



# Development of a return to play checklist following patellar instability surgery: a Delphi-based consensus

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## Abstract

**Purpose** To date, there is no consensus for the appropriate timing or functional evaluation for safe return to play following patellar instability surgery. The purpose of this study is to develop a consensus-based return to play checklist following patellar stabilization surgery using the Delphi method.

**Methods** A 3-part survey series was conducted following the systematic guidelines of the Delphi technique for gathering consensus from experts in the management of patellofemoral instability. All surveys were completed between July and November of 2017. A literature search was performed in SCOPUS and PubMed to identify existing sources on return to play following patellar instability surgery and determining patellofemoral joint strength in athletes, which served as the basis for the surveys.

**Results** 12 of the 19 selected participants (63%) completed the first-round survey, 11 of those 12 participants (92%) completed the second-round survey, and 10 of these 11 participants (91%) completed the final survey. Of the final ten participants, there was representation from seven different states in the USA. Nine of the ten (90%) respondents endorsed the final checklist. The final checklist included eight overarching domains with defined and reproducible objective criteria.

**Conclusion** The standardized list of objective and reproducible criteria for rehabilitation outlined below should help practitioners focus more on patient-centred factors and less on arbitrary timelines. No prior study has gathered consensus from experts on this topic; therefore, this study should serve as a benchmark to help guide patients back to sport safely.

**Level of evidence** V.

**Keywords** Return to play · Patellofemoral instability surgery · Checklist

## Introduction

Patellar instability is an important clinical entity in sports medicine [1]. An epidemiological study by Waterman et al. [1] reported the incidence of patellar dislocation to be 2.29 per 100,000 person-years in the USA between 2003 and 2008, with a peak incidence of 11.19 per 100,000

person-years occurring in individuals between 15 and 19 years of age. Recurrent patellar instability following conservative treatment has been reported to be between 15 and 50% in the literature [2–6]. As a result, surgical intervention has gained acceptance as the gold standard of treatment for refractory cases of patellar instability.

Techniques for surgical treatment of patellar instability include proximal soft tissue procedures as well as distal bony procedures. Soft tissue procedures generally include repair or reconstruction of the medial patellofemoral ligament (MPFL) and medial retinaculum. Distal bony procedures, including various forms of tibial tubercle osteotomies, can be performed in isolation and in combination with proximal realignment. However, despite their general success, recurrent instability rates following MPFL reconstruction (not including repair) and anteromedialization of the tibial tubercle have been reported to be as high as 28% and 17%, respectively [7, 8]. These relatively high rates of surgical

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failure have led us to investigate the consensus on return to sport criteria, to ensure that athletes resume their activities when they are adequately recovered.

A recent systematic review of the literature on return to play guidelines following isolated MPFL surgery for patellar instability by researchers noted a paucity of evidence-based criteria for establishing safe return to sports [9]. The review covered return to play criteria, which includes a form of rehabilitation, a timeline, and other criteria including bracing, range of motion, and activity progression. While a variety of criteria were used, there did not appear to be a uniformly accepted measure for return to play across practices. This increases room for error in interpretation by physicians and physical therapists as to whether or not the athlete meets the criteria in the most objective manner possible. Furthermore, the overall lack of reported outcomes on return to sports following patellar instability surgery suggests that there is still much to be discovered within this area of research [5, 10]. The purpose of this study was to develop an expert consensus-based return to play checklist following patellar stabilization surgery using the Delphi method [11]. Using a predetermined methodology for consensus building based on expert practices in the field was hypothesized to allow us to generate an effective and practical checklist in an efficient manner. Clinically, this study provides valuable pragmatic guidance for health-care providers and athletic trainers providing care for athletes recovering from patellofemoral instability surgery. This checklist, once validated, can help define parameters for safer return to play.

## Materials and methods

This study followed the systematic guidelines described in the Delphi technique in an attempt to build consensus amongst experts in the field of orthopaedic sports medicine [11]. The Delphi technique has been used worldwide to measure expert consensus “within certain topic areas” [11]. Specifically, this study seeks to identify return to play guidelines in the form of reproducible criteria for patients undergoing surgery for patellofemoral instability. Recommendations from Sprague et al. [12] were used in the development of the surveys to ensure best practices with regard to survey length, format, and aesthetic for enhancing the likelihood of receiving accurate and high rates of response from the expert panel of participants. The details of the checklist development are described below.

