# Return to sport decisions after an acute lateral ankle sprain injury: introducing the PAASS framework—an international multidisciplinary consensus

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## ABSTRACT

**Background** Despite being the most commonly incurred sports injury with a high recurrence rate, there are no guidelines to inform return to sport (RTS) decisions following acute lateral ankle sprain injuries. We aimed to develop a list of assessment items to address this gap.

**Methods** We used a three-round Delphi survey approach to develop consensus of opinion among 155 globally diverse health professionals working in elite field or court sports. This involved surveys that were structured in question format with both closed-response and open-response options. We asked panellists to indicate their agreement about whether or not assessment items should support the RTS decision after an acute lateral ankle sprain injury. The second and third round surveys included quantitative and qualitative feedback from the previous round. We defined a priori consensus being reached at >70% agree or disagree responses.

**Results** Sixteen assessment items reached consensus to be included in the RTS decision after an acute lateral ankle sprain injury. They were mapped to five domains with 98% panellist agreement—PAASS: Pain (during sport participation and over the last 24 hours), Ankle impairments (range of motion; muscle strength, endurance and power), Athlete perception (perceived ankle confidence/reassurance and stability; psychological readiness), Sensorimotor control (proprioception; dynamic postural control/balance), Sport/functional performance (hopping, jumping and agility; sport-specific drills; ability to complete a full training session).

**Conclusion** Expert opinion indicated that pain severity, ankle impairments, sensorimotor control, athlete perception/readiness and sport/functional performance should be assessed to inform the RTS decision following an acute lateral ankle sprain injury.

**Trial registration number** ACTRN12619000522112.

## INTRODUCTION

Lateral ankle sprains are one of the most common injuries sustained during sport, but they are often perceived to be minor injuries that heal expediently with minimal need for therapeutic intervention.[1–3] More than half of individuals who sustain a lateral ankle sprain injury do not seek formal medical treatment[1–3] and many return to sport (RTS) before injury-associated impairments are resolved.[4] In fact, 71%–75% of US high school athletes were sanctioned to RTS within 3 days of incurring an acute lateral ankle sprain, with 95% sanctioned to RTS within 10 days of injury.[5]

There are currently no criteria-based guidelines to inform RTS decisions following an acute lateral ankle sprain injury. A recent systematic review did not identify any studies that have prospectively evaluated RTS criteria for individuals who have incurred an acute lateral ankle sprain injury.[6] Further, a review of expert opinion identified little consensus on domains, specific assessments or cut-off thresholds to inform RTS decisions following acute lateral ankle sprain injuries.[7] Lack of RTS guidelines and appropriate health care[2 8] may contribute to premature RTS after a lateral ankle sprain injury.[5] We propose that premature RTS may be one factor that contributes to the high prevalence of recurrent ankle problems.[9–11] To inform the development of criteria to guide the RTS decision in individuals who have sustained an acute lateral ankle sprain injury and provide the basis for prospective cohort studies to test the utility of the criteria, we aimed to collate expert opinion using a Delphi survey process—a process that has been previously used to develop other RTS criteria (eg, following hamstring injury[12 13]).

We aimed to develop consensus for assessment items that should inform RTS decisions for individuals who have sustained an acute lateral ankle sprain injury. This is the first step for developing RTS criteria for acute lateral ankle sprain injuries.

## METHODS

We used a three-round Delphi approach to establish consensus of opinion from a panel of experts on assessment items that should be included to inform the RTS decision after an acute lateral ankle



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sprain injury. Items that did not achieve consensus after the third survey round were left undecided. Each Delphi survey round involved: data collection via an online survey platform, analysis of responses and provision of feedback to panellists. We registered the study at the Australian New Zealand Clinical Trials Registry. Trial information was submitted prior to the start of data collection, but it was not approved until data collection had commenced.

## Participants

Eligibility criteria for participants (panellists) were: (1) health and exercise professional (eg, physiotherapist, athletic trainer/therapist, sports medicine physician); (2) working with athletes competing in nationally selected representative teams or teams in Tier/Division 1 national competitions (eg, English Premier League, National Collegiate Athletic Association Division 1, Suncorp Super Netball); (3) working in field or court sports in which acute lateral ankle sprain injuries are among the most prevalent injuries; (4) involved in making RTS decisions for athletes with an acute lateral ankle sprain injury; and (5) proficiency in the English language. The sports targeted for this study included: basketball,[14] volleyball,[15] netball,[16] handball,[17] korfball,[18] soccer,[19] rugby,[20] American/Canadian football,[21] Australian rules football,[16] Gaelic football,[16] lacrosse,[22] field hockey,[16] hurling,[16] camogie,[16] tennis,[23] badminton[23] and squash.[16 23] Health professionals working with Paralympic, Invictus Games or other groups of disabled athletes, or athletes from selective populations (eg, military or World Maccabiah Games) were not eligible to partake in the panel.

