London International Consensus and Delphi study on Hamstring Injuries

Supplementary material - Methodology

Modified Delphi design methodology

The current assessment and treatment of hamstring injury presents a challenge in many sports, with the incidence increasing despite incremental volumes of literature, and while this literature has provided many answers and solutions, there are still large gaps. Recent systematic reviews in aspects of hamstring injury (HSI) management report high risk of bias in many studies[1-3], making some treatment recommendations unreliable. Evidence is more often available for recreational, amateur, or sub-elite sport from multisport cohorts, with less clinical applicability / generalisability to elite populations. In this situation clinicians must make assessment and treatment decisions based on incomplete, weak, and poor-quality evidence. Clinical expertise and experience therefore become vital. A research approach to gain insight from practitioners' expertise would be useful. Single experts can be useful but a scientific approach that aims for a consensus/ agreement among a group of experts can provide more optimal recommendations.[4] The Delphi methodology was thought by this group to present a systematic and scientific approach to capture the decision-making experience and expertise of global experts to identify and investigate areas in HSI where new decision-making approaches could be developed. The London 2020 international hamstring consensus group was established as a multidisciplinary collaboration to advance the assessment management of HSI. An information gathering project was established to investigate current international decision-making, in the assessment and treatment of HSI. It was hoped that this could attain consensus on best practice decision-making in HSI and identify areas of research need in HSI and new decision-making approaches that could improve the outcomes after HSI.

Paton BM, *et al. Br J Sports Med* 2023;0:1–17. doi: 10.1136/bjsports-2021-105384

Aims

1/ To Examine whether global decision-making practice is aligned with best available evidence

2/ To identify areas where research evidence is lacking or of insufficient quality for clinicians to make assessment and treatment decisions.

3/ To achieve a consensus agreement on current global best practice in assessment and management of HSI.

Study Design

This study used a modified Delphi design aiming to bring an international panel of experts to a consensus on current best practice for decision-making in HSI.

The Delphi process is an iterative staged process utilising the opinion and expertise of a group of experts to achieve consensus on a topic. It is useful in topics where limited literature is available to guide decisions[5 6] and relies on expert opinion and expert clinical practice.[7]

A Delphi expert consensus approach was applied to decision-making after HSI. There have been previous Delphi consensus studies in muscle injuries[8 9] , injury prevention[10] and aspects of management of Hamstring injury, such as return to play [11 12] but other aspects of hamstring assessment and treatment may also benefit from this approach such as classification systems, decision making in rehabilitation and the justification for surgery, particularly given the disparate and conflicting approaches used currently.[13 14] The reporting standard for conducting and reporting Delphi studies (CREDES) was followed.[15]

Paton BM, *et al. Br J Sports Med* 2023;0:1–17. doi: 10.1136/bjsports-2021-105384

modified Delphi Process

This modified Delphi study focussed on decision-making in aspects of HSI. It was undertaken after a reviews of decision-making aspects of the assessment and management of HSI[16 17] (also see appendix 1 with paper 1 Classification). Ethical approval for the study was sought and obtained from the institutional ethical review board (Project ID 5938/002). The study comprised two rounds of a purposive digital survey interspersed with a face-to-face meeting round (see figure 1). Each round was modified based on feedback to achieve a consensus among an international panel of experts. Each Delphi round comprised a digital questionnaire, an analysis, and a feedback report.

Stage 1: A review of the literature informed the domains to be included in an online survey which was undertaken from November 2019 to January 2020.

Stage 2: The round 1 online survey gathered the opinions of a global expert panel, with open ended questions to identify the key domains requiring more investigation in HSI decision-making. The survey used institutionally based digital survey platform – Opinio (ObjectPlanet, Oslo, Norway), with a link to an online questionnaire sent out to each of the experts with an invitation to participate.

Stage 3: Open Meeting - The responses from the survey were collated and analysed, and the key domains were identified where there were gaps in literature evidence and clinical practice in Hamstring injury decision-making. This was fed back to a subset of the expert panel attending in 2 days of an open meeting during an international conference. They formed the ISEH hamstring injury consensus group They had an opportunity to discuss each key domain and produced a series of statements for consensus voting.

Stage 4: A round 2 survey was then developed to allow a wider international vote on the consensus statements produced. This included those experts who participated in round 1 but also others identified with significant hamstring expertise to ensure a representative global sample. Those clinical academics with expertise in rehabilitation completed the relevant sections of the survey. The survey responses were collated

Paton BM, *et al. Br J Sports Med* 2023;0:1–17. doi: 10.1136/bjsports-2021-105384

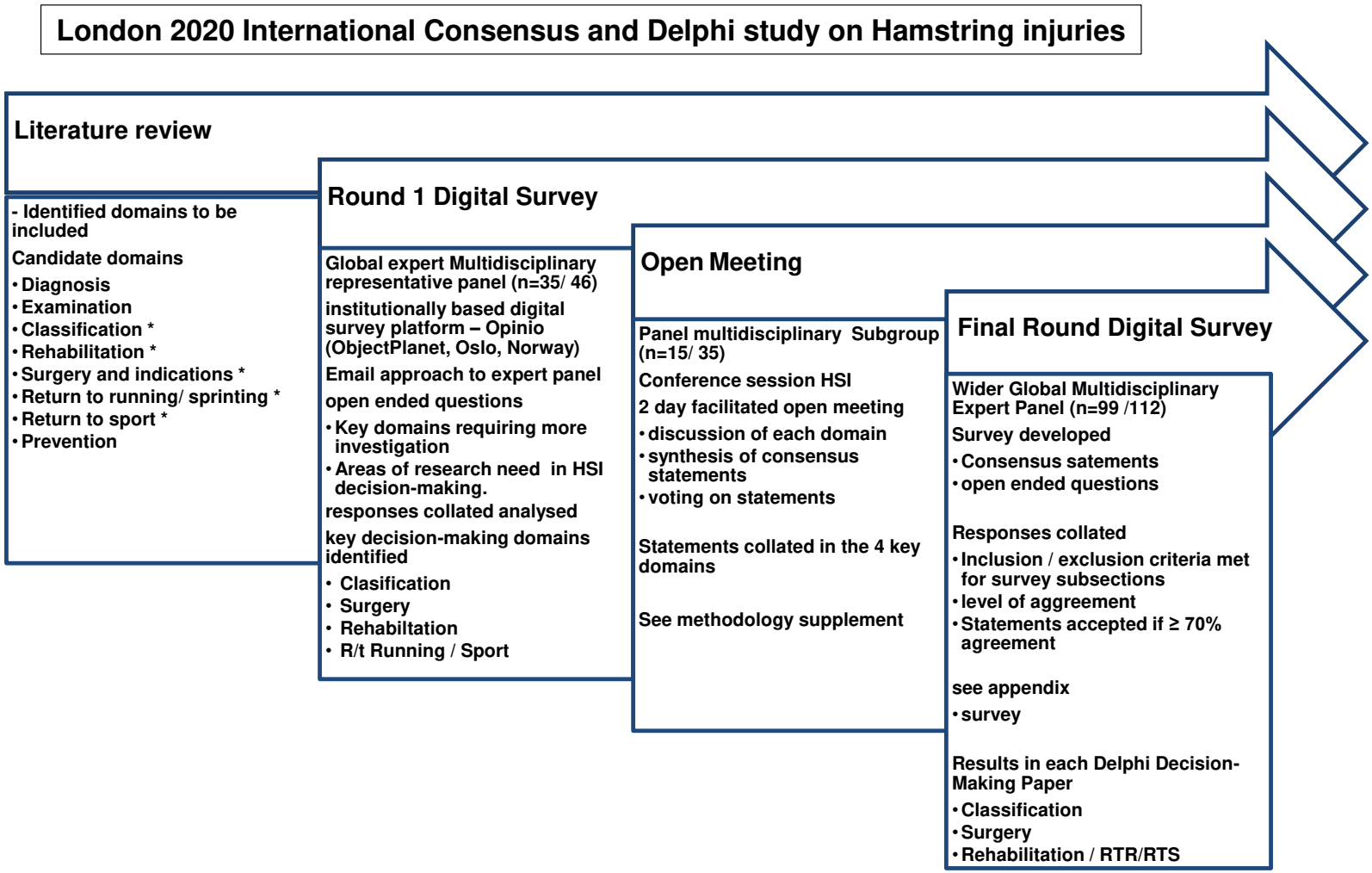


Figure 1 Study design for Delphi and Consensus

Participants – Expert Panel

An international representative multidisciplinary group of expert clinicians / researchers were Invited to participate in this HSI decision-making project, based on their expertise in the assessment and management of hamstring injuries. Identifying appropriate experts is vital to the Delphi process.[6] The criteria for expert inclusion comprised Academic criterion of peer reviewed publication (authorship) in hamstring research and or clinical criteria: - a high level of expertise assessing, managing and/or researching injuries, based on the number of injuries seen and years worked in HSI. All participants needed to be willing complete the digital survey and or attend the consensus meeting and a sufficient level of written and spoken English.

