating surgeons.
Figure 2

Procedures most frequently performed by the participating surgeons.
Figure 3

Meniscus repair methods performed by the participating surgeons.
Figure 4

Diagnostic methods used by the participating surgeons.
Figure 5

Time since meniscus suture to recommendation of a full range knee motion.
Figure 6
Patient's age for meniscus repair qualification.

Supplementary Files

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