While there do not appear to be clear recommendations for the ideal number of panellists in a Delphi survey process,[24] it has been suggested that having more participants is associated with greater reliability and judgement of data.[25] It is recommended that panels be heterogeneous with individuals of different personalities, perspectives and backgrounds, and include those with clinical and scientific expertise in the area of study.[26] To ensure heterogeneous panel recruitment, we targeted individuals from different geographical locations, health professions, research and clinical degrees, and types of sports. Authors identified potential panellists (based on eligibility criteria) from their geographical region and sent invitations to eligible individuals between December 2018 and March 2019. Individuals were given 2 weeks to accept or decline the invitation to participate and were reminded via email after 1 week.

## Online surveys

Data collection consisted of online surveys (online supplemental appendices 1–3) which included closed-response and open-response questions[27] informed by a review of the literature[6] and international expert consensus research on lateral ankle sprain assessment.[28 29] Panellists were asked to indicate '*Yes*', '*No*' or '*Unsure/I do not know*' to a statement such as: '*Do you feel the assessment of ankle range of motion should be a criterion to support the RTS decision after an acute lateral ankle sprain?*'.[12] RTS was defined as '*sanctioned for unrestricted training and cleared/available for match play/competition selection*' and was based on definitions of time loss injury from Fuller *et al*[30] and RTS from Ardern *et al*.[31]

A panellist's opinion to include a RTS assessment item was defined as selection of the '*Yes*' answer option, and an opinion to exclude a RTS assessment item was defined as selection of the '*No*' option. Panellists were asked to provide reasons for their responses in the form of free text. To increase richness of data,[25] surveys included open-response questions (eg, '*Is there anything else you feel should be a criterion to support the RTS decision after an acute lateral ankle sprain?*'). Based on Delphi guidelines, we made an a priori decision that consensus was reached when >70% of respondents either included or excluded an RTS assessment item.[27] Assessment items that reached consensus were removed from the following survey.

Prior to sending the first round survey to panellists, it was piloted on sports physiotherapists involved in making RTS decisions for individuals recovering from an acute lateral ankle sprain injury. This step was undertaken to improve clarity of questions and identify any ambiguities.[32] No changes were required to the survey after pilot testing.

## Procedures

For each of the three Delphi survey rounds, panellists were sent an email invitation with a link to the online survey. They were given approximately 4 weeks to complete the survey, with reminders sent after 1 and 3 weeks. Percentage agreement was calculated and reported to panellists for items that reached consensus after each survey round. For items that did not reach consensus, the percentage of panellists who selected the '*Yes*', '*No*' and '*Unsure/I do not know*' responses and the key reasons for responses, determined by thematic analysis of free text responses,[12] were reported to panellists in the subsequent round. Reasons for responses were also used to rephrase the original question in the final survey round.[12] New RTS assessment items suggested by panellists in the first survey were checked against previously included items and developed into questions for the second survey.

After the second survey, RTS assessment items that had reached consensus were mapped to domains representing separate aspects of RTS. This was provisionally undertaken in a meeting of three authors (MDS, BV, ED) and then presented to the authorship team for consideration and agreement. The domains and mapped RTS assessment items were presented to panellists as part of the third Delphi round. Panellists were asked to indicate if they agreed or did not agree with each of the domains and mapped assessment items.

## Data analysis

Survey data were exported from SurveyMonkey for calculation of achievement of consensus. Level (%) of agreement was calculated for each item. For items that did not reach consensus after the final Delphi survey round, the percentage of panellists who selected each answer option ('*Yes*', '*No*' or '*Unsure/I do not know*') is reported. Content analysis was used to identify themes from open-response questions.[33] Responses were initially read for familiarisation and then re-read for identification of themes. Once themes were identified, data were categorised. Themes and categorisation of data into themes were discussed between three researchers (MDS, ED, BV—one female and two male physiotherapists with 18–41 years of experience) to ensure agreement. This culminated in a thematic summary of explanation of responses and a list of new RTS assessment items which were included in subsequent surveys.