Possible experts were excluded if they had 1/ insufficient experience of assessment or management of hamstring injury (2) insufficient time to fully complete the online survey. Clinicians and non-clinicians were included but asked to answer only those survey questions related to their fields of expertise. A purposive, heterogeneous representative sample of experts were chosen with a mix of:- professional discipline (Sport and exercise medicine physicians, physiotherapists, orthopaedic surgeons, sport and exercise scientists/researchers), international location, gender, sporting discipline in line with Delphi methodology.[18]

Decision-making in HSI management crosses multiple domains of expertise, and a multiprofessional panel of experts was sought . This involved disparate domains of surgery, post-surgical and conservative rehabilitation, classification, diagnosis, running and return to sport. It was difficult to find experts with this combined domain expertise. This heterogenous group , meant that the criteria for expertise were difficult to choose, Academic criteria are important, but achieving publication alone was thought to be too narrow, with the potential to miss important stakeholders[15], as some academics have less clinical HSI diagnostic, decision-making and injury management expertise in some domains. Clinical criteria were also deemed important, as many experts have not published research. For clinical experience criteria, the number HSI/ year (requirement >5) and years of practice with HSI (requirement >5) were chosen, but to avoid eliminating important stakeholders, the respondents with <5 years of practice and seeing <5 HSI/yr were assessed and responses were included if they were researchers and had academic

publication in HSI. They were also included if they had <5 year working with HSI if they worked in elite sport but their annual case number was greater than 10. It was difficult to gauge clinical experience, as the range of injury types and severity, and the quality and recency of practice with these injuries varied between our experts. Some experts deal with only one aspect of the management pathway and surgeons, physiotherapists and athletic trainers/ coaches have very different domain expertise. Choosing criteria for expertise is difficult for any Delphi study and represents an area of possible bias and weakness in this methodology.[19]

Representation is also key to Delphi/ consensus methodology and lack of representation may allow for insufficient challenge of flawed current practice, or exacerbate current inequalities.[19] To avoid bias every effort was made to include multiple professions and regions/ countries globally, although it was found that there were more experts in HSI in some global locations. We sought to be as inclusive as possible to encompass all views , but to maintain appropriate expertise. This balance is difficult to maintain in Delphi studies.

There is no guideline for number of experts to be involved in a consensus[18], but the sample size was set at 30 for the initial survey to ensure a full international and multidisciplinary sport/ profession mix . A possible drop out and non-response rate was predicted. Research recommendations for the Delphi technique were followed with opinion-based research.[5 20]

Procedure Stage One and Two – Survey Round 1

The initial literature review allowed us to generate candidate decision-making domains in HSI (see table 1). The round one survey (Appendix 1) aimed to gather information, and understand, from the experts' viewpoint, where are the gaps in the literature evidence and clinical practice in Hamstring injury decision-making. We aimed to identify which were the key domains requiring further research. Expert opinion was then sought on these key domains in the meeting day and round 2 survey and a best expert

Paton BM, *et al. Br J Sports Med* 2023;0:1–17. doi: 10.1136/bjsports-2021-105384

consensus was produced on these domains. Four domains were identified – Classification and diagnosis, Surgery, rehabilitation (including rehabilitation post-surgery), return to running and sport.

Table 1 Topic/Domain areas for discussion around assessment and treatment in hamstring injury

Items for Survey Hamstring decision-making Candidate Domains identified from Systematic review	
Examination post HSI	
Imaging and Diagnosis	
Injury Classification systems	*
Surgical vs Conservative treatment	*
Surgical methods	
Injury Prognostication	
Prevention of HSI	
Rehabilitation of HSI	*
Exercise prescription	
Dosage of rehabilitation	
Progression of rehabilitation	
Returning to running	*
Returning to sprinting	*
Returning to sport	*

(* Domains chosen by panel in round 1 Survey)

The initial round 1 survey comprised open ended qualitative information gathering questions and some quantitative data questions using Likert scales determined level of agreement (see Appendix 1). The survey used a digital institution-based software package – Opinio 7.12 (copyright 1998-2020 ObjectPlanet, Oslo Norway). For the two surveys we followed the Checklist for Reporting Results of Internet E-Surveys (CHERRIES)[21] to avoid bias.

Steering Committee

The rehabilitation survey was designed by 2 experienced clinical academic physiotherapists, and a Professor of Orthopaedic surgery, who each have greater than 20 years clinical experience treating HSI and research expertise in HSI, as well as previous experience with Delphi research. A structured, iterative process was undertaken to develop the survey and it was piloted by a mixed group of 5 sports medicine physicians, 5 physiotherapists and 5 orthopaedic surgeons, and the survey was further refined based on their feedback. The expert panel were approached by Email located from publicly available correspondence information on peer reviewed journal articles, or on their publicly available institutional profile pages. Institutional ethical approval was obtained for the study from the institutional academic ethics committee (Project ID 5938/002) and information was provided prior to participation, but actively completing the survey was implied (and stated) as the consent to participate. Any participant with who withdrew had data removed.

Procedure Stage 3 – open consensus meeting

The above review, and the results of the initial survey were collated and analysed with a thematic and factor analysis.[22] The expert panel identified key domains (see * in table 1) and key questions for these domains (see tables in appendix 3), which were outlined and presented for discussion. All of the panel members who completed the survey were invited to the discussion. The discussion took place via a group consensus two-day meeting, alongside an international conference, to allow as many of the participants to join as possible. A nominal group consensus model was followed with a facilitated, structured approach to gather qualitative information, from this group.[23] This approach has been followed in other consensus projects.[24 25] After discussions, the key consensus statements were synthesised and refined. Note was made of key discussion and dissention points. Sessions were facilitated to encourage discussion and also draw out dissenting[26] and outlier views as these were considered important to avoid a "herding bias" as a consensus may not necessarily produce 'the correct' answer to a question.[19] The research was led and facilitated by a less published researcher/expert (BP) to maintain impartiality, to balance any opposing professional viewpoints and avoid any "Eminence bias". These sessions were chaired by each author related to their area of specialisation – classification

(JM), Rehabilitation (BP), Return to running/sport (MG) and surgery (FSH). Consensus statements were gradually refined through a process of facilitated debate, not forcing consensus, until the entire panel were satisfied and on day 2, were put to the group for anonymous electronic voting. See Appendix 4 for the list of statements – rehabilitation, RTS/RTR, classification and surgery.

The consensus committee (FSH, BP, and JM) made a criterion decision that the consensus threshold was set a priori at 70%, with ≥70% of agreed / yes responses constituting consensus acceptance of statement. This cut off has been used by other authors in Delphi studies.[27-29] Statements not achieving consensus were removed and new items were added based on comments in the discussion, with further voting until consensus was achieved.

Procedure Stage 4 – Final Round Online Survey

A further online survey was developed, to test these statements with a final round survey to a wider global international group of experts who met the previous inclusion / exclusion criteria. The participants voted on the statements with yes, no, uncertain responses. Some further Likert or factor ranking questions determined level of agreement. (See Example Question Appendix 2).

Candidates voted on statements and ranked their key decision-making factors or justifications related to the domain areas found in the round 1 Survey. See Appendix 4 – tables, for consensus statements, voting results and typical discussion points or areas of disagreement (open ended questions)

Expert Panel for the final round

The final survey was split into domain sections – Classification, surgery, rehabilitation, return to running / Sport. Participants were asked to complete only the domains (sections of the survey) that were within their field and scope of expertise. The survey responses were anonymous and were evaluated for completeness.. Within their expertise areas, panel members were asked to complete sections as carefully as possible. The participants voted on the statements with yes, no, uncertain ("forced choice") responses. This made the final survey shorter and less onerous for participants but some further Likert or factor ranking questions determined level of agreement. Open ended boxes after each consensus statement also allowed them to comment, and comments were collated and analysed Survey

responses in each domain were evaluated by 2 steering group members and any non-completed forms or incomplete responses from non-experts in that particular domain were removed from the analysis.

Time Frames

September 2019 to Jan 2020 Round 1 - design of questionnaire to be delivered online with round 1 questionnaire and collation of round 1 responses.

January 2020 consensus days and conference consensus meeting, with Feedback of round 1 responses to face to face expert panel and synthesis of consensus statements for voting, - initial small panel vote on consensus statements.

August 2020 - May 2021 – Final Round – design and online delivery of international survey based on consensus statements to obtain wider sample level of agreement.

May 2021 –Dec 2021collation of consensus day information and write up for possible publication.

Respondents

The volume of responses made reporting in one single paper difficult. For this reason, three papers are presented with decision-making domain areas of – Classification, surgery and rehabilitation and RTS. The compositions and characteristics of the expert panel for each round survey and the face-to-face meeting are reported below in table 2.

The response rates and the inclusion and exclusions for each survey round are given in the flow chart in figure 2 below.