In June 2017, an initial list of experts based on recommendations from orthopaedic surgeons at our institution was compiled. The list consisted primarily of internationally renowned orthopaedic sports medicine surgeons, who are all recognized for their treatment of patellofemoral disorders. A combination of criteria was used to develop the final list

of experts. These criteria included: (1) at least one publication in the preceding 5 years pertaining to patellofemoral disorders, (2) affiliation with an academic institution, and (3) participation in at least one internationally recognized orthopaedic conference. Invitations were sent out to 18 board-certified, actively practicing sports medicine surgeons as well as one DPT, physical therapist, and adjunct instructor from a world-renowned orthopaedic hospital. Personalized invitations were sent to each participant over e-mail, explaining the goals of the study, as well as listing the principal investigators and their institutional affiliation. All survey responses were separated from the respondent’s names and received equal weighting in the consensus-building effort.

Question development for the first-round survey was undertaken by a research staff member, two medical students, one physical therapist, and two attending orthopaedic surgeons. A prior systematic review performed at our institution laid the framework for the development of this checklist [9]. An additional search was performed beyond this systematic review, however, using PubMed and SCOPUS to identify tests or criteria not identified in a prior systematic review. Notably, the prior study included only studies with isolated MPFL reconstruction or repair. Therefore, this new search included a combination of terms such as “patellar instability,” “patellar dislocation,” “postoperative rehabilitation,” and “return to sport,” as well as “tibial tubercle osteotomy,” “Elmslie–Trillat,” “Fulkerson osteotomy,” “osteotomy,” and “lateral release.” Titles were then reviewed for relevance and compared against the titles from the aforementioned systematic review. When deemed relevant and not identified in the previous study, the manuscripts were reviewed for pertinent return to play criteria and rehabilitative measures for patellar joint stability. This search yielded an additional 48 papers—none of which discussed measures beyond what was previously discovered in the prior systematic review, except for the mention of radiographic confirmation of bone healing. Thus, in formulating the groundwork for the checklist, special attention was paid to objective criteria, weight-bearing progressions, range of motion measurements, and quadriceps strengthening exercises, since these domains were highlighted in the previous systematic review and confirmed upon further exploration of the current literature [9]. Internal discussions were conducted to expand upon these focus areas and 30 unique domains (Fig. 1) were established that pertain to patellofemoral rehabilitation and address objective measures, functional testing, or subjective evaluation and could qualify as criteria for a return to play checklist [5, 7, 13–38]. A number of these domains were intentionally quite broad to allow for expert contribution and discussion.

These unique domains helped guide the development and framework of the first survey round. The Delphi method, on the whole, consisted of two complete rounds

Please select a rating on a scale of 1-10 to express your opinion of whether or not the following test(s) and/or measurement(s) are relevant and necessary for evaluating patients POSTOPERATIVELY who wish to return to sport following surgery for patellar instability (10 = absolutely necessary, 1 = completely unnecessary).

Please consider any and all soft tissue or bony procedures that you use to treat patellar instability. In addition, please provide a brief rationale for your decision in the section after your rating.

1. Apprehension Test
2. Patellar Glide Test
3. Patellar Tilt Test
4. Patellar Positioning Evaluation
5. Q-Angle Measurement
6. J-Sign Evaluation
7. Hypermobility Evaluation
8. Palpation of Medial Retinaculum
9. Visual Quadriceps Inspection
10. Quadriceps Pull Test
11. Basset's Sign
12. Evaluation of Lower Limb Alignment
13. Gait Pattern Analysis
14. Gravity Subluxation Test
15. Tibial Tubercle to Trochlear Groove (TTTG) Assessment
16. VMO (Vastus Medialis Oblique) Capability Assessment
17. Isokinetic Testing
18. Single-Leg Squat Testing
19. Star Excursion Balance Test (SEBT)
20. Drop Jump Test
21. Side-Hop Test
22. Core Stability Test(s)
23. Balance Test(s)
24. Lower Extremity Muscle Strength Test(s)
25. Lower Extremity Muscle Endurance Test(s)
26. Lower Extremity Muscle Power Test(s)
27. Patient-Reported outcome Measures (Kujala, Lysholm, Tegner, IKDC, KOOS, etc.)
28. Range of Motion Measurement
29. Joint Line Circumference Measurement
30. Thigh Circumference Measurement
31. Please provide any additional tests or information that you think will be useful in our development of a patellar instability RTP checklist

**Fig. 1** Summary of the 31 questions and instructions for survey #1 in the series

of questionnaires and a third and final round that included a single clarifying question with a drafted checklist for review and comment by each participant. All survey rounds were circulated and completed between July and November 2017. All questionnaires were electronically

distributed and constructed using Google Forms, with the respective data retrieved and analyzed in Google Sheets.