# RESULTS

The three rounds of this Delphi survey occurred from December 2018 to February 2020.

## Participants

Invitations to participate in this study were sent to 250 individuals. Of these invitees, 198 (79.2%) accepted the invitation



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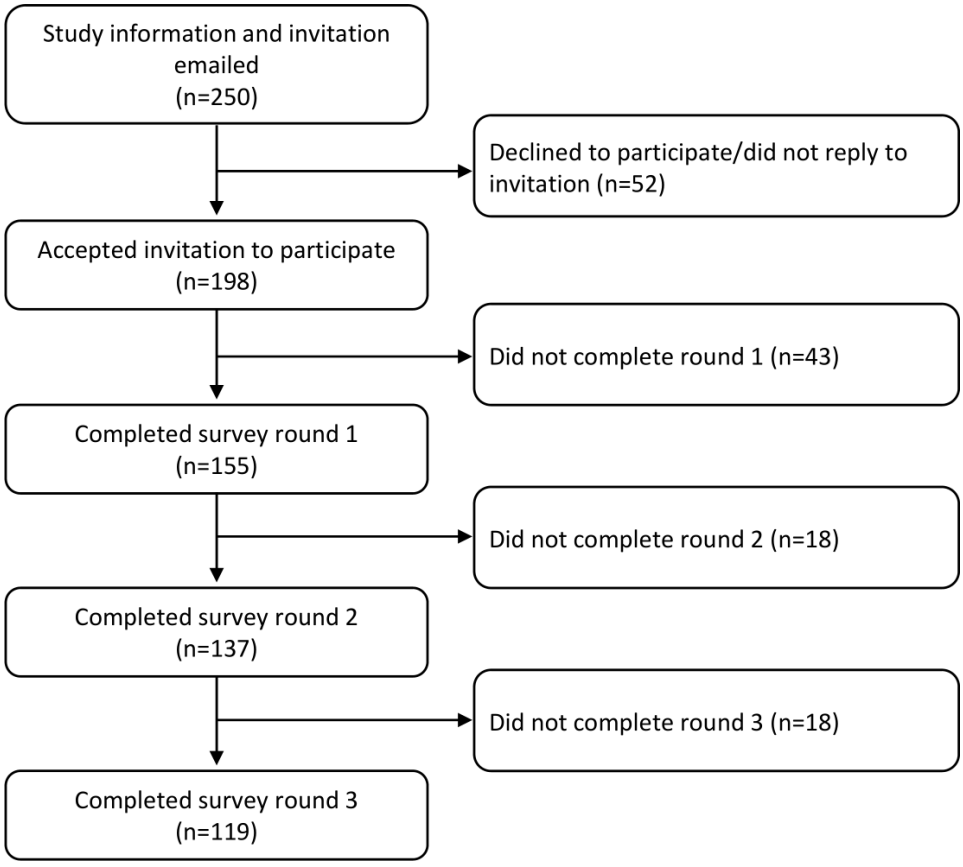



**Figure 1** Participant flow through study.

and were sent the link to the first Delphi survey (figure 1). A total of 155 panellists (78.3%) completed round 1 of the survey, defined as completing the questions on RTS assessment items. Round 2 and round 3 of the survey were completed by 137 and 119 panellists, respectively (88.4% and 76.8% of panellists who completed survey 1). Demographics of panellists who completed survey 1 are presented in table 1. There were minimal differences in age (<2 years), sex (≤1%), profession (≤5%) and sports (≤6%) between panellists who completed the three surveys (online supplemental appendix 4)—implying a similarity in these participant features across all surveys.

### Consensus on assessment items to support the RTS decision

After the three Delphi survey rounds, 16 of the 35 assessment items presented to panellists reached consensus (>70% agreement) to be included in the RTS decision-making process after an acute lateral ankle sprain injury (table 2), and 17 assessment items reached consensus to not be included (table 3). Two assessment items, intra-articular swelling and static postural control/balance, did not reach consensus after the third and final round of the Delphi survey process (table 4).

### Consensus on RTS domains and mapping of assessment items

Based on the agreed-upon RTS assessment items, five domains were created and proposed to the panellists. They were Pain, Ankle impairments, Athlete perception, Sensorimotor control and Sport/functional performance (PAASS); 99% of panellists agreed with these domains. The mapping of assessment items to domains was agreed on by 98% of panellists, with two panellists (2%) not in full agreement (figure 2).