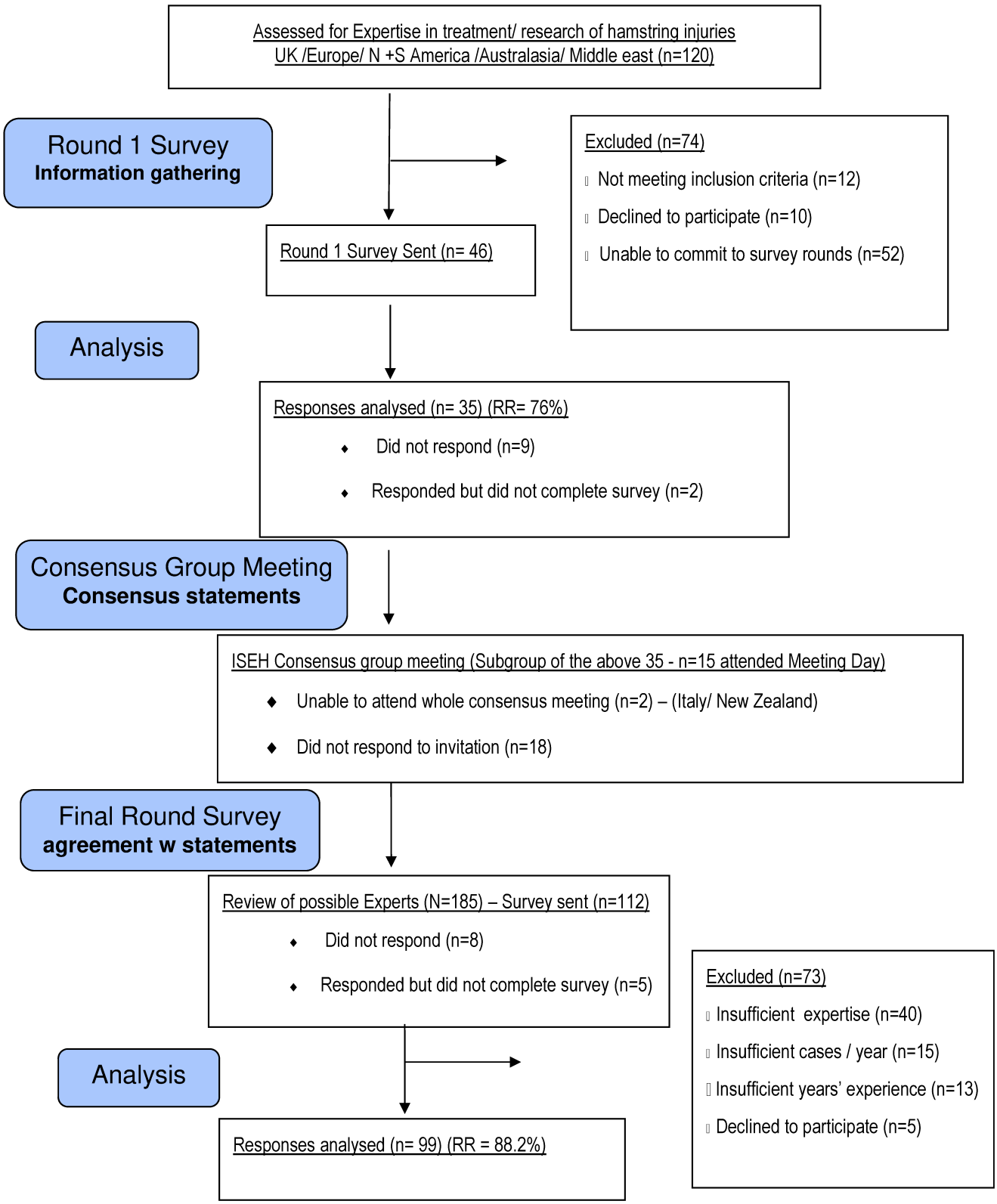


Figure 2: Flow diagram of participants and response rates (RR)

Table 2 participant charactreristics of the Expert Panels

Characteristic	Categories	Survey Round	Meeting	Survey Final Round
Sex	**(M: F)**	33:2	**14:1**	**81:18**
Age (years)	**27 - 36**	11 (31.4 %)	**6**	**32 (31.6%)**
	37 - 46	13 (37.1%)	**4**	**33(33.7%)**
	47 - 56	9 (25.7%)	**4**	**20 (20.4%)**
	57 - 70	2(5.7%)	**1**	**14 (14.3%)**
Role clinician	**clinician only**	3 (5.7%)		**26 (25%)**
	researcher/scientist only	2 (8.6%)		**11 (11 %)**
	clinician + researcher	30 (85.7%)	**15 (100%)**	**62 (63%)**
	Neither clinician nor researcher	0		**1 (1%)**
Hamstring cases / year	**none**	0		**5 (5%)**
	0-5	1(2.9%)		**6 (6%)**
	5-10	6 (17.1%)		**25 (24%)**
	10-15	7 (20%)		**12 (12%)**
	15-20	10 (28.6%)		**13 (13%)**
	20 or more	11 (31.4%)		**38 (38%)**
Health care profession	**Sports medicine Physician**	**4 (10%)**	**1 (7%)**	**21 (18 %)**
	Orthopaedic surgeon	**8 (21%)**	**5 (35%)**	**18 (17 %)**
	Physical Therapist	**22 (55%)**	**10 (64%)**	**43 (40 %)**
	Sports scientist	**1 (3%)**		**25 (24 %)**
	Athletic trainer / Strength & Conditioning coach	**2 (5%)**		**7 (6 %)**
	Other	**2 (5%)**		**2 (2%)**
Country of practice	**North America**	**4 (11%)**		**10 (10%)**
	Europe	**26 (66%)**	**12 (80%) (UK,Neth,Ir)**	**65 (64%)**
	Middle East/Africa	**4 (11%)**	**1 (7%) SAf**	**12 (12%)**
	Southeast Asia			**1 (1%)**
	South America			**1 (1%)**
	Australasia / pacific	**5 (13%)**	**2(13%) (Aust)**	**10 (10%)**
Sports	**football**	**31 (29%)**	**4 (27%)**	**79 (80%)**

Paton BM, *et al. Br J Sports Med* 2023;0:1–17. doi: 10.1136/bjsports-2021-105384

	athletics	**19 (19%)**	**2 (13%)**	**59 (60%)**
	Rugby codes	**13(12%)**	**4 (27%)**	**40 (40%)**
	NFL	**5 (5%)**		**9 (9%)**
	AFL	**3 (3%)**		**9 (9%)**
	basketball	**9 (9%)**		**30 (30%)**
	volleyball	**4 (4%)**		**1 (1%)**
	Skiing and winter sports	**9(9%)**		**21 (21%)**
	hockey	**3 (3%)**	**1 (7%)**	**22 (21%)**
	judo/ martial arts/wrestling	**2 (2%)**		**24 (24%)**
	cricket			**15 (15%)**
	Ice hockey			**12 (12%)**
	Acrobatics/ gymnastics / dance			**17 (17%)**
	Gaelic football			**7 (7%)**
	Racquet sports			**17 (17%)**
	handball			**20 (20%)**
	Other	**9 (8%)**	**4 (27%)**	**6 (6%)**
Years working with HSI	**0-4**	**5 (14.3%)**		**17 (17%)**
	11-14	**8 (22.9%)**		**13 (13%)**
	5-10	**9 (25.7%)**		**22 (21%)**
	15-20	**4 (11.4%)**		**23 (23%)**
	more than 20	**9 (25.7%)**		**24 (24%)**
Highest academic	**Bachelor/Diploma**			**14 (14%)**
	Masters			**35(35%)**
	PhD			**34 (35%)**
	Clinical Doctorate			**15 (15%)**
Had hamstring injury	**hamstring problem**			**38 (38%)**
	not applicable			**61 (62%)**

UK-United Kingdom, Neth-Netherlands, IR-ireland, Aust-Australia , SAf- South Africa

Appendix 1 Hamstring Injury Survey

Hamstring survey

1. what is your profession

- ○ Sports medicine physician
- ○ Orthopaedic surgeon
- ○ Physical Therapist
- ○ Sports scientist
- ○ Athletic trainer / Strength & Conditioning coach
- ○ Coach
- ○ Other

2. Which sports do you work with

- ☐ football
- ☐ athletics
- ☐ Rugby codes
- ☐ AFL
- ☐ basketball
- ☐ volleyball
- ☐ skiing
- ☐ other winter sports
- ☐ Other

3. How many Hamstring injuries do you assess and or treat per year?

less than 5	5-10	10-20	20-30	more than 30
○	○	○	○	○

4. What are the questions that need to be answered on mechanism of Hamstring injury

5 top questions on Mechanism of Injury (in order of importance)

5. What are the questions that you would like to be answered on Pathology of hamstring injury?

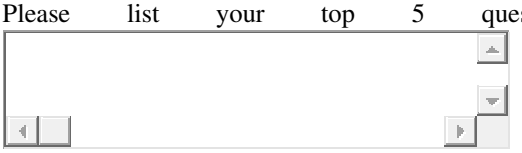
list your top 5 key questions on pathology in hamstring injury (in order of importance)

6. what do you see as the most important risk factors for hamstring injury?

please list the most important risk factors (in order of importance)

7. what questions are most important to answer in terms of risk of hamstring injury?

Please list your top 5 questions (in order of importance)



8. what questions are most important to answer in terms of risk of RECURRENCE of Hamstring injury?

Please list your top 5 questions (in order of importance)

Paton BM, *et al. Br J Sports Med* 2023;0:1–17. doi: 10.1136/bjsports-2021-105384

9. what exercises do you use for the prevention of injury?

- ☐ Eccentric
- ☐ concentric
- ☐ isometric
- ☐ hip based
- ☐ knee based
- ☐ other

what dosages do you prescribe

10. please rank the above exercises in terms of importance for prevention of Hamstring injury.