The first-round survey was initiated simultaneous to the personalized invitations to each expert. Three co-investigators in the sports medicine research division formulated a

31-question survey based on the above findings to be distributed as the initial round of questionnaires (Fig. 1). The first 30 items consisted of a broad and basic questioning schema, where experts ranked a given testing area based on its relevance and necessity in evaluating patients for return to play following patellar instability surgery. These first 30 items of the first-round survey were two-part questions—the first part asked the participant to rate the item on a simple Likert scale from 1 to 10, and the second part asked for a rationale to go with their rating. In the 1 to 10 rating scale, a rating of 1 equated to “completely unnecessary” and a rating of 10 equated to “absolutely necessary.” The rationale and the rating were required questions in the survey. The final question was optional and allowed participants to suggest other tests for consideration. A reminder was sent 7 days after the first e-mail to those who had not yet responded, and the last participant completed the survey 13 days after it was sent out.

At the conclusion of the first round, the additional suggested tests from respondents were evaluated and included in the second round if felt to be relevant to the process. Responses to each question were assessed according to the following criteria: an average rating above 7 was automatically included in the second round of surveying; an average rating below 3.5 was automatically excluded from the second round of surveying; if the average rating fell between 3.5 and 7, the item was scrutinized on an individual basis and a decision was made regarding inclusion based on the rationales provided by the participants. If questions in this intermediate group (ratings of 3.5–7) were deemed to be misinterpreted by one or more participants, they were re-worded and fine-tuned internally and then included in the second round. This process of including intermediate scored testing domains allowed respondents to rectify their response if they were originally outside of consensus—an important component of the Delphi method for consensus building.

The second round of questions was sent out by e-mail 8 days after the conclusion of the first round and included 20 total items. One of the 20 questions was a conditional question based on a response from the previous question, and another one was optional, leaving a minimum of 18 total questions to be answered by all participants. The second survey was only sent to participants who completed the first round (12 out of 19). The series of questions in this round included significantly more details and specificity for respondents to consider. The purpose of this series of questions was to go beyond the mere requirement of a test and to specifically understand the objective criteria that a practicing physician would require their patients to satisfy within each test. Each question included an optional comment section for elaboration or clarification, and the style of question was one of the following: (1) single-answer multiple choice question, (2) multiple-answer multiple choice question, or (3) free-form text question. Further,

images were included to help specify items related to functional testing. For the last question of the survey, respondents were provided the option to give further feedback on the listed questions. The final respondent completed the survey 15 days after it was sent out. If a testing criterion received greater than 80% support, it was included in the checklist draft. If an item did not attain 80% support amongst participants, the comments were evaluated further to ensure accurate interpretation of the question and then it was either removed from the eligible list of items or considered for re-polling.

The third and final survey round was sent by e-mail 2 months after the completion of the second survey. Only those participants who completed the second survey were sent the final survey. The larger time gap between surveys is explained by the effort that was required to create a draft of the checklist. If an item from the second-round survey had greater than 80% consensus amongst participants, it was included as an item in the draft of the return to play checklist. In the third survey round, this draft of the return to play checklist was sent to each participant. The draft was attached to the e-mail in Portable Document Format (PDF), along with a link to the final three-question survey. The final three-question survey consisted of two multiple choice questions and a third optional, open form question. The first multiple choice question asked which subjective questionnaire the expert preferred between the patient-reported outcome measures (PROMs) KOOS (Knee injury and Osteoarthritis Outcome Score) and IKDC (International Knee Documentation Committee) scores. This question was asked so that a single recommendation could be included for the subjective questionnaire in the final checklist, since the open-ended first-round survey generated eight unique PROMs from the various experts. KOOS and IKDC, however, emerged from the second-round survey as equal favourites. Thus, this third-round survey question was an attempt to establish a clear favourite between the two questionnaires. The second multiple choice question simply asked if the expert agreed with the majority of tests included in the checklist draft. The third, open-ended question allowed respondents to provide final suggestions and thoughts on the checklist. Ten of the final 11 participants completed the survey within 2 days. The final, 11th, participant did not respond to the final survey despite being sent an e-mail reminder 7 days later. Institutional Review Board (IRB) approval was not required as this study did not involve human subjects or access to protected health information.