## DISCUSSION

Our international multidisciplinary Delphi survey study developed consensus for assessment items that should and should not be included in the RTS decision-making process for individuals who have sustained an acute lateral ankle sprain injury. Tables 2–4 show the list of items.

### The PAASS framework for RTS decisions

Expert opinion indicated 16 items that should be used to assess pain severity, ankle impairments, sensorimotor control, athlete perception/readiness and sport/functional performance to inform the RTS decision. Assessment items were organised into the PAASS framework (figure 2) based on agreed-upon domains. Overall, assessment items included were those that expert panellists felt directly influenced sport-specific function and/or contributed to risk of injury recurrence. Along with physical tests of sport/functional performance, sensorimotor control and ankle function, the importance of considering the athlete's perception of their ankle (eg, perceived confidence/reassurance and stability) and readiness to RTS were recognised as an essential part of the RTS decision-making process. This confirms the importance of obtaining input from the athlete and shared decision-making in determining RTS ability.[12 13]

### Assessment items not included in the RTS decision

Expert panellists agreed that 17 of the assessment items presented should not be included in the RTS decision after an acute lateral ankle sprain injury. First, items were excluded if they were not considered to influence RTS ability. Assessment of structural integrity of ligaments on imaging, ligamentous laxity and pain



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**Table 1** Demographics of panellists who completed survey 1 (n=155)

| | n (%) |
|---|---|
| Sex, male | 122 (78.7) |
| Age (years)* | 41.3 (8.7) |
| Clinical experience (years)* | 16.1 (7.9) |
| Profession | |
| Physiotherapist | 82 (52.9) |
| Athletic trainer | 28 (18.1) |
| Sports medicine physician | 27 (17.4) |
| Athletic therapist | 7 (4.5) |
| Exercise physiologist/sports scientist | 5 (3.2) |
| Strength and conditioning coach | 4 (2.6) |
| Other | 2 (1.3) |
| Highest education level | |
| Postgraduate | 124 (80.0) |
| Bachelor's degree | 19 (12.3) |
| Certificate/diploma | 8 (5.2) |
| Not stated | 4 (2.6) |
| Sport working in | |
| Soccer/football | 54 (34.8) |
| Basketball | 26 (16.8) |
| Rugby | 25 (16.1) |
| Volleyball | 12 (7.8) |
| American/Canadian football | 10 (6.5) |
| Handball | 6 (3.9) |
| Netball | 5 (3.2) |
| Field hockey | 4 (2.6) |
| Other | 13 (8.4) |
| Country | |
| Australia | 11 (7.1) |
| Belgium | 14 (9.0) |
| Brazil | 11 (7.1) |
| Canada | 7 (4.5) |
| China | 11 (7.1) |
| Denmark | 7 (4.5) |
| France | 6 (3.9) |
| Ireland | 5 (3.2) |
| Italy | 9 (5.8) |
| Japan | 4 (2.6) |
| New Zealand | 7 (4.5) |
| Nigeria | 1 (0.6) |
| Norway | 10 (6.5) |
| Qatar | 2 (1.3) |
| South Korea | 10 (6.5) |
| Switzerland | 6 (3.9) |
| The Netherlands | 8 (5.2) |
| UK | 10 (6.5) |
| USA | 16 (10.3) |

Data are presented as number (n) and percentage (%) unless otherwise stated.
*Data are presented as mean (SD).

severity on palpation, which may be important for injury diagnosis,[29] were excluded from the RTS decision-making process as they were thought to resolve in parallel with functional gains and not to be linked to sport-specific function. Similarly, panellists felt that foot mechanics and lower limb/trunk kinematics would not influence the RTS decision-making process. Second, experts felt that general measures of patient-reported foot and ankle function (eg, health-related quality of life, Foot and Ankle Ability Measure[34] or Foot and Ankle Outcome Score[35]) were not sufficiently sensitive to assess RTS requirements. Thus, it was felt that the athletes' opinion on their ability to RTS was captured through the assessment of perceived ankle stability, ankle reassurance/confidence and psychological readiness. Third, the perceived relatively quick RTS,[5] progression of ability and resolution of impairments after an acute lateral ankle sprain led to the exclusion of items that were assessed over longer timeframes (eg, pain severity over the last week) and those with deficits associated with time away from sport and exercise (eg, aerobic and anaerobic fitness). While evidence suggests loss of fitness occurs