Rank your top 5 in order of importance

11. What are the questions you would most like answered around prevention of hamstring injury?

Please list your top 5 questions (in order of importance)

12. What are the key questions you would like answered around prevention of RECURRENCE of hamstring injury?

Please list your top 5 questions (in order of importance)

13. Which Hamstring injury classification systems do you use?

List your top 5 classification systems in order of preference

14. What are the questions you think need answering regarding Hamstring injury classification?

List your top 5 questions in order of importance

15. Which imaging do you use after hamstring injury?

- ☐ ultrasound
- ☐ Magnetic resonance imaging (MRI)
- ☐ Xray
- ☐ other

16. What are the key factors that influence your decisions for ordering imaging?

top 5 decision making factors for ordering imaging (list in order of importance)

17. What are the most important questions that need answering around Imaging in hamstring injury?

Please list your top 5 questions (in order of importance)

18. What are the questions you would most like answered regarding diagnostic tests after Hamstring injury?

please list your top 5 questions in order of importance

19. What other aspects of examination or examination tests do you put most weight on for Diagnosis?

Paton BM, *et al. Br J Sports Med* 2023;0:1–17. doi: 10.1136/bjsports-2021-105384

please list your top 5 examination tests for diagnosis. (In order of importance)

20. Do you use bracing in the early-stage post injury or surgery?

- no Bracing
- hip Brace
- knee brace
- used only after surgery

if you use bracing - what ROM? and What time period

21. what are the factors you would consider in precautions?

please list the top 5 factors in decision making for precautions post injury or surgery (in order of importance)

22. what are the key criteria that you use to progress Range of movement and initial loading of the injured hamstring?

Please list your top 5 criteria for progression (in order of importance)

23. What are the key questions that you would like answered regarding the early phase of rehabilitation?

Please list your top 5 questions (in order of importance)

24. what are the most important factors for you when considering choice of hamstring exercise?

Please list your 5 most important factors (in order of importance)

25. what factors do you use to determine - DOSAGE of exercise (ie frequency duration and intensity)

Dosage factors

26. what factors do you use to determine - when to PROGRESS exercise (ie frequency duration and intensity)

Progression factors

27. what other muscle groups do you prioritise in the kinetic chain?

- ☐ Adductors
- ☐ Gluteals
- ☐ Quadriceps
- ☐ Calf
- ☐ Hip flexors
- ☐ other

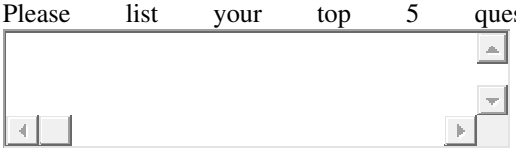
What top 5 questions would you most want answered relating to Hamstring injury and other muscles in kinetic chain? (List them in order of importance

28. what adjuncts do you find useful for strengthening Hamstring muscles in rehabilitation? (ie adjuncts like - electrical stimulation, Blood Flow restriction training, etc)

adjuncts (please list your top 5 in order of utility)

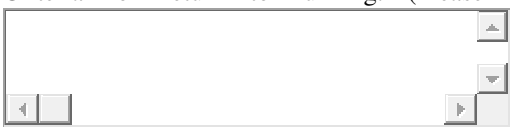
29. What questions would you most like answered on exercise prescription in Hamstring injury rehabilitation?

    Please list your top 5 questions (in order of importance)



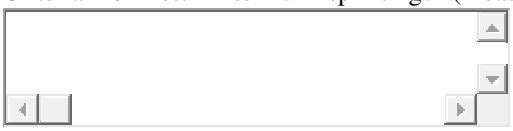
30. What are your criteria for return to running?

    Criteria for return to running. (Please list your top 5 in order of importance)



31. What are your criteria for return to full sprinting?

    Criteria for return to full sprinting? (Please list your top 5 in order of importance)



32. What are your criteria for return to sport (match / competition)?

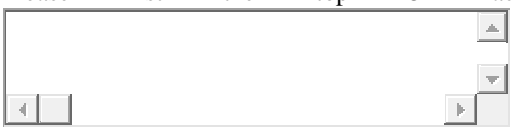
    Criteria for return to full sport (competition / match)? Please list your top 5 in order of importance.

33. What are the questions you would like answered on return to running and sport after hamstring injury?

    Please list your top 5 questions (in order of importance)

34. What factors would influence your decision making when deciding if surgery would be indicated?

    Please list the top 5 factors (in order of importance)



35. What are the questions you would most want answered on surgery for Hamstring injury?

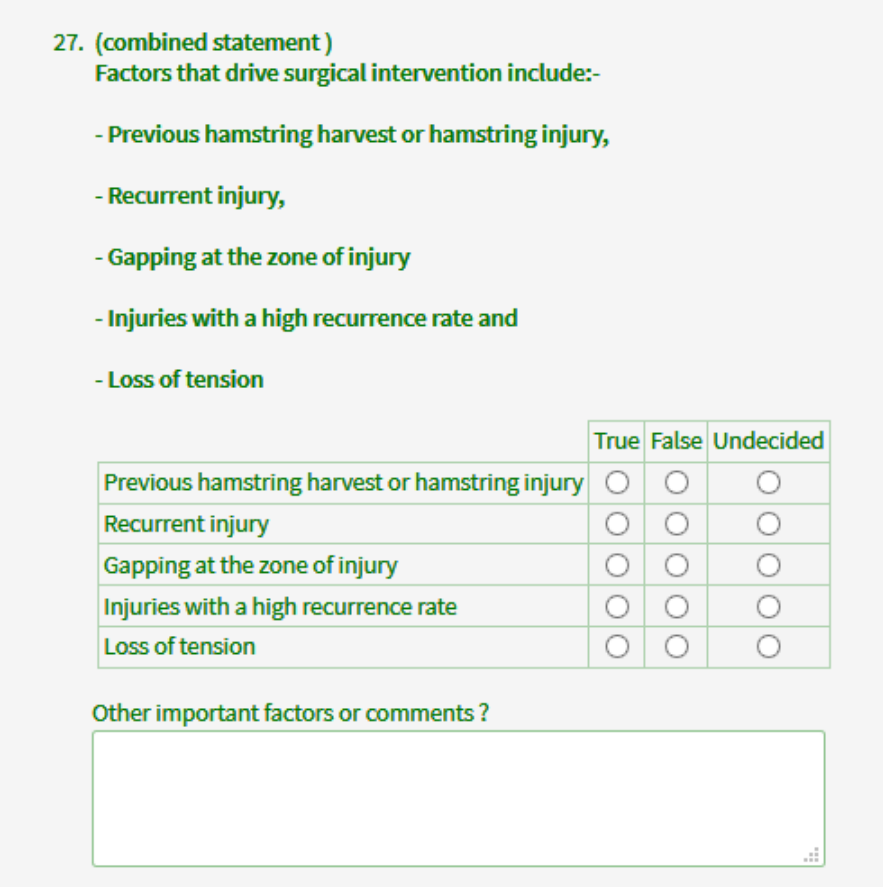
Paton BM, *et al. Br J Sports Med* 2023;0:1–17. doi: 10.1136/bjsports-2021-105384

Please list your top 5 questions on surgery (in order of importance)

36. What are the questions you would most want answered regarding rehabilitation after surgery?

List your top 5 questions in order of importance

Appendix 2 Round 2 Draft Question Examples –matrices responses



27. (combined statement)
Factors that drive surgical intervention include:-

- Previous hamstring harvest or hamstring injury,

- Recurrent injury,

- Gapping at the zone of injury

- Injuries with a high recurrence rate and

- Loss of tension

	True	False	Undecided
Previous hamstring harvest or hamstring injury	○	○	○
Recurrent injury	○	○	○
Gapping at the zone of injury	○	○	○
Injuries with a high recurrence rate	○	○	○
Loss of tension	○	○	○

Other important factors or comments ?

Appendix 3 Survey round 1 Questions and typical responses

Nb Questions on classification and imaging are supplied in the classification paper.

Table 1 What are the key questions that you would like answered regarding the early phase of rehabilitation after HSI?

Domain Area	*responses*	*Typical Responses*
Early interventions (STM / neural mob/ + adjuncts BFR / EM stim)	***9***	Is there a role for adjunct treatment modalities? At what time point are they safe and to what level of intensity?
Progression criteria (including pain)	***6***	What outcomes should we be aiming to achieve for criteria-based progression along stages
Optimum exercise/ load types	***6***	What are the optimal exercises to use in this phase? How early can we safely prescribe eccentric / long length exercises?
Pain importance	***5***	What are the outcomes of pain monitored/threshold approach to rehabilitation?
Modalities for inflammation / healing (RICE, Meds)	***5***	Does prolonged use of Ice, Compression or medication positively or negatively affect hamstring healing rates?
Timescales (start and progress load)	***4***	How early can we safely prescribe eccentric / long length exercises?
Flexibility/ ROM	***3***	Is there a role for Knee flexibility work?
Immobilisation & Bracing (optimum, effects)	***3***	Does initial immobilisation positively or negatively affect hamstring healing rates?
Neural factors, inhibition & activation	***3***	What are the outcomes of return to run process, early vs delayed vs criteria based, vs early introduction of eccentrics - any effect on neuromuscular inhibition?
Optimum dosing (Frequency, Intensity, Duration)	***2***	What exercise dosages are optimal for loading early phase after HSI?
Safety of early loading	***1***	Does early mobilization / rehab (including stretching), and activation of the hamstring speed or limit recovery?
Tissue strain load /exercise	***1***	What is the strain placed on muscle/tendon by different rehab exercises?
Weight bearing	***1***	When does initial reduction in weightbearing help or hinder healing?
Early strength	***1***	What are the outcomes of early introduction of eccentric exercises?
Total	***50***	

Table 2 What questions would you most like answered on exercise prescription in HSI rehabilitation?