## Results

Twelve of the 19 selected participants (63%) completed the first-round survey in the allotted time. In this survey, 6 of the 30 items received a score below 3.5 (out of 10), 13 items

were scored between 3.5 and 7, and 11 items were scored above 7. 11 of the 12 participants from the first round (92%) completed the second-round survey in the allotted time. Of the 18 items answered by all participants in the second round, 10 items (55%) had less than 80% agreement and 8 items (45%) had greater than 80% agreement. The eight items that had greater than 80% support were included in the checklist draft, either as a single item or consolidated into one when appropriate. The third-round survey was completed by 10 of the 11 participants (91%) who completed the second round. Of the ten participants, there was representation from seven different states in the USA.

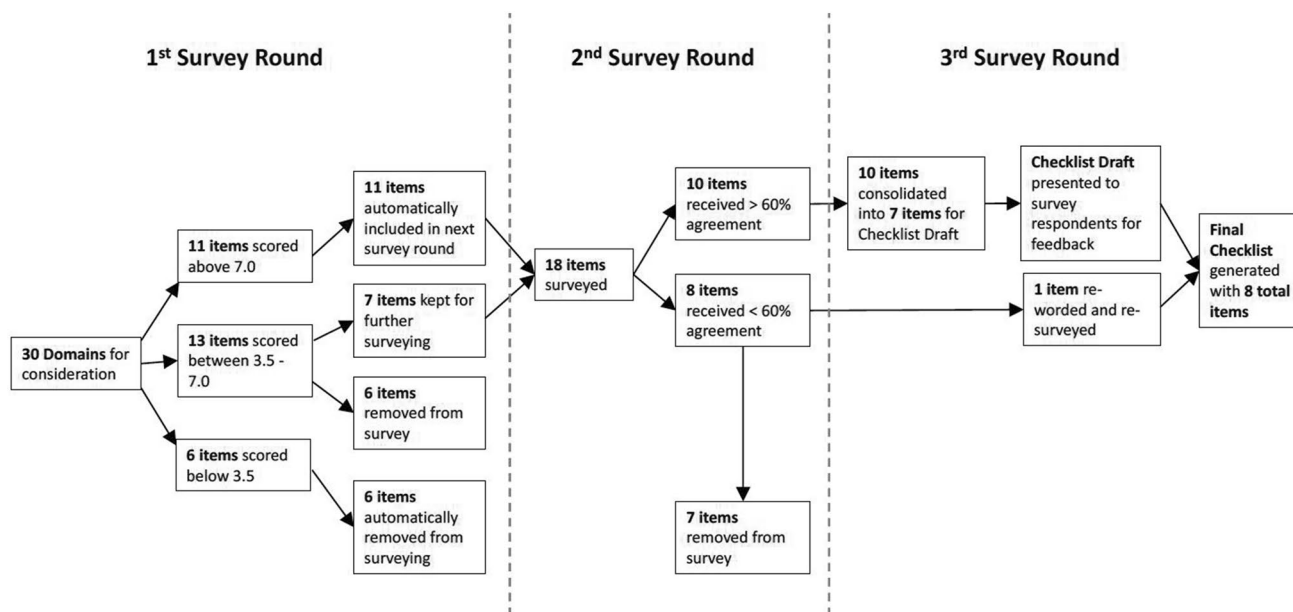
Nine of the ten (90%) respondents endorsed the final checklist. One of the ten respondents did not believe the checklist was necessary for return to play after patellar instability surgery and thus did not give their endorsement of the checklist. Six of ten (60%) respondents preferred the IDKC form over the KOOS for a patient-reported outcomes questionnaire, and thus this was specified in the final checklist for the sake of providing a single form to recommend. The free-form responses in the third survey round did not introduce new material for the checklist, but instead respondents mostly reiterated their support of the efforts. A summary of the survey results by round is provided in Fig. 2.