**Table 2** Consensus on assessment items that should be included in the return to sport decision after an acute lateral ankle sprain, indicating the round of inclusion and level of agreement

| Assessment item to be included | Round (1–3) | Agreement (%) |
|---|---|---|
| Sport-specific activities | 1 | 98 |
| Pain severity during sport participation | 1 | 93 |
| Ankle range of motion | 1 | 90 |
| Ankle muscle strength | 1 | 87 |
| Hopping | 1 | 87 |
| Agility | 1 | 87 |
| Completion of a full training session | 3 | 87 |
| Jumping | 1 | 84 |
| Pain severity over the last 24 hours | 1 | 81 |
| Perceived ankle reassurance/confidence | 1 | 81 |
| Proprioception | 1 | 74 |
| Perceived ankle stability | 1 | 74 |
| Psychological readiness | 1 | 74 |
| Ankle muscle endurance | 1 | 73 |
| Dynamic postural control/balance | 1 | 73 |
| Ankle (and lower limb) muscle power* | 2 | 72 |

*Lower limb muscle power and ankle muscle power were initially presented to panellists as separate items, but 96% of panellists agreed that these items would be assessed together.

**Table 3** Consensus on assessment items that should not be included in the return to sport decision after an acute lateral ankle sprain, indicating the round of exclusion and level of agreement

| Assessment item not to be included | Round (1–3) | Agreement (%) |
|---|---|---|
| Structural integrity of the ligaments on imaging | 2 | 89 |
| Pain severity over the last week | 3 | 88 |
| Pain severity on palpation | 3 | 88 |
| Health-related quality of life | 2 | 85 |
| Hip and knee muscle endurance | 3 | 85 |
| Ankle muscle length | 3 | 85 |
| The Functional Movement Screen | 2 | 84 |
| Aerobic fitness | 3 | 84 |
| Anaerobic fitness | 3 | 82 |
| Ligamentous laxity | 2 | 81 |
| Ankle joint arthrokinematics | 3 | 78 |
| Ankle muscle reaction time | 3 | 76 |
| Acute:chronic workload | 3 | 76 |
| Lower limb and/or trunk kinematics | 2 | 75 |
| Hip and knee muscle strength | 3 | 74 |
| Foot biomechanics | 2 | 74 |
| Straight-line running speed | 3 | 72 |
| Patient-reported foot and ankle function (using questionnaires such as the Foot and Ankle Ability Measure[34] or Foot and Ankle Outcome Score[35]) | 3 | 70 |



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Table 4 Level (%) of agreement for assessment items that did not reach consensus after the third and final round of the Delphi survey process

| Assessment item that did not reach consensus | Included (%) | Not included (%) | Unsure (%) |
|---|---|---|---|
| Intra-articular swelling | 67 | 26 | 7 |
| Static postural control/balance | 48 | 48 | 4 |

after 2 weeks of detraining,[36] panellists indicated that subtle deficits in aerobic or anaerobic fitness or a suboptimal acute:chronic workload would not stop clearance of an athlete for RTS after an acute lateral ankle sprain. Fourth, items were excluded if it was thought that limitations would be captured with other assessment items included in the PAASS framework. Experts felt that meaningful deficits in ankle muscle length and ankle joint arthrokinematics would be identified when assessing ankle range of motion, and similarly hip and knee muscle strength/endurance deficits would be identified during hopping, jumping and sport-specific tests. They felt that straight-line running would be included within the assessment of sport-specific activities (when required by the sport). Panellists also indicated that it was not required, or possible, to clinically assess ankle muscle reaction time separately from dynamic balance and agility.

## Assessment items that did not reach consensus

Of the 35 items presented to panellists in this study, only two items did not reach inclusion or exclusion consensus: intra-articular swelling and static postural control/balance. Key reasons provided by panellists for the inclusion of intra-articular swelling were that swelling can impair muscle, joint, proprioceptive and sport-specific function, and intra-articular swelling is an indication of joint/cartilage damage that may affect long-term joint health. Panellists who indicated that intra-articular swelling should not be included felt that intra-articular swelling is not related to pain or dysfunction, and it is not reasonable to delay RTS based on the presence of swelling, as long as function is restored and impairments have resolved. Close to equal numbers of panellists voted for the inclusion and exclusion of static postural control/balance in the RTS decision. Panellists who thought static postural control/balance should be included felt that it was an important part of understanding function and ability. The following reasons were provided by panellists who indicated that static postural control/balance should not be included in the RTS decision-making process: it is superseded by dynamic postural control/balance when determining ability to RTS, and assessing dynamic postural control/balance provides the necessary information to determine RTS.