Domain Area	***responses***	***Typical Responses***
Progression of exercise	***8***	What is optimum order of progression of exercise? inner to outer? short length to long concentric to eccentric to isometric? OKC vs CKC? knee to hip based?
Dosage	***5***	What is the optimum dosage of strength exercise?
Contraction types	***5***	What type of contraction should be emphasised during hamstring injury rehabilitation?
Running /sprinting	***4***	What is a safe but stimulating dosage of pitch-based running?
Exercise choice	***4***	what are the optimal exercises for hamstring injury prevention?
Importance of symptoms	***3***	How effective is early introduction of eccentrics and pain threshold training?
Safety vs effectiveness balance	***3***	What is a safe but stimulating dosage of strength exercise?
Tissue healing stage	***2***	What modes of exercise should be carried out at certain healing stages?
Timing	***2***	When should certain exercise types, isometric, concentric, eccentric, SSC be implemented throughout rehabilitation
Insufficient evidence	***2***	Can we get more insights to the specific mechanisms of HSI at a contraction mode, neural and structural level to aid prevention and rehabilitation exercise choices?
Flexibility	***1***	What are the effects of flexibility exercises?
Strength	***1***	What types of strength are crucial?
Which Muscles	***1***	How best do we target loading the Biceps femoris long or short head and do we need to?
Functional exercise	***1***	More RCTs (analogous to those employing the Nordic) exploring the functional effectiveness of different exercises
Neural factors	***1***	Which exercises promote optimal hamstring activation?
Total	***43***	

Table 3 What are the questions you would like answered on return to running and sport after HSI?

Domain Area	***responses***	***Typical responses***
running mechanics	***8***	Does early return to running effect rehab outcomes?
optimum monitoring	***7***	What key benchmarks should we be considering before each stage and research about
recovery	***2***	How long to leave it between bouts of HSR?
sport specifics	***3***	What are the sport-specific match demands that we can replicate towards the end of rehabilitation?
load tolerance	***1***	Does early return to running effect rehab outcomes?
strength	***3***	What are key strength components and levels to enable safe return
dosage	***2***	What dosage of running should be permitted before sprinting is safe
timing	***4***	How early is it safe to sprint?
Total	***30***	

Table 4 What are the questions you would most want answered on Surgery for HSI?

Domain Area	***responses***	***Typical responses***
Outcomes	***8***	Does it affect functional outcomes?
Indications	***9***	What level of tendon disruption requires surgery?
Surgery vs Conservative	***7***	Is it more effective than conservative management?
Long term effects	***4***	What are the long-term outcomes for elite athletes having had surgery?
Surgery & RTS	***3***	Does it affect time to return preinjury level of sporting activity?
Recurrence rate	***3***	Does surgery reduce reinjury?
Techniques	***3***	Can surgical drainage of large intramuscular haemorrhage improve recovery without repair of muscle?
Timing post injury	***3***	How soon after certain pathologies should surgery be undertaken?
Rehabilitation post-Surgery	***1***	Development of an evidence-based rehabilitation protocol.
Terminology	***1***	Consistent terminology much-needed
Injury factors	***1***	Can we grade injuries needing surgery
Surgery never required	***1***	
Relationship w classification	***1***	When is surgery indicated for particular hamstring classifications?
Total	***45***	

Appendix 4 Consensus statements – and voting for Round 2 Survey

Table 1 - Consensus statements and percentage agreement for round 2 survey – Global expert Panel - ***Rehabilitation***

Statements related to General Rehabilitation		TRUE	FALSE	Undecided	Samples of typical responses - discussion points or areas of disagreement
Initial and progressive loading of injured hamstring muscles should include exercise with different: - -contraction types, muscle lengths, functional movements, body positions, but the type of exercise will depend on the sports specific adaptation required, symptoms and risks of reinjury		**89.8%**	**8.5%**	**1.7%**	Initial loading about neuromuscular stimulation and improving healing / Muscle tension at length not ideal/ initial loading isometric to minimise stress or shearing on tendon / eccentric contractions should be the focus.
The ORDER and SPEED of PROGRESSION of exercises - (concentric / isometric / eccentric exercises), hip and knee-based exercises, Inner and outer length exercises and open and closed kinetic chain exercises) - will depend on: -	***adaptation required***	**96.2%**	**0.0%**	**3.8%**	Level of agreement reflects the importance of the target adaptations required as a criterion for prescription.
	symptoms	**88.9%**	**7.4%**	**3.7%**	Symptoms were the main criterion used by rehabilitation clinicians to make decisions.
	type of injury	**75.0%**	**15.4%**	**9.6%**	Overall, the injury and tissue type were major considerations for clinicians in deciding on exercise.
	risk of recurrence	**60.4%**	**26.4%**	**13.2%**	No comments made -? Possibly reflecting the little literature available on this.
	stage of tissue healing	**90.7%**	**5.6%**	**3.7%**	Tissue and stage of healing showed strong agreement - discussions suggested that it was harder to know at tissue level how healing was progressing, and symptoms were used as a surrogate to this.
The CRITERIA FOR PROGRESSION of exercise should include: -	***symptoms pain***	**90.7%**	**1.9%**	**7.4%**	Symptoms were the main criterion used by rehabilitation clinicians to make decisions.
	strength	**92.7%**	**3.6%**	**3.6%**	While strength overall showed good agreement - there was less agreement on which components of strength were thought to be most important.
	Special tests	**62.7%**	**13.7%**	**23.5%**	Lack of agreement on specific tests - but a combination of factors was thought to be more important
	Functional milestones	**87.3%**	**5.5%**	**7.3%**	Function was agreed to be important - but panel could not agree on which functional milestones are most important.
	Flexibility	**67.9%**	**17.0%**	**15.1%**	Flexibility and ROM were thought by the panel to be less important as a criterion- and comments were that strength exercises at longer length were sometimes used to build flexibility concurrently with strength.
	The severity of the injury	**73.1%**	**15.4%**	**11.5%**	After the initial diagnosis and early treatment stage the progressions were led more by the above criteria than the severity of the injury - although many issued cautions with tendon injuries and higher-grade tendon injuries due to risk of re rupture.
The Dosage of exercise (frequency, intensity, duration) should be based on: -	***The response to previous loading***	**96.3%**	**1.9%**	**1.9%**	Graded process of loading and assessing response - both during and after exercise - especially in terms of pain - it was felt this gave the optimum speed of rehab
	Examination findings	**88.2%**	**9.8%**	**2.0%**	High agreement that examination was vital prior to progressions in dosage.
	Stage of Healing	**86.5%**	**7.7%**	**5.8%**	Appropriate healing level to tolerate applied loads.
	Periodisation factors	**88.2%**	**3.9%**	**7.8%**	Weekly and seasonal factors affect decisions on dosage and are key considerations in elite sport environments.
	Sporting level	**82.7%**	**15.4%**	**1.9%**	These 3 questions related to knowing the end goal in load capacity for match fitness, which will depend on type and level of sport.
	Current and previous capacity	**88.7%**	**7.5%**	**3.8%**	
	The target adaptations related to the patient's goals and or sport	**92.3%**	**3.8%**	**3.8%**	
	Strength	**92.6%**	**3.7%**	**3.7%**	Training principles of overload - ensuring strength loads are progressed to enable muscle to keep adapting - i.e., avoid accommodation to the equivalent applied loads.

Fitness	**78.8%**	**13.5%**	**7.7%**	Cardiovascular fitness may not affect dosage in gym-based work but will affect running work.
Severity of the injury	**84.6%**	**11.5%**	**3.8%**	It may not be appropriate to load some injuries too heavily - as they may not have symptoms but still be at risk of retear - it biceps femoris and central tendon involvement.
The whole rehabilitation process should be agreed within the MDT and have athlete engagement	**96.8%**	**1.6%**	**1.6%**	MDT and athlete engagement were key - the discussions were around all the stakeholders' potentially conflicting goals and timeframes.
The patient's sport and previous level of participation will impact the progression of exercise selection and ultimate return to activity	**95.2%**	**3.2%**	**1.6%**	The discussions were like the 3 questions above.
It is important to consider the possibility of sciatic nerve / neural symptoms when considering a patient's progression through rehabilitation. Neural mobility could be considered in treatment but the protection of the repaired or vulnerable tissue should be maintained.	**90.5%**	**0.0%**	**9.5%**	Strong agreement. Neural Tethering / scarring in the healing process was also thought to be one reason for lack of progression with conservative treatment.
ADJUNCTS to REHABILITATION, such as blood flow restriction, electrical stimulation and hydrotherapy should be considered in the early stages to enhance tissue healing and recovery (Caution should be used with cuff pressures over repairing tissues when using blood flow restriction (BFR) training)	**68.9%**	**6.6%**	**24.6%**	There was less uniform global practice when relating to use of adjuncts such as BFR- this reflects small evidence base only in HIS.
Rehabilitation should be MONITORED with appropriate markers that are progressive with recovery	**98.4%**	**0.0%**	**1.6%**	Monitoring was agreed but the most common form of monitoring was very varied!! - most panellists mentioned monitoring with GPS data allowing on field training / match play load data.
Final stage strengthening should aim to achieve adequate symptom free, outer range, eccentric and isometric strength in injured and uninjured limb.	**95.2%**	**1.6%**	**3.2%**	Panel had agreement on the types of strength to be achieved by final stage rehab - with outer length eccentric and isometric strength - in line with evidence on strength.
It is key during a hamstring rehabilitation to assess, treat and prescribe exercises addressing the whole kinetic chain.	**90.5%**	**3.2%**	**6.3%**	Panel agreed that biomechanical kinetic chain was important but there was less agreement on which were the most important components - many panellists suggested that it should be individualised and decided based on thorough subject and objective examination.