The final checklist includes eight overarching domains with defined and reproducible objective criteria (Fig. 2). These final checklist items were approved by nine of the ten (90%) participants surveyed as mentioned above. The eight domains include the following: (1) negative patellar apprehension test, (2) radiographic confirmation of bone healing (if bony procedure was performed), (3) normalization of

gait, (4) adequate knee stability, (5) adequate lower extremity muscle strength and endurance, (6) adequate lower extremity muscle power, (7) adequate range of motion, and (8) satisfactory completion of a patient-reported outcome questionnaire. Within the domain of adequate knee stability, single-leg stance evaluation (82%) and the side hop test (82%) both received over 80% agreement to serve as adequate measures. For measuring muscle strength and endurance, only single-leg squat (91%) exercises received greater than 80% support and thus was included in the final checklist. Step-down exercises received some support (64%), but not sufficient consensus to be included in the final checklist. As a measure of lower extremity muscle power, 82% of respondents supported comparing single-leg hop distance between legs. Eighty-two percent of respondents supported the use of a patient-reported questionnaire for determining a patient's subjective readiness for return to play. In the questioning for the third round, six of ten (60%) participants supported the use of the IKDC questionnaire, whereas four of ten (40%) supported the use of the KOOS outcome score. For the sake of providing a single recommendation, the IKDC was included in the final checklist, but the KOOS and other PROMs were acknowledged as acceptable substitutes for IKDC at the surgeon's discretion.

## Discussion

The most important revelation of the present study is the development of a reproducible, objective return to play checklist following patellofemoral instability surgery.



**Fig. 2** Summary of survey results and the Delphi process

Traditionally, return to play has been determined largely by time from surgery without strict consideration for patient-centred factors that might play a more specific role in safe return to play [9]. Menetrey et al. [27] proposed a shift to this paradigm with the following six clinical criteria for determining return to sport after patellar instability: (1) no pain; (2) no effusion; (3) no patellofemoral instability; (4) full range of motion; (5) nearly symmetrical strength (80–95%); and (6) excellent dynamic stability. While not validated in any form, their study also noted that patients who undergo surgery should satisfy these criteria within 3 months of the operation—a relatively short interval to expect a full recovery of all patients. A previous systematic review suggests that time to return to play can vary, ranging from 4 weeks to 6 months, with several papers mentioning no timeline at all [9]. Since the intention of the present study was to identify objective, patient-centred criteria, and there is great variability in the accepted timeline for return to play, time as a variable was not directly addressed. A minimum time to return to sport, however, should be further investigated to ensure proper bone and soft-tissue healing. The lack of evidence-based return to play criteria in the current literature presents an opportunity for practice-changing research. If easily implemented into sports medicine practice, a validated return to play checklist has the potential to minimize the risk of re-injury for athletes returning to sports following surgery for patellar instability.

As outlined in the methods section of this paper, an extensive review of the literature was performed on clinical studies involving surgery for patellar instability. In this thorough review of the literature on patient outcomes following patellar instability, most studies stopped short of defining reproducible objective criteria for return to sport [9]. Instead, studies listed general guidelines such as weight-bearing restraints, quadriceps strengthening exercises, range of motion goals, use of an immobilizer, and formal physical therapy programmes. A systematic review of 53 papers cited weight-bearing guidelines in 90.6% of studies, quadriceps strengthening in 75.5% of studies, range of motion goals in 84.9% of studies, immobilization in 77.3% of studies, and formal physical therapy programmes in 11.3% of studies [9]. Furthermore, the 48 additional studies that were reviewed in the present study included mention of at least one of these aforementioned domains in 79.2% of studies. Though not included in the systematic review, a large portion of existing studies also utilize validated subjective patient questionnaires for measuring outcomes; including but not limited to the International Knee Documentation Committee (IKDC) score, Kujala score, Knee injury and Osteoarthritis Outcome Score (KOOS), and the Lysholm score [39–41]. In the first round of the Delphi survey, experts scored subjective patient outcome questionnaires an average 8 out of 10 with regard to their relevance for determining patient psychological and

subjective readiness for return to play. This was confirmed in the literature review, and thus (IKDC) was included in the final checklist. The development of a postoperative checklist with objective criteria has been desired in the literature for some time [9, 27]. In creating this checklist, it was paramount to include measures that were both objective and reproducible across a diverse patient demography. An effective checklist should be applicable to patients of most ages, backgrounds, and sports. Weight-bearing activities, muscle strength tests, and range of motion measures guided the development of an all-encompassing Delphi survey series. Other tests were included as deemed necessary for completeness and thorough coverage of the subject [12].