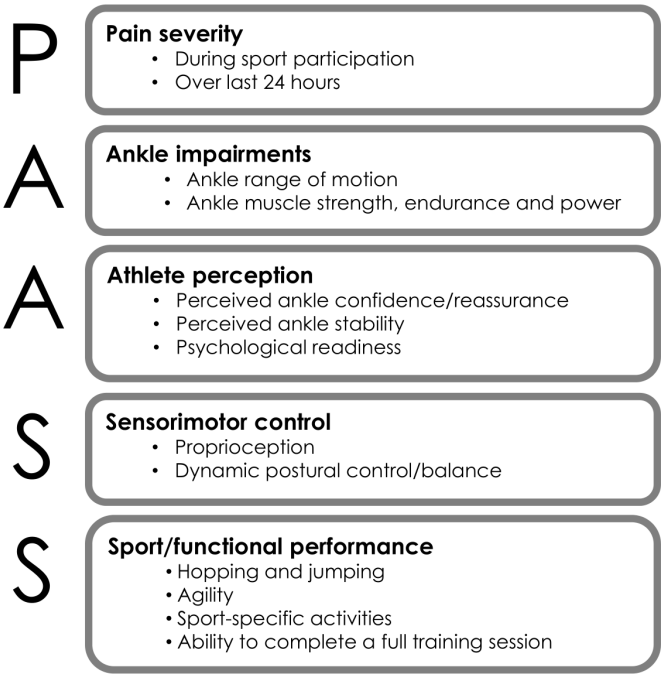



Figure 2 Return to sport domains (PAASS) and mapping of the agreed-upon return to sport items to domains (in nominal ordered list). Ability to complete a full training session reached consensus in round 3 and was not presented to panellists for their agreement on mapping. This placement was agreed on by the author group. Panellists agreed that ankle muscle strength would be assessed using tests of total lower limb muscle strength.

## RTS compared with initial assessment items

There are some commonalities between assessment items in the PAASS RTS assessment framework and impairments suggested to be important to include in the initial assessment of acute lateral ankle sprain injuries.[29] Assessment of pain, ankle joint range of motion, ankle muscle strength and dynamic balance were identified as important to include in both the RTS decision-making process and initial injury assessment. Swelling, ankle joint arthrokinematics, static postural balance, gait, physical activity level and patient-reported foot and ankle function were recommended to be assessed after an acute lateral ankle sprain injury but did not reach consensus for inclusion in the RTS decision-making process. The lack of inclusion of these items in the RTS decision-making process was due to the progressive resolution of deficits and changing focus of management through the rehabilitation continuum, and the specificity of determining RTS ability rather than daily function.

## Study strengths and limitations

Our study included diverse geographical, sporting and professional representation. The 155 panellists were from 19 countries, 6 professions and 15 sports, and had a wealth and diversity of clinical experience. This enhances the generalisability of the data obtained and facilitates the utility of the PAASS RTS assessment framework globally. The number of panellists and geographical representation exceeds that of recent consensus statements.[12 13 29 37 38] Similar to other consensus papers on RTS criteria[13] and management of musculoskeletal/sporting injuries,[37 38] the majority of panellists were physiotherapists. The inclusion of panellists working in a range of different sports provides a list of assessment items that can be used generically across different sports. However, there may be items specific to individual sports that were not identified in this study. The panellists in this study were all health and exercise professionals, and we did not include athletes to gain their perspective. This is an important consideration for future research.

While consensus was obtained on assessment items that should be used to inform the RTS decision, we did not investigate specific tests for the agreed-upon assessment items. For



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example, we did not ask experts to nominate the test(s) they would use to assess an athlete's dynamic postural control/balance or pain severity. Thus, while this study provides clinicians with items to assess, it does not specify how clinicians should assess these items. Further, there are no data on cut-off points for measures that indicate if an athlete should or should not RTS. For example, we do not know what deficit in perceived stability is acceptable to sanction an athlete as being ready to RTS. These are important future research directions[7] and we encourage researchers to hypothesise and test thresholds for assessment items in the PAASS RTS assessment framework. We aimed to obtain consensus on assessment items to inform an athlete's ability to RTS, defined as '*sanctioned for unrestricted training and cleared/available for match play/competition selection*' but not return to performance.[31] Panellists may include different outcomes to assess whether or not an athlete is performing at or above their preinjury level.[31]