Table 2 - Consensus statements and percentage agreement for round 2 survey – Global expert Panel - ***Return to Running***

Statements related to return to running	TRUE	FALSE	Undecided	Samples of typical responses - discussion points or areas of disagreement
On pitch/track/field (sport specific) running is a significant part of hamstring rehabilitation.	**98.4%**	**1.6%**	**0.0%**	Levels of agreement for these 2 questions reflects the importance of running as part of HSI rehabilitation.
Running dosages should be gradually increased to ensure return to full sprinting.	**100.0%**	**0.0%**	**0.0%**	Hamstring muscle function discussed and difference in function at speed was acknowledged.
Sprinting dosage loads should approach game level intensities and volumes to reduce risk of recurrence on return to sport	**95.2%**	**4.8%**	**0.0%**	Sprinting in games presents injury risk and sprint work is a key component in final phase rehabilitation.
Further research should investigate the specific actions, bias, roles of individual muscles in function of running and sprinting to aid rehab exercise prescription.	**84.7%**	**0.0%**	**15.3%**	Differences in muscle roles were discussed and the panel expressed need for more research into how the differences in muscle function will then impact rehabilitation.
Further research should investigate types (styles) and dosages of running (quantity, speed) that promote adaptations but reduce risk of recurrence	**90.3%**	**1.6%**	**8.1%**	Discussions suggested that running had not been prioritised sufficiently in literature and identified a research need.
Further research should investigate safe time frames to commence running post Hamstring injury or surgery	**90.3%**	**1.6%**	**8.1%**	Risk of reinjury is high when reexposing HSI athletes to running - and the panel wanted safter time frames for return - and more research onto timeframes.

Mild pain with running is permissible in rehabilitating certain HSI, but we need to consider the function of the individual, the anatomy, injury, classification and the 24-hour pain pattern (subjective and objective)	**83.9%**	**9.7%**	**6.5%**	The panel acknowledged many athletes have pain when restarting running - there was less agreement on how much pain was permissible / deleterious - the stated consideration factors reached agreement but other factors did not.
In HSI Pain free running is a criterion for return to sprinting.	**85.5%**	**8.1%**	**6.5%**	The panel agreed that pain levels should be reduced prior to permitting sprinting - the panel acknowledged that the initial commencement of full sprinting - was a high-risk period for reinjury.

Table 3 - Consensus statements and percentage agreement for round 2 survey – Global expert Panel - ***Return to sport***

Statements related to Return to Sport	TRUE	FALSE	Undecided	Samples of typical responses - discussion points or areas of disagreement
In HSI, Range of motion is a consideration for RTS. If previous data is available, then within 10% of previous scores should be used otherwise within 20% of the other limb	**45.0%**	**23.3%**	**31.7%**	Flexibility was not considered a key factor by many clinicians - stretching did not always produce improvements in function or performance and less agreement over acceptable levels.
Kinetic chain strength/function is a consideration criterion for RTS.	**78.3%**	**6.7%**	**15.0%**	All agreed Kinetic chain was important - but panel did not agree on key kinetic chain factors. A clinical reasoning approach was advocated to assess each athlete based on the required sporting demand and key injury risk activities.
Progression to Peak isometric force in mid and outer range, isotonic strength (eccentric only/eccentric & concentric) are all considerations for RTS	**83.3%**	**1.7%**	**15.0%**	Optimal types of exercise were controversial but consistent with literature - eccentric or isometric exercises at length were considered important and reached agreement.
Benchmarks for strength should reflect the end goal demands of the athlete but should be within 10% of previous data or population means	**66.1%**	**10.2%**	**23.7%**	The low agreement for this question reflected differences in opinion on strength benchmarks.
Athlete subjective apprehension is a consideration for RTS criteria.	**98.3%**	**0.0%**	**1.7%**	The strong agreement reflects the importance the panel placed on the athletes leading the RTS / RTR process - and ensuring their opinion was prioritised.
Athlete self-assessment of their readiness to RTS is a key factor in the return to sport decision making process.	**86.7%**	**5.0%**	**8.3%**	
Askling H-Test is a useful test in the return to sprinting decision process	**57.6%**	**18.6%**	**23.7%**	The respondents were divided on use of pain provocation tests. Their usefulness was acknowledged but it was felt that no one specific test could assess readiness to return to sprinting - and the tests should form part of an ongoing assessment and clinical reasoning process.
Endurance Capacity testing of the hamstrings should be a consideration for RTS	**78.3%**	**6.7%**	**15.0%**	Endurance was felt to be important, but it was harder to get agreement on which endurance tests were most important - running endurance was felt to be important but the panel suggested that the level of endurance related to the specific sporting demands.
Pain free sprinting is a criterion for return to play	**96.7%**	**1.7%**	**1.7%**	The importance of sprinting in match play / competition was acknowledged, with high agreement. There was less agreement on the dosage of full sprinting. While some pain was permitted in running, sprinting in RTS - was expected to be pain-free.
Completing full unrestricted training session should be a criterion for Return to Sport	**93.3%**	**6.7%**	**0.0%**	Training sessions reached agreement - particularly as this assessed the athlete with sports specific demands and endurance requirements.
The use of previous GPS metrics can guide the required dosage of appropriate metrics i.e., volume, sprints, speed, HSR	**83.3%**	**3.3%**	**13.3%**	Many in the panel were using GPS to measure running dosage - and their usefulness was thought to be key - with practice expertise moving faster than research evidence base - this was thought be an area requiring greater research.
Return to sport should be a multidisciplinary process that involves all stakeholders ideally	**98.3%**	**0.0%**	**1.7%**	The importance of a whole MDT and coaching athlete stakeholder involvement reached high LOA - but many clinicians acknowledged significant pressure from stakeholder groups to modify their clinical decision-making.

Table 4 - Consensus statements and percentage agreement for round 2 survey – Global expert Panel - ***Classification***

Consensus statements related to Classification		TRUE	FALSE	Undecided	Samples of typical responses - discussion points or areas of disagreement
Anatomical (radiological) classification is essential in the diagnostic process		**62.0%**	**22.0%**	**16.0%**	It is essential in the higher-grade hamstrings to determine the tendon involvement however with smaller strains radiology is non-essential.
There is a need for One main classification system (agreed terminology and nomenclature).		**84.8%**	**2.0%**	**13.1%**	A 'one size fits all' may not be appropriate. Different sports have different mechanisms of injury, demands and therefore RTP times, and re injury rates. Seems logical that what may work for track and field doesn't necessarily hold true for football. Difficult to fit everything into one main classification anatomy, function, and prognostication.
Classification needs clear parameters such as (but not limited to) :-	***Anatomical, radiological classification***	**95.9%**	**0.0%**	**4.1%**	It appears research remains undecided for the influence of anatomical location and free vs central tendon involvement in classification systems.
	Free Tendon vs Central Tendon	**86.9%**	**6.1%**	**7.1%**	Again, the evidence is limited in the classification of tendon vs MTJ injuries (as an example). No evidence suggests central tendon involved injuries are better off with surgical intervention or not. The only evidence we do have is that treating without the MRI and using clinical markers to guide progression is the only consistent approach, whether central tendon is involved or not.
	Should evolve to include surgical criteria	**52.1%**	**19.8%**	**28.1%**	Surgical criteria would be useful for practitioners deciding on prognosis and management.
Classification systems should have agreed Terminology		**91.8%**	**2.0%**	**6.1%**	Diagnostic classification system should be clear in reports and research. Only for consistency's sake from both a scientific and clinical perspective.
There is a need for a registry for hamstring injuries		**68.7%**	**10.1%**	**21.2%**	more data is useful, but I fear people will bias their interpretation of it (E.g., all central tendon injuries take longer to rehab than MTJ - but this is because you treated them based on the MRI which showed central tendon and you were conservative as a result). This bias is tough to avoid in these registry datasets and people will misconstrue the data. Would be difficult with so many sports. Maybe intra sport registry.
Mechanism of injury should be commented alongside the classification (where appropriate / known)		**82.0%**	**11.0%**	**7.0%**	This always allows for a clearer prognosis/ This is more useful than the classification system. /Affects anatomical involvement, prognosis, and rehab decisions.
We SHOULD differentiate between muscles in the classification?		**88.9%**	**4.0%**	**7.1%**	Obvious/Different muscles have different functions so a classification that guides rehab is desirable hamstrings have different structure and therefore function which needs to be clearly stated to understand if certain muscles are at greater re-injury risk or require longer / Requires a very demanding system that may be too difficult to adhere to.
Beyond anatomical classification, there is a need to have: -	***functional criteria running beside***	**90.0%**	**6.0%**	**4.0%**	Time to walk pain free/Confidence to Sprint/ patient expected time to return to sport.
	PROMS running beside	**80.4%**	**10.3%**	**9.3%**	Current PROMs for hamstring injury may not be particularly useful/ PHAT LEFS/ Marx score/ FASH.

Imaging is vital in the classification system		**70.5%**	**14.7%**	**14.7%**	To decide between conservative or surgery, not otherwise/ Would prefer that classification would guide us to ask for imaging. Not that imaging is always essential especially in low grade injury/ in professional sport, imaging is more often required than not, however does not always change management.
Immediate Physical Examination signs like bruising, loss of muscle tension, palpable defects and /*or significant* ***weakness and excessive/no response on provoking activities warrant further investigation***		**92.6%**	**2.1%**	**5.3%**	In this presentation you are suspecting a free tendon or complete rupture which may require surgery/ Pain level and mechanism (suggesting a complete tear, avulsion, or anything else that might require a surgical opinion.
MRI is the preferred imaging for diagnosis and classification		**89.5%**	**4.2%**	**6.3%**	If used, I prefer MRI/ Ultrasound imaging can be very useful if conducted by a physician/ sonographer with lots of training. Ultrasound is also very suited to examine the damaged muscle- connective tissue area under movement. Ultrasound can also be a good cheaper alternative.
MRI side to side comparison is ideal for classification		**49.5%**	**25.3%**	**25.3%**	This does not happen that often due to financial restrictions. Enough information can likely be gained from a unilateral MRI to give an accurate diagnosis. /Contralateral side is not always a 'healthy' side/Should be used together with US/I prefer a correct protocolized MRI only of the affected side.
When is Ultrasound most useful / relevant as	***primary imaging after injury PRE 48 hours***	**14.8%**	***58.0%***	**27.3%**	Ultrasound is not particularly useful when there is a lot of oedema, in the early post-injury period.
	primary imaging after injury POST 48 hours	**25.8%**	***42.7%***	**31.5%**	4-day deadline is best to see well the hematic collection.
	in the rehabilitation phase	**61.8%**	**16.9%**	**21.3%**	It depends in what aspect. Architecture - yes. Lesion tracking -no.

Table 5. Consensus statements and percentage agreement for round 2 survey – Global expert Panel - ***Surgery***

Statements related to domain of Surgery		**responses**	**not answered**	**TRUE**	**FALSE**	**Undecided**	**Samples of typical responses - discussion points or areas of disagreement**
Factors that drive surgical intervention include: -	***Previous hamstring harvest or HSI***	**83**	**32**	**26.5%**	**38.6%**	**34.9%**	I think all of these are relevant but none of them determine/ drive/ necessarily require surgical intervention. Undecided if any of these factor into surgical intervention unless coupled with poor functional outcomes (e.g., lack of rehab progress etc). The level of athlete and stage of competition are also factors to consider.
	Recurrent Injury	**83**	**32**	**33.7%**	**38.6%**	**27.7%**	All factors should be considered, and the importance of each factor differs depending on type of injury and type of patient. Recurrence: not been proven that surgery will reduce recurrence rate. I am not aware of any convincing, high quality scientific data on the success of surgery following hamstring injuries.
	Injuries with a high recurrence rate	**84**	**31**	**40.5%**	**28.6%**	**31.0%**	
	Gapping at the zone of injury	**86**	**29**	**87.2%**	**2.3%**	**10.5%**	This was felt to be the main driver. Degree of tendon retraction important the main indication for surgery if complete free tendon (BA grade 4) for grade intra tendon injury > 50% of the CSA. High (3b) grade injuries can make a complete return to sport.
	Loss of tension	**82**	**33**	**70.7%**	**13.4%**	**15.9%**	Loss of tension is evident in most injuries, as an acute sign, but improves with healing, it is less important than size of gap and loss of tendon tension more important than myofascial tension
The indications for surgery in hamstring injuries are dependent on: - the anatomy of the injury the demands on the athlete/patient and the expected functional outcome.		**85**	**30**	**87.1%**	**9.4%**	**3.5%**	I don't know that we have enough information now to be able to say with any confidence who is truly in need of surgery (if anyone), Until we simply have decent outcome studies looking at usual care, and something comes out of the data, we're guessing. Dependent on the anatomy but not the demands of the athlete/ patient or the expected functional outcome. Function, recurrence, and lack of progress are the main ones for me. Failure of conservative care would seem to be the only indication at the moment as near as I can tell. This is true but just in some type of injuries (e.g., those affecting the free tendon).

							Anatomy yes If conjoint tendon full rupture in elite athlete, I would advocate surgery. Semimembranosus full rupture would advocate conservative. Degree of tendon retraction important in ST or BF rupture. If small and healing possible then would trial conservative first.
Surgical management has the capacity to: -	***Speed up recovery timescales***	**86**	**29**	**36.0%**	**36.0%**	**27.9%**	Speed up: not supported by literature/surveys. Current protocols are very slow. For Speed up recovery timescales = I would say speeds up and gives more consistent/ predictable recovery which gives us good outcomes. Only for high grade avulsions.
	Restore Anatomy and function	**85**	**30**	**87.1%**	**1.2%**	**11.8%**	We need more research into this, but potentially true as surgery is often undertaken with failed conservative management.
	Reduce risk of recurrence	**85**	**30**	**48.2%**	**17.6%**	**34.1%**	Need more research into this but potentially true as surgery often undertaken with failed conservative management. Reduced recurrence has been the experience in our cohort. Recurrence: not been proven that surgery will reduce recurrence rate. I have seen reinjury at different location following grade 4 injuries and free tendon repair. Reoccurrence will be hugely influenced by post operative rehabilitation and a progressive RTP. Surgery will restore anatomy, but an injury may reoccur due to ineffective rehabilitation. Recurrent injury only relevant if recurrent tendon or previous surgery, or sciatic nerve issue requiring neurolysis. Reduces recurrence we believe but less predictability with conservative treatment in high grade tendon injury.
Hamstring fixation should be performed endoscopically		**84**	**31**	**9.5%**	**25.0%**	***65.5%***	Need better field of view - attachment footprint is too large and sciatic nerve involvement should be checked
The reporting of hamstring recurrence should be based on the IOC criteria and cover a two-year time frame		**84**	**31**	**53.6%**	**11.9%**	**34.5%**	Long term outcomes certainly would make for a fairer appraisal of benefits. Assume this in reference to the Methodological consensus statement on reporting of injuries? I think as we standardize our approach, this is certainly the most relevant and up to date reference for reporting. Yes, for research purposes but 2 years is a long time. I would prefer 1 season
Undisplaced bony hamstring avulsions DO NOT require immediate operative intervention		**81**	**34**	**50.6%**	**18.5%**	**30.9%**	There are several factors that contribute to this decision-making process, having a binary approach is too difficult. In addition, there needs clarity of what type of bony avulsion is being referenced. It depends on athlete characteristics. Function during rehab should dictate this. Need to be re-imaged and monitored closely.
Displaced bony avulsions of the ischium should be managed operatively if symptomatic		**81**	**34**	**72.8%**	**4.9%**	**22.2%**	Depends on function, how much displacement, and athlete level and characteristics.
Surgical intervention for bony avulsions of the ischium should be: -	***Internal fixation***	**78**	**37**	**46.2%**	**5.1%**	**48.7%**	It depends on the time frame and the fragment size, bone to bone healing is preferable. If the fragment is too small, non-union may develop with internal fixation and in this scenario resection and soft tissue repair is favoured.
	Resection of Avulsed bone and Soft Tissue Repair	**77**	**38**	**31.2%**	**14.3%**	**54.5%**	
Undisplaced soft tissue hamstring avulsions can be initially managed non operatively		**80**	**35**	**61.3%**	**7.5%**	**31.3%**	Depends on time frames and upcoming competitions. Maybe able to be managed non-operatively if time frames allow. However, surgery will help give an accurate RTP prediction. This is dependent on several factors such as extent of injury, which hamstring, playing position etc
Undisplaced proximal hamstring origin tears should be managed operatively in athletes		**79**	**36**	**32.9%**	**27.8%**	**39.2%**	We don't have RCTs,
Criteria for surgical intervention in the proximal free tendon injuries include	***loss of muscle and tendon tension which results in a gap***	**79**	**36**	**83.5%**	**1.3%**	**15.2%**	Dependent on size of gap, and the level of athlete?
	risk of functional loss / performance deficit with non-operative management	**79**	**36**	**72.2%**	**7.6%**	**20.3%**	Proven loss of function in a patient who has a thorough understanding of the outcomes of surgical and conservative care and the patient still wishes to undergo surgery. We don't have RCTs, tough one. Dependant on whether elite or recreational athlete.
The management of free tendon injuries with displacement differs from that of intramuscular tendon injuries where the overall fascial envelope is still intact		**79**	**36**	**69.6%**	**6.3%**	**24.1%**	Intramuscular tendon injuries benefit from the 'scaffold' of surrounding muscular tissue I think free tendon injuries are a different type of injury than a hamstring injury with damage to the intramuscular tendon and require therefore specific treatment. The jury is still out on this. It would be a good topic for a well-coordinated multi-centre RCT.
	corticosteroid injections	**80**	**35**	**2.5%**	**80.0%**	**17.5%**	Evidence conflicting, but panel consensus disagreement on this statement.

Undisplaced soft tissue hamstring avulsions is there a role for	***injecting Blood / Platelet Rich Plasma (PRP)?***	**80**	**33**	**16.3%**	***50.0%***	**33.8%**	? PRP although evidence is weak at best. We have not used PRP but can see why it is worth consideration if you were going to trial conservative management.
	Other injections	**69**	**46**	**1.4%**	***53.6%***	**44.9%**	Dry needling. No conclusive evidence that these approaches improve outcomes.
Does haematoma aspiration have a role in	***avulsions***	**79**	**36**	**19.0%**	**40.5%**	**40.5%**	Perhaps large haematoma around the sciatic nerve - risk of fibrosis and adhesions.
	Tendon Injuries	**79**	**36**	**19.0%**	**41.8%**	**39.2%**	Injections/aspirations increase infection risk and haematomas often recur after aspiration. However, there may be. Has a role but precaution as the blood product may actually assist healing and fibrosis/ tear bridging. exceptions in case of very large or painful haematomas where the patient is fully informed and decides to take the risk. Only when it gives symptoms (content of haematoma is comparable to PRP).
	Other types of HSI	**78**	**37**	**28.2%**	**33.3%**	**38.5%**	Morel-lavallae lesion Contusions for symptomatic relief
There is a role for drainage of haematomas without surgery for hamstring muscle injuries and avulsions		**77**	**38**	**29.9%**	**32.5%**	**37.7%**	The haematoma being a space occupying lesion and preventing complete healing makes theoretical sense, but the few times we've tried it, the gap promptly refilled with blood despite firm compression bandaging. Maybe there's a technically better way to do this, but we've not figured it out yet. Hematoma potentially contributes to regeneration.

REFERENCES

1. Fanchini M, Steendahl IB, Impellizzeri FM, et al. Exercise-Based Strategies to Prevent Muscle Injury in Elite Footballers: A Systematic Review and Best Evidence Synthesis. *Sports Medicine* 2020;50(9):1653-66. doi: 10.1007/s40279-020-01282-z
2. McCall A, Carling C, Davison M, et al. Injury risk factors, screening tests and preventative strategies: A systematic review of the evidence that underpins the perceptions and practices of 44 football (soccer) teams from various premier leagues. *British Journal of Sports Medicine* 2015;49(9):583-89. doi: 10.1136/bjsports-2014-094104
3. Michalis AH, Apostolos S. Hamstring strains in football. Prevention and rehabilitation rules. Systematic review. *Biol Exerc* 2016;12(1):121-48.
4. Minas H, Jorm AF. Where there is no evidence: Use of expert consensus methods to fill the evidence gap in low-income countries and cultural minorities. *International Journal of Mental Health Systems* 2010;4 doi: 10.1186/1752-4458-4-33
5. Hasson F, Keeney S, McKenna H. Research guidelines for the Delphi survey technique. *Journal of Advanced Nursing* 2000;32(4):1008-15.
6. Powell C. The Delphi technique: Myths and realities. *Journal of Advanced Nursing* 2003;41(4):376-82. doi: 10.1046/j.1365-2648.2003.02537.x
7. Negrini S. Why evidence-based medicine is a good approach in physical and rehabilitation medicine. Thesis. *European Journal of Physical and Rehabilitation Medicine* 2014;50(5):585-91.
8. McCall A, Pruna R, Van der Horst N, et al. Exercise-Based Strategies to Prevent Muscle Injury in Male Elite Footballers: An Expert-Led Delphi Survey of 21 Practitioners Belonging to 18 Teams from the Big-5 European Leagues. *Sports Medicine* 2020;50(9):1667-81. doi: 10.1007/s40279-020-01315-7
9. Mueller-Wohlfahrt HW, Haensel L, Mithoefer K, et al. Terminology and classification of muscle injuries in sport: the Munich consensus statement. *Br J Sports Med* 2013;47(6):342-50. doi: 10.1136/bjsports-2012-091448 [published Online First: 2012/10/20]
10. Donaldson A, Cook J, Gabbe B, et al. Bridging the gap between content and context: Establishing expert consensus on the content of an exercise training program to prevent lower-limb injuries. *Clinical Journal of Sport Medicine* 2015;25(3):221-29. doi: 10.1097/JSM.0000000000000124
11. van der Horst N, Backx F, Goedhart EA, et al. Return to play after hamstring injuries in football (soccer): a worldwide Delphi procedure regarding definition, medical criteria and decision-making. *British Journal of Sports Medicine* 2017;51(22):1583-91. doi: 10.1136/bjsports-2016-097206
12. Zambaldi M, Beasley I, Rushton A. Return to play criteria after hamstring muscle injury in professional football: A Delphi consensus study. *British Journal of Sports Medicine* 2017;51(16):1221-26. doi: 10.1136/bjsports-2016-097131
13. Lightsey HM, Kantrowitz DE, Swindell HW, et al. Variability of United States Online Rehabilitation Protocols for Proximal Hamstring Tendon Repair. *Orthopaedic Journal of Sports Medicine* 2018;6(2) doi: 10.1177/2325967118755116
14. Hamilton B, Alonso JM, Best TM. Time for a paradigm shift in the classification of muscle injuries. *J Sport Health Sci* 2017;6(3):255-61. doi: 10.1016/j.jshs.2017.04.011 [published Online First: 2018/10/26]
15. Jünger S, Payne SA, Brine J, et al. Guidance on Conducting and REporting DElphi Studies (CREDES) in palliative care: Recommendations based on a methodological systematic review. *Palliat Med* 2017;31(8):684-706. doi: 10.1177/0269216317690685 [published Online First: 2017/02/14]
16. Chang JS, Kayani B, Plastow R, et al. Management of hamstring injuries: current concepts review. *Bone Joint J* 2020;102-B(10):1281-88. doi: 10.1302/0301-620X.102B10.BJJ-2020-1210.R1 [published Online First: 2020/10/01]
17. Hillier-Smith R, Paton B. Outcomes following surgical management of proximal hamstring tendon avulsions. *Bone & Joint Open* 2022;3(5):415-22. doi: 10.1302/2633-1462.35.Bjo-2021-0196.R1
18. Hsu CC, Sandford BA. The Delphi technique: Making sense of consensus. *Practical Assessment, Research and Evaluation* 2007;12(10):1-8.
19. Blazey P, Crossley KM, Ardern CL, et al. It is time for consensus on 'consensus statements'. *British Journal of Sports Medicine* 2022;56(6):306. doi: 10.1136/bjsports-2021-104578
20. de Villiers MR, de Villiers PJT, Kent AP. The Delphi technique in health sciences education research. *Medical Teacher* 2005;27(7):639-43. doi: 10.1080/13611260500069947
21. Eysenbach G. Improving the quality of Web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES). *Journal of medical Internet research* 2004;6(3):e34-e34. doi: 10.2196/jmir.6.3.e34
22. Harper D, Thompson AR. Qualitative Research Methods in Mental Health and Psychotherapy: A Guide for Students and Practitioners2011.
23. Fink A, Kosecoff J, Chassin M, et al. Consensus methods: characteristics and guidelines for use. *American journal of public health* 1984;74(9):979-83. doi: 10.2105/ajph.74.9.979

24. Fuller CW, Ekstrand J, Junge A, et al. Consensus statement on injury definitions and data collection procedures in studies of football (soccer) injuries. *Clinical Journal of Sport Medicine* 2006;16(2):97-106. doi: 10.1097/00042752-200603000-00003
25. Griffin DR, Dickenson EJ, O'Donnell J, et al. The Warwick Agreement on femoroacetabular impingement syndrome (FAI syndrome): An international consensus statement. *British Journal of Sports Medicine* 2016;50(19):1169-76. doi: 10.1136/bjsports-2016-096743
26. Shrier I. Consensus statements that fail to recognise dissent are flawed by design: a narrative review with 10 suggested improvements. *British Journal of Sports Medicine* 2020:bjsports-2020-102545. doi: 10.1136/bjsports-2020-102545
27. Verhagen AP, De Vet HCW, De Bie RA, et al. The Delphi list: A criteria list for quality assessment of randomized clinical trials for conducting systematic reviews developed by Delphi consensus. *Journal of Clinical Epidemiology* 1998;51(12):1235-41. doi: 10.1016/S0895-4356(98)00131-0
28. Huisstede BMA, Hoogvliet P, Henk Coert J, et al. Multidisciplinary consensus guideline for managing trigger finger: Results from the European HANDGUIDE study. *Physical Therapy* 2014;94(10):1421-33. doi: 10.2522/ptj.20130135
29. Kleynen M, Braun SM, Bleijlevens MH, et al. Using a Delphi technique to seek consensus regarding definitions, descriptions and classification of terms related to implicit and explicit forms of motor learning. *PLoS ONE* 2014;9(6) doi: 10.1371/journal.pone.0100227