The principal findings of this study are summarized in the form of a checklist for return to play following patellar instability surgery (Fig. 3). The final checklist was approved by nine of the ten participants surveyed; the one participant who did not approve of the final checklist ultimately felt that a checklist was not necessary for return to play. Successful completion of the checklist comprises clearing seven or more of the items (6 items if no bony procedure was performed), instead of the total eight, based on respondent feedback. The patellar apprehension test is the first item on the checklist. This measure is not only highly sensitive and specific, but it is objective and binary, thus serving as a suitable test for a checklist. In addition, a relatively new technique known as the moving patellar apprehension test (MPAT) developed by Ahmad et al. [42] has shown increasing sensitivity and specificity. As the second domain, unanimous support was reached to include radiographic confirmation of bone healing when performing a bony procedure. The third item on the checklist is gait normalization. This measure has been used extensively in the anterior cruciate ligament (ACL) rehabilitation literature. Irregularities in gait postoperatively have been shown to predispose patients to long-term complications such as osteoarthritis [43, 44]. The fourth domain calls for adequate knee stability as demonstrated by a single-leg stance evaluation, side-hop test, and Y-balance test. Single-leg stance evaluation has been shown to reliably measure static balance following ACL reconstruction and is used clinically following patellar instability surgery as well [45]. Both the side-hop test and Y-balance test have also been studied and can predict superior functional performance following lower extremity injuries [46, 47].

Lower extremity muscle strength and endurance comprised the fifth domain of the checklist. The single-leg squat and step-down exercises, which are both widely accepted for lower extremity muscle rehabilitation in the literature, are proposed to measure this domain [28]. A specified step-down distance of 8 inches was proposed and supported by respondents and thus included in the final checklist. Lower extremity muscle power was selected as the sixth domain in the checklist and will be measured

### Patellar Instability Surgery: An Objective Return-to-Play Checklist

Instructions - The patient must satisfy **7** (6 if no bony procedure was performed) of the following **8** criteria prior to return to sports:

1. Negative patellar apprehension test
2. Radiographic confirmation of bone healing (if bony procedure was performed)
3. Normalization of gait
4. Adequate knee stability as demonstrated by the following:
  - a. Single-leg stance evaluation (no fault\* in 60 seconds)
  - b. Side-hop test (1 fault\* in 60 seconds; affected side within 10% of unaffected side reps)
  - c. Y-balance test (3 measurements on each side; affected side within 5% of unaffected side reach distance)
5. Adequate lower extremity muscle strength and endurance as demonstrated by:
  - a. Single-leg squat (within 10% of unaffected side reps in 60 seconds, no more than 1 fault\* in those reps)
  - b. Step-down exercise (8-inch step-down, 180 seconds, metronome @ ~30 beats per minute; no more than 3 faults\* on affected side)
6. Adequate lower extremity muscle power as demonstrated by:
  - a. Single leg hop (distance on affected side within 10% of normal side)
7. Range of motion on affected side:
  - i. Less than 5° of extension loss (compared to normal side)
  - ii. Less than 10° of flexion loss (compared to normal side)
8. Adequate completion (score ≥ 90%) of the following patient-reported outcome questionnaire for determining mental readiness to play:
  - a. IKDC Subjective Knee Evaluation Form

\* **Fault** = pelvic drop, valgus movement, or touching something with hand during exercise

OFFICIAL CHECKLIST FOR RETURN-TO-PLAY	
1. Patellar Apprehension Test	<input type="checkbox"/> PASS <input type="checkbox"/> FAIL
2. Bone Healing	<input type="checkbox"/> PASS <input type="checkbox"/> FAIL
3. Gait Normalization	<input type="checkbox"/> PASS <input type="checkbox"/> FAIL
4. Knee Stability > 90% of normal on all 3 tests	<input type="checkbox"/> PASS <input type="checkbox"/> FAIL
5. Muscle Strength & Endurance > 90%	<input type="checkbox"/> PASS <input type="checkbox"/> FAIL
6. Muscle Power > 90% of normal	<input type="checkbox"/> PASS <input type="checkbox"/> FAIL
7. Range of Motion (<5° extension, <10° flexion)	<input type="checkbox"/> PASS <input type="checkbox"/> FAIL
8. IKDC (or similar) Form ≥ 90%	<input type="checkbox"/> PASS <input type="checkbox"/> FAIL

**Fig. 3** Final patellar instability return to play checklist with instructions

using the single-leg hop test (SLHT). The SLHT has been used extensively for lower extremity muscle rehabilitation and has achieved great reliability as a functional performance test in the literature [28, 48, 49]. The participants were also surveyed for their suggestions on best practices in completing the various functional tests

(muscle strength, stability, endurance, and power). Most respondents favoured timed intervals for strength, stability, and endurance; however, power was thought to be best measured as an overall single leg hop distance compared to the normal side. Physical therapists were consulted to determine the specific guidelines for these tests.

The seventh domain of the checklist includes range of motion. The group of panelists acknowledged the importance of adequate range of motion, but could not agree on the objective and reproducible parameters. Given that all respondents preferred a return to normal range of motion, parameters were provided that have been anecdotally accepted in practice—less than 5 degrees of extension loss and less than 10 degrees of flexion loss. The lack of consensus for a reproducible range of motion criteria is one reason that failure of a single checklist item would still qualify as satisfactory completion of the checklist. Finally, in an attempt to measure the patient’s mental readiness for return to play, the panelists agreed to include an eighth item—a patient-reported outcome measure. This outcome measure was intended to provide insight into the patient’s own perceived readiness for return to play and should be used alongside the checklist to guide clinical judgement. The results of the surveys favoured IKDC; however, the various comments from respondents favoured freedom within this domain. Therefore, the IKDC score is recommended, but other similar questionnaires may be used as a replacement—notably, KOOS and Kujala, given the ubiquity of their use. Finally, since there is limited evidence on the use of these measures for patellar instability, an adequate passing score should be determined at the discretion of the operating surgeon.

There are several limitations in this study. One of the challenges inherent to the nature of checklists is their inability to account for subjective assessments. In particular, the checklist is limited in its ability to account for quality of movement following patellofemoral stabilization. Practitioners should exert caution to ensure that patients do not demonstrate poor movement qualities such as valgus posturing and inadequate knee or hip flexion prior to return to sport. Despite efforts to include experts from varying geographical regions, the response rate in the first round of surveying was 63%. This was lower than expected, yet a minimum response rate for determining validity in the Delphi method has not been described. In fact, other valid Delphi studies have had lower response rates [50]. The re-phrasing or exclusion of intermediate scored parameters, while important for the Delphi consensus technique on the whole, is limited by the abilities of the researchers to evaluate individual responses. In addition, this is a study of expert consensus, and thus there may be information not considered or important findings that eluded the pool of experts.

There is significant clinical utility of a standardized checklist for return to play following patellar instability surgery. Given the involved nature of the checklist exercises and the time required for completion, it is best that the scoring be done by an appropriately certified physical therapist with the adequate allotment of time. The objectivity of the checklist should allow for qualified individuals besides the surgeon to sufficiently complete the required components. Clinically,

this checklist has the potential to more accurately predict proper athlete conditioning, lower extremity biomechanics, and patellar stability prior to return to sport. Clinicians who utilize this checklist will have additional objective data to help base their day-to-day clinical recommendations.

## Conclusion

The list of objective, reproducible, and functional criteria for rehabilitation outlined above and developed through expert consensus will help practitioners focus on patient-centred factors and move away from an over-reliance on arbitrary timelines. No prior study has gathered consensus from experts on this specific topic, and therefore this serves as a benchmark to guide patients back to sport safely. Furthermore, it is necessary for the results of this study to be validated for assessing readiness for return and reducing the risk of recurrent patellar instability following return to sports.

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## Compliance with ethical standards

**Conflict of interest** Each author certifies that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangements) that might pose a conflict of interest in connection with the submitted article.

**Ethical approval** IRB approval was not required for this study.

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