### Clinical application of findings

The PAASS framework proposed in this study provides clinicians and researchers with expert-recommended assessment items that can be used to inform RTS decisions after an acute lateral ankle sprain injury. Clinicians can use this framework to enhance clinical decision-making when identifying impairments and determining an athlete's ability to RTS. There are a range of clinical tests that can be used to assess each item, such as a numerical rating scale to measure pain severity, ankle stability and ankle confidence/reassurance,[39] or the T-test,[40] 505 Test[41] or V Reactive Agility Test[41] to measure agility. We appreciate that RTS decision-making is multifactorial and context specific. Researchers and clinicians should respect the complexity and temporal nature of the assessment items within the PAASS framework. As outlined in the Strategic Assessment of Risk and Risk Tolerance framework, the PAASS items must be considered in context with the other elements of tissue health (eg, age and injury recurrence) and tissue stresses (eg, type of sport and ability to protect the tissues), and risk tolerance modifiers (eg, timing in season).[42]

## Key messages

**What are the findings?**

- Five domains covering 16 assessment items constitute the PAASS framework developed by international experts from a wide range of sports that have a high prevalence of ankle sprains.
- The PAASS framework is: Pain (during sports participation and over the last 24 hours), Ankle impairments (range of motion; muscle strength, endurance and power), Athlete perception (perceived ankle confidence/reassurance and stability; psychological readiness), Sensorimotor control (proprioception; dynamic postural control/balance), Sport/functional performance (hopping, jumping and agility; sport-specific activities; ability to complete a full training session).

**How might it impact on clinical practice in the future?**

- The PAASS framework provides clear clinician consensus-driven direction of what is important and what is not important when making decisions for return to sport (RTS) after an acute lateral ankle sprain injury.
- Pain, ankle impairments, athlete perception, sensorimotor control and sport/functional performance are domains that are advised to be assessed in deciding RTS after an acute lateral ankle sprain.

## CONCLUSION

This international interprofessional Delphi survey study recommends that health professionals should assess pain severity, ankle impairments, athlete perception, sensorimotor control and sport/functional performance to determine an athlete's ability to RTS after an acute lateral ankle sprain injury.

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## REFERENCES

1 Delahunt E, Gribble PA. Structured clinical assessment: a brake to stop the ankle joint 'rolling'. *Br J Sports Med* 2018;52:1294.
2 Gribble PA, Bleakley CM, Caulfield BM, *et al*. 2016 consensus statement of the International ankle Consortium: prevalence, impact and long-term consequences of lateral ankle sprains. *Br J Sports Med* 2016;50:1493–5.
3 McKay GD, Goldie PA, Payne WR, *et al*. Ankle injuries in basketball: injury rate and risk factors. *Br J Sports Med* 2001;35:103–8.
4 McCann R, Kosik K, Terada M, *et al*. Residual impairments and activity limitations at return to play from a lateral ankle sprain. *International Journal of Athletic Therapy and Training* 2018;23:83–8.
5 Medina McKeon JM, Bush HM, Reed A, *et al*. Return-to-play probabilities following new versus recurrent ankle sprains in high school athletes. *J Sci Med Sport* 2014;17:23–8.
6 Tassignon B, Verschueren J, Delahunt E, *et al*. Criteria-Based return to sport decision-making following lateral ankle sprain injury: a systematic review and narrative synthesis. *Sports Med* 2019;49:601–19.
7 Wikstrom EA, Mueller C, Cain MS. Lack of consensus on Return-to-Sport criteria following lateral ankle sprain: a systematic review of expert opinions. *J Sport Rehabil* 2019;29:231–7.
8 Gribble PA, Bleakley CM, Caulfield BM, *et al*. Evidence review for the 2016 international ankle Consortium consensus statement on the prevalence, impact and long-term consequences of lateral ankle sprains. *Br J Sports Med* 2016;50:1496–505.
9 Konradsen L, Bech L, Ehrenbjerg M, *et al*. Seven years follow-up after ankle inversion trauma. *Scand J Med Sci Sports* 2002;12:129–35.
10 Anandacoomarasamy A, Barnsley L. Long term outcomes of inversion ankle injuries. *Br J Sports Med* 2005;39:e14.
11 Doherty C, Bleakley C, Hertel J, *et al*. Recovery from a first-time lateral ankle sprain and the predictors of chronic ankle instability: a prospective cohort analysis. *Am J Sports Med* 2016;44:995–1003.
12 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. *Br J Sports Med* 2017;51:1583–91.
13 Zambaldi M, Beasley I, Rushton A. Return to play criteria after hamstring muscle injury in professional football: a Delphi consensus study. *Br J Sports Med* 2017;51:1221–6.
14 McCarthy MM, Voos JE, Nguyen JT, *et al*. Injury profile in elite female basketball athletes at the women's national Basketball association combine. *Am J Sports Med* 2013;41:645–51.
15 Kilic O, Maas M, Verhagen E, *et al*. Incidence, aetiology and prevention of musculoskeletal injuries in volleyball: a systematic review of the literature. *Eur J Sport Sci* 2017;17:765–93.
16 Fong DT-P, Hong Y, Chan L-K, *et al*. A systematic review on ankle injury and ankle sprain in sports. *Sports Med* 2007;37:73–94.
17 Bere T, Alonso J-M, Wangensteen A, *et al*. Injury and illness surveillance during the 24th men's Handball world Championship 2015 in Qatar. *Br J Sports Med* 2015;49:1151–6.
18 Backx FJ, Beijer HJ, Bol E, *et al*. Injuries in high-risk persons and high-risk sports. A longitudinal study of 1818 school children. *Am J Sports Med* 1991;19:124–30.
19 Shalaj I, Tishukaj F, Bachl N, *et al*. Injuries in professional male football players in Kosovo: a descriptive epidemiological study. *BMC Musculoskelet Disord* 2016;17:338.
20 Fuller CW, Taylor A, Raftery M. Eight-season epidemiological study of injuries in men's international Under-20 rugby tournaments. *J Sports Sci* 2018;36:1776–83.
21 Mulcahey MK, Bernhardson AS, Murphy CP, *et al*. The epidemiology of ankle injuries identified at the National football League combine, 2009-2015. *Orthop J Sports Med* 2018;6:232596711878622.
22 Putukian M, Lincoln AE, Crisco JJ. Sports-specific issues in men's and women's LaCrosse. *Curr Sports Med Rep* 2014;13:334–40.
23 Chevinsky JD, Newman JM, Shah NV, *et al*. Trends and epidemiology of Tennis-Related Sprains/Strains in the United States, 2010 to 2016. *Surg Technol Int* 2017;31:333–8.
24 Hsu CC, Sandford BA. The Delphi technique: making sense of consensus. *Practical Assessment, Research & Evaluation* 2007;12:1–8.
25 Murphy MK, Black NA, Lamping DL, *et al*. Consensus development methods, and their use in clinical Guideline development. *Health Technol Assess* 1998;2:1–88.
26 Powell C. The Delphi technique: myths and realities. *J Adv Nurs* 2003;41:376–82.
27 Diamond IR, Grant RC, Feldman BM, *et al*. Defining consensus: a systematic review recommends methodologic criteria for reporting of Delphi studies. *J Clin Epidemiol* 2014;67:401–9.
28 Bossard DS, Remus A, Doherty C, *et al*. Developing consensus on clinical assessment of acute lateral ankle sprain injuries: protocol for an international and multidisciplinary modified Delphi process. *Br J Sports Med* 2018;52:1539.
29 Delahunt E, Bleakley CM, Bossard DS, *et al*. Clinical assessment of acute lateral ankle sprain injuries (roast): 2019 consensus statement and recommendations of the International ankle Consortium. *Br J Sports Med* 2018;52:1304–10.
30 Fuller CW, Ekstrand J, Junge A, *et al*. Consensus statement on injury definitions and data collection procedures in studies of football (soccer) injuries. *Br J Sports Med* 2006;40:193–201.
31 Ardern CL, Glasgow P, Schneiders A, *et al*. 2016 consensus statement on return to sport from the first world Congress in sports physical therapy, Bern. *Br J Sports Med* 2016;50:853–64.
32 Jairath N, Weinstein J. The Delphi methodology (Part one): a useful administrative approach. *Can J Nurs Adm* 1994;7:29–42.
33 Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol* 2006;3:77–101.
34 Martin RL, Irrgang JJ, Burdett RG, *et al*. Evidence of validity for the foot and ankle ability measure (FAAM). *Foot Ankle Int* 2005;26:968–83.
35 Martin RL, Burdett RG, Irrgang JJ. Development of the foot and ankle disability index (FADI). *J Orthop Sports Phys Ther* 1999;29:A32–3.
36 Joo CH. The effects of short term detraining and retraining on physical fitness in elite soccer players. *PLoS One* 2018;13:e0196212.
37 Reiman MP, Agricola R, Kemp JL, *et al*. Consensus recommendations on the classification, definition and diