

Assessing diagnostic challenges in acute soft-tissue knee injuries

a Delphi study

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Aims

This Delphi study assessed the challenges of diagnosing soft-tissue knee injuries (STKIs) in acute settings among orthopaedic healthcare stakeholders.

Methods

This modified e-Delphi study consisted of three rounds and involved 32 orthopaedic healthcare stakeholders, including physiotherapists, emergency nurse practitioners, sports medicine physicians, radiologists, orthopaedic registrars, and orthopaedic consultants. The perceived importance of diagnostic components relevant to STKIs included patient and external risk factors, clinical signs and symptoms, special clinical tests, and diagnostic imaging methods. Each round required scoring and ranking various items on a ten-point Likert scale. The items were refined as each round progressed. The study produced rankings of perceived importance across the various diagnostic components.

Results

In Round 1, the study revealed widespread variability in stakeholder opinions on diagnostic components of STKIs. Round 2 identified patterns in the perceived importance of specific items within each diagnostic component. Round 3 produced rankings of perceived item importance within each diagnostic component. Noteworthy findings include the challenges associated with accurate and readily available diagnostic methods in acute care settings, the consistent acknowledgment of the importance of adopting a patient-centred approach to diagnosis, and the transition from divergent to convergent opinions between Rounds 2 and 3.

Conclusion

This study highlights the potential for a paradigm shift in acute STKI diagnosis, where variability in the understanding of STKI diagnostic components may be addressed by establishing a uniform, evidence-based framework for evaluating these injuries.

Take home message

- Variability in stakeholder perceptions of clinical considerations underscores existing challenges in the pathway for assessing and managing soft-tissue knee injuries (STKIs).
- The study highlights the importance of adopting a patient-centred approach to diagnosis, focusing on patient risk factors

and clinical presentations, while special clinical tests are considered less important.

- There is potential for a paradigm shift in acute STKIs towards establishing a uniform, evidence-based framework to help streamline the diagnostic process.

Table I. Study population.

Characteristic	N (%)
Sex	
Male	21 (66)
Female	11 (34)
Total	32
Healthcare role	
Emergency medicine consultant	3 (9)
Emergency nurse practitioner	4 (13)
Orthopaedic consultant	12 (38)
Orthopaedic registrar	2 (6)
Physiotherapist	7 (22)
Radiologist	2 (6)
Sports medicine consultant	2 (6)
Experience, yrs	
1 to 5	3 (9)
6 to 10	6 (19)
11 to 15	8 (25)
15 +	15 (47)

Introduction

Soft-tissue knee injuries (STKIs) are among the most common musculoskeletal injuries, with a significant proportion occurring in an acute setting.¹ A STKI refers to damage to the ligamentous, tendinous, and muscular structures that help stabilize the knee and absorb force during movement.² STKIs may result in significant pain and functional limitations, with the current standard of care often requiring the involvement of many healthcare professionals and services.^{1,3}

To achieve accurate assessment and appropriate treatment, a health professional must undertake a thorough history and physical examination, utilizing special tests, clinical judgement, and diagnostic imaging. However, pain, swelling, and guarding in acute clinical settings increase the difficulty of efficiently diagnosing knee injuries.⁴ There is also a reported need for more confidence by non-orthopaedic healthcare providers in performing clinical musculoskeletal examinations. This is reflected in the finding that as many as 82% of recent medical school graduates cannot exhibit fundamental proficiency in musculoskeletal examinations.⁵ Consultants with specialist training also demonstrated deficiencies in diagnostic accuracy. Emergency medicine consultants had an accuracy as low as 26%, while orthopaedic consultants have been shown to miss diagnosis in 28% of patients.^{6,7}

Furthermore, evidence suggests that only 10% to 15% of patients with initial diagnoses of an anterior cruciate ligament (ACL) injury are correct, with many healthcare systems relying on unnecessary imaging.⁸ This often leads to patients consulting multiple healthcare providers before receiving a valid diagnosis, delaying rehabilitation or surgical management. These difficulties experienced in the clinical cycle of care are reflected in reports that a median of three

Table II. Rankings of perceived importance of patient factors when diagnosing acute soft-tissue knee injuries.

Patient factors	Rank	Median	IQR
Patient history of surgery for a soft-tissue knee injury	1	1	1 to 2
Patient history of a soft-tissue knee injury	2	2	1 to 2.75
Age, yrs	3	3	0
Generalized joint hypermobility	4	4.5	4 to 6
Patient history of malalignment	5	5	4 to 6
BMI, kg/m ²	6	6	5 to 6
Sex	7	7	4 to 7
Family history of soft-tissue knee injuries	8	8	7 to 8
Ethnicity	9	9	0

health professionals need to be consulted before diagnosing an ACL injury, resulting in a delay of 13 weeks between the time of injury and the time of presentation.⁹ As STKIs are associated with a significant personal and economic burden, the need to ensure the accuracy of clinical diagnoses is clear.¹⁰

Literature suggests that the specific details of a patient's history and the clinical findings on examination are valuable diagnostic tools when distinguishing acute STKIs. It has been proposed that a multifactorial contribution of patient and external risk factors predisposes individuals to injury.^{1,11,12} Patient factors are inherent to the individual, including physiological, anatomical, developmental, and hormonal factors. External factors refer to variables that are external to the individual and depend on the circumstance of the injury. Clinical indicators reported in the classical presentations of various STKIs to help differentiate between injuries include the aetiology and localization of pain, mechanism of injury, onset of swelling, and associated symptoms.^{13,14} Associated symptoms include feelings, sounds, and functional changes experienced during an injury. However, empirical data on the importance of these risk factors and clinical findings among various healthcare professionals remain unclear.

The Delphi technique is a research method that aims to achieve consensus or convergence of opinions among a panel of experts through a series of questionnaires when there may be uncertainty or limited data available on a subject.^{2,15} This Delphi study aims to identify the most critical considerations in the diagnostic process of acute STKIs among orthopaedic stakeholders. The components of diagnosis explored are patient factors, external factors, signs and symptoms, special clinical tests, and diagnostic imaging.

Methods

This modified e-Delphi study consisted of three rounds from April 2023 until July 2023 and was conducted online through Qualtrics (USA), an online interactive questionnaire platform. Across the UK, 32 orthopaedic healthcare stakeholders from diverse clinical backgrounds were invited to participate. The only selection criteria were being qualified as any of

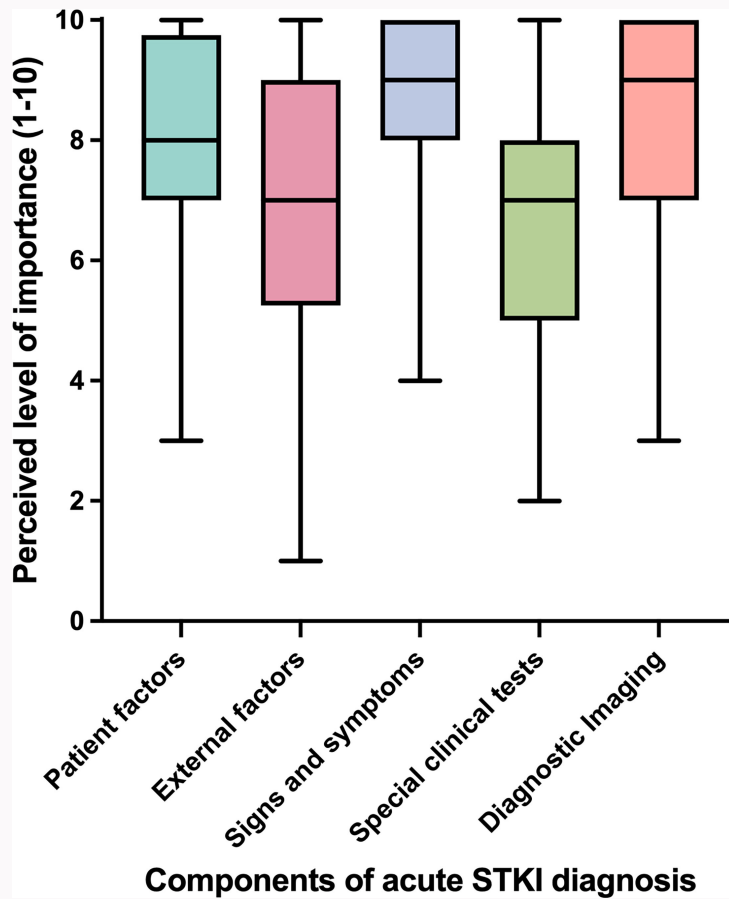


Fig. 1
Perceived importance of the diagnostic components for acute soft-tissue knee injuries.

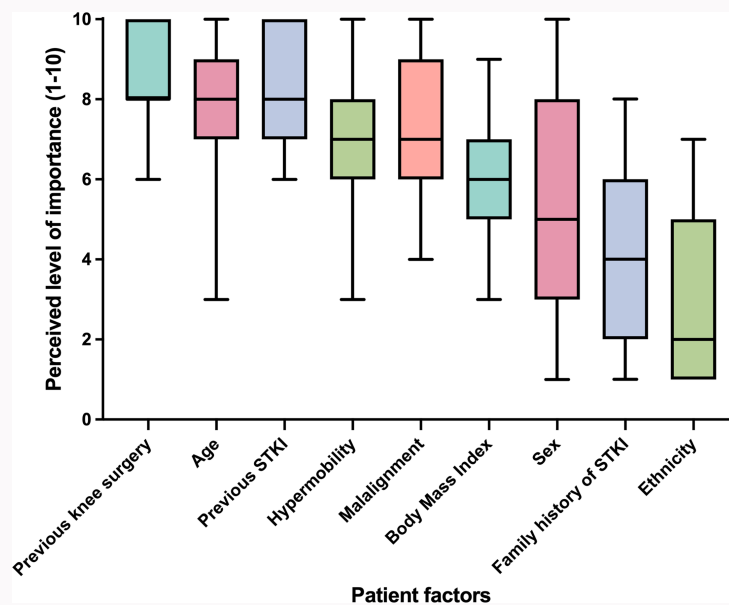


Fig. 2
Perceived importance of patient factors in the diagnosis of acute soft-tissue knee injuries.

the following: physiotherapist, emergency nurse practitioner, sports medicine physician, radiologist, orthopaedic registrar, and orthopaedic consultant. All responses were recorded anonymously. Non-respondents were reminded every three

days to submit their responses until the round was completed. Demographic data from the study cohort are summarized in [Table I](#).

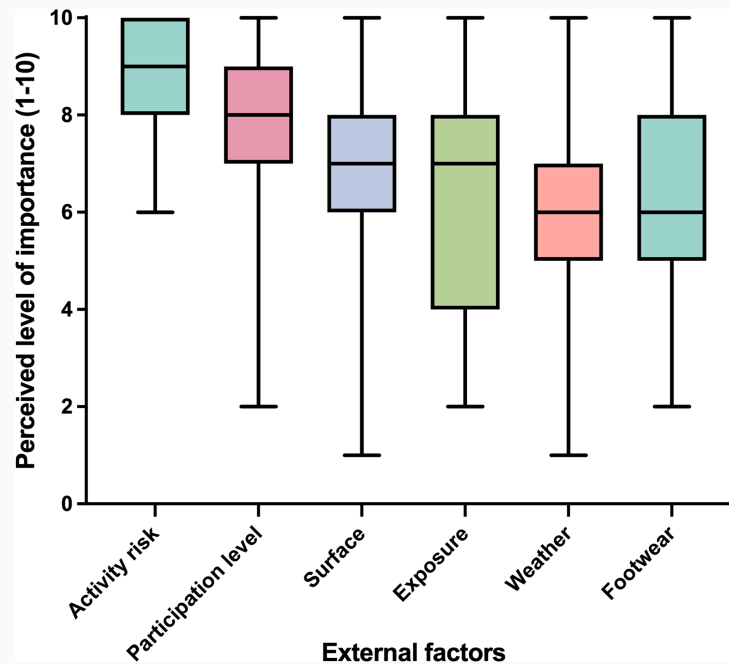


Fig. 3 Perceived importance of external factors in the diagnosis of acute soft-tissue knee injuries.

Table III. Rankings of perceived importance of external factors when diagnosing acute soft-tissue knee injuries.

External factors	Rank	Median	IQR
Type of sport or activity during injury	1	1	0
Level of participation	2	2	2 to 2.75
Surface	3	3	3 to 4
Type of exposure during injury	4	4.5	4 to 5
Weather	5	5	4 to 5
Footwear	6	5	3 to 6

The first round asked participants to evaluate and rate the “perceived level of importance” of patient factors, external factors, signs and symptoms, special tests, and diagnostic imaging in diagnosing acute STKIs on a ten-point Likert scale from 0, “not at all important”, to 10, “extremely important”. Participants were asked to submit any items, comments, or suggestions they deemed to be relevant within these five categories. In the second round, participants were asked to evaluate and rate the importance of each suggested item within its respective category on a ten-point Likert scale. The third round of the study presented the items in rank order to participants. Participants were then allowed to refine their assessments by utilizing an interactive ranking scale to either leave the rankings unchanged, or drag and drop each item higher or lower. No ethical approval was required, per Health Research Authority criteria. Informed consent was received from all participants.

Statistical analysis

The primary statistics used were central tendency for importance and levels of dispersion for consensus. The median score measured the results’ central tendency, while the IQR measured the results’ dispersion level. The threshold for importance was a median of 7, and the threshold for consensus was an IQR of 2.5. The thresholds were determined based on guidelines and frameworks from previous healthcare Delphi studies.^{16,17}

Results

Round 1

Figure 1 illustrates the responses in Round 1 for the perceived importance of various components of acute STKI diagnosis. Patient factors received a median score of 8 (IQR 7.5 to 9.75), and signs and symptoms a median of 9 (IQR 8 to 10), indicating high importance with strong consensus. External factors received a median of 7 (IQR 5.75 to 9), also considered highly important but with weaker consensus. Special tests and diagnostic imaging received median scores of 7 (IQR 5 to 8) and 9 (IQR 7 to 10), indicating high importance but weaker consensus.

Round 2

The response rate for Round 2 was 96% (31/32). Figure 2 illustrates the responses in Round 2 for the perceived importance of patient factors in diagnosing acute STKIs. Patient history of surgery for a STKI, and age, received median scores of 8 (history of surgery IQR 8 to 10) (age IQR 7 to 9), indicating high importance and strong consensus. Additionally, patient history of a STKI and malalignment had median scores of 8 (IQR 7 to 10) and 7 (IQR 6 to 9), respectively, suggesting high importance with weaker consensus. Other factors, such as BMI, sex, family history of STKIs, and ethnicity, received lower median scores.

Figure 3 illustrates the responses in Round 2 for the perceived importance of external factors in diagnosing acute STKIs. The type of sport or activity during injury and the level of participation (amateur or professional) received median scores of 9 (IQR 8 to 10) and 8 (IQR 7 to 9), respectively, indicating high importance and strong consensus. The surface type also garnered a median score of 7 (IQR 6 to 8), reflecting high importance and strong consensus. Conversely, the type of exposure (training or competition) during injury had a median score of 7 (IQR 4 to 8) suggesting high importance but weaker consensus. Factors such as weather and footwear received lower median scores.

Figure 4 illustrates the responses in Round 2 for the perceived importance of signs and symptoms in diagnosing acute STKIs. Swelling of the knee received median scores of 10 (IQR 9 to 10), indicating high importance and strong consensus. Reported instability, "giving way", or "shifting" feeling in the knee scored a median of 10 (IQR 8 to 10). Similarly, reported twisting or pivoting of the knee during injury, reported "locking", "clicking", and "catching" in the knee, and inability to weightbear all median scores of 9 reflecting high importance. Reported hyperextension of the knee and reported valgus/varus trauma had median scores of 9 (IQR 7 to 10), suggesting high importance but weaker consensus. Factors such as range of motion (ROM) in the knee, pain location, reported "popping", "cracking", or "tearing" in the knee during injury, pain severity, and bruising of the knee received slightly lower median scores above 7 but with varying levels of consensus.

Figure 5 illustrates the responses in Round 2 for the perceived importance of special clinical tests (Lachman's test, anterior and posterior draw test, valgus and varus stress test, patella apprehension test, straight leg raise) in diagnosing acute STKIs.¹⁸ The full range was recorded for all special clinical tests in the acute and delayed setting. All special clinical tests were rated with higher median importance median in the delayed setting.

Figure 6 illustrates the responses in Round 2 for the perceived importance of considerations for imaging in diagnosing acute STKIs. Factors such as a locked knee or very limited ROM, high-energy injury mechanisms, and gross swelling or grade 3 knee effusion received high median scores of 9.5, 9, and 9, respectively, with tight IQRs and strong consensus. Additionally, patient-reported symptoms like knee instability and inability to weightbear received median scores of 8 with strong consensus. Factors such as reported patella dislocation and adolescence/skeletal immaturity received slightly lower median scores with wider IQRs. Reassurance to enable discharge received a low median score.

Round 3

The response rate for Round 3 was 94% (30/32). Rankings of the perceived importance of patient factors when diagnosing acute STKIs are presented in Table II.

Rankings of the perceived importance of external factors when diagnosing acute STKIs are presented in Table III.

Rankings of the perceived importance of signs and symptoms when diagnosing acute STKIs are presented in Table IV.

Rankings of the perceived importance of reasons for diagnostic imaging for acute STKIs are presented in Table V.

Discussion

This study highlights the variability of stakeholder perceptions, identifies the challenges associated with accurate and readily available diagnostic methods, presents the importance of adopting a patient-centred approach to diagnosis, and reveals a transition from divergent to convergent opinions between Rounds 2 and 3.

In Round 1, patient factors and clinical presentations were considered the most critical components of the diagnostic process, highlighting their integral role in injury assessment (Figure 1). Interestingly, while diagnostic imaging was ranked highly important, there was a lack of consensus. This may be linked to the issue of imaging practicalities in acute settings where factors such as accessibility and affordability often make it an unviable option. The high rating for diagnostic imaging may also reflect clinicians' desire for objective and conclusive evidence in acute settings.

Furthermore, the low perceived importance of special clinical tests may be linked to the associated difficulties of performing these tests in acute settings due to pain, guarding, and swelling (Figure 1). This culminates in a conflict in clinical decision-making, where healthcare professionals must rely on special clinical tests in acute settings that are perceived as unimportant and have low diagnostic capacity.^{4,14} When also considering the difficulties in accessing diagnostic imaging, Round 1's findings suggest that there may currently be a gap in acute healthcare settings for utilizing an affordable, reliable, evidence-based approach to diagnosing STKIs.

In Round 2, important trends were identified with a widespread divergence of opinion. Ratings for specific patient factors demonstrated a clear pattern focused on the importance of previous injury, surgical history, and age (Figure 2). Notably, sex achieved consensus on having low importance, which could reflect that the consideration of sex in STKIs may be more relevant to preventative measures than diagnosis.

External factors had a wide range of responses in Round 2 (Figure 3). The high rating of the activity risk level aligns with the literature. At the same time, variability across the other factors demonstrates a need for a greater understanding of the impact of other external factors. In this area, there is potential to improve the knowledge and health literacy of the various roles external factors play in STKIs, as all elements presented have been shown in the literature to impact an individual's predisposition to sustaining a STKI.^{1,11,19,20}

The high importance of signs and symptoms reinforces the importance of a thorough physical examination during injury assessment and diagnosis. However, the wide spread of responses may also demonstrate the inter-professional variation in clinical experience, education, and training. This variance highlights a clear gap in the understanding of the predictive power and subsequent clinical utility of various signs and symptoms when diagnosing STKIs (Figure 4).

The increase in the importance of special tests from acute to delayed presentation reflects the challenges posed by the distinct phases of injury assessment (Figure 5). This difference represents the impact of timing on the perceived value of clinical special tests in diagnosis and the opportunity

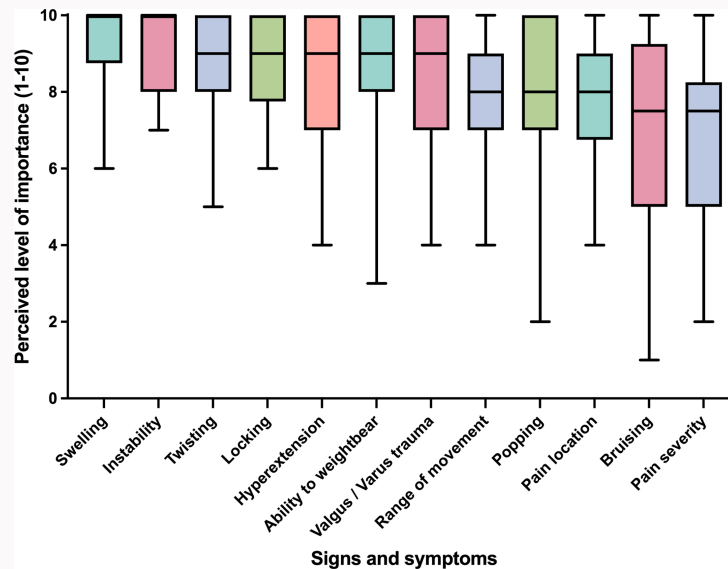


Fig. 4
Perceived importance of signs and symptoms in the diagnosis of acute soft-tissue knee injuries.

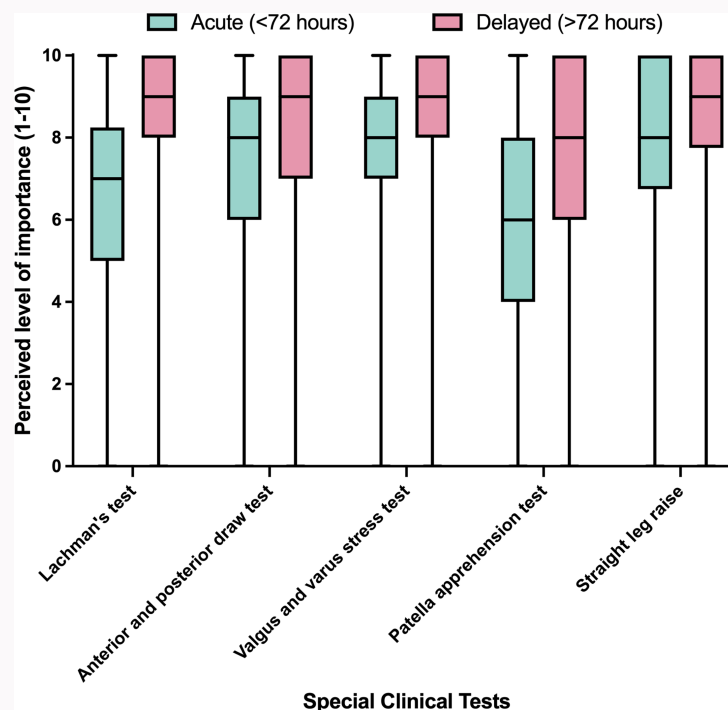


Fig. 5
Perceived importance of special tests in the diagnosis of acute soft-tissue knee injuries: acute versus delayed presentation.

for a more comprehensive evaluation in a delayed setting. These findings highlight the need for clinicians to adapt their diagnostic approaches based on the timing of the injury. Specifically, delayed presentation in STKI diagnosis may be favoured due to several factors that enhance the diagnostic accuracy of special tests, including reduced inflammation and pain, improved patient cooperation, and access to diagnostic imaging.⁴

In Round 2, the scope of “consideration for diagnostic imaging” was selected under the diagnostic imaging component to provide insight into current imaging guidelines.

In the acute setting, the appropriate indicators were consistently rated as important when considering urgent imaging (Figure 6). These results confirm that this cohort of healthcare professionals supports the use of urgent imaging in the assessment of STKIs. These indicators could potentially be used in forming acute STKI imaging guidelines.

Across all components except signs and symptoms, there was a convergence of opinions from Round 2 to Round 3. The convergence of opinion may represent that while variability may stem from differing clinical experiences and educational backgrounds, healthcare professionals can

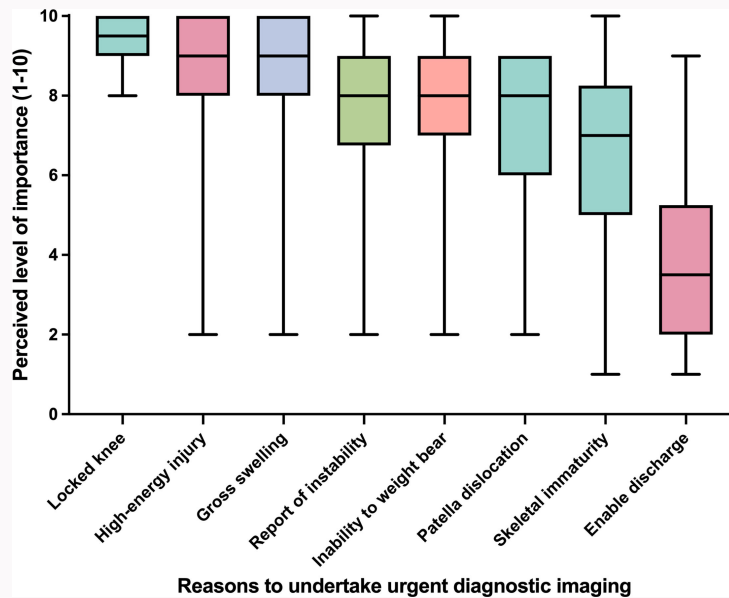


Fig. 6

Perceived importance of considerations for undertaking urgent diagnostic imaging of acute soft-tissue knee injuries.

Table IV. Rankings of perceived importance of signs and symptoms when diagnosing acute soft-tissue knee injuries.

Signs and symptoms	Rank	Median	IQR
Swelling of the knee	1	2.5	1 to 4
Reported instability, "giving way" or "shifting" feeling in the knee	2	3.5	2 to 6
Reported twisting or pivoting of the knee during injury	3	4	3.25 to 6
Reported hyperextension of the knee during injury	4	4	3 to 7
Reported "locking", "clicking", "catching" in the knee	5	5	3 to 6.75
Range of motion in the knee	6	6.5	5.25 to 9
Reported "popping", "cracking", or "tearing" in knee during injury	7	7	5.25 to 8.75
Ability to weightbear	8	7.5	5 to 9
Reported direct trauma to the inside or outside of the knee	9	8	5 to 8
Pain location	10	10	8.25 to 10
Bruising of the knee	11	11	0
Pain severity	12	12	11.25 to 12

Table V. Rankings of perceived significance of reasons for urgent diagnostic imaging for acute soft-tissue knee injuries.

Reason for diagnostic imaging	Rank	Median	IQR
Locked knee/very limited range of motion	1	1	0
High-energy injury mechanism	2	2	2 to 2.75
Gross swelling/Grade 3 knee effusion	3	3	0
Patient report of knee instability	4	4	4 to 5
Inability to weightbear	5	5	4 to 5
Patient report of patella dislocation	6	6	0
Adolescence/skeletal immaturity	7	7	0
Reassurance to enable discharge	8	8	0

collectively identify important indicators when presented with a structured framework. This may support the development of an evidence-based assessment framework that could use important indicators to guide diagnosis.

The limitations to consider in this study include the lack of universal guidelines for Delphi studies, and variation in participants' orthopaedic knowledge. This study did, however, follow established Delphi procedures incorporating suggestions and frameworks from previously validated and peer-reviewed Delphi studies.¹⁵⁻¹⁷ While there are differences in

orthopaedic training and expertise among the participants, engaging a range of professionals was crucial to establish a consensus that accurately represents the diverse perspectives of individuals dealing with STKIs in acute settings.

Variability in stakeholder perceptions of clinical considerations underscores existing challenges in the pathway for assessing and managing STKIs. This study suggests a lack of accurate and accessible diagnostic capabilities for STKIs in the acute setting, along with inconsistencies in the stakeholder understanding of risk factors and clinical findings in STKIs. Future research can build on this study by collecting long-term diagnostic data and evaluating the causal relationships between the identified variables and the incidence of STKIs. This may enhance the diagnostic pathway and contribute to developing educational and preventative programmes, benefiting at-risk populations.

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B. Gompels: Writing – review & editing, Investigation, Methodology.
S. McDonnell: Conceptualization, Methodology, Supervision.

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Data sharing

The data that support the findings for this study are available to other researchers from the corresponding author upon reasonable request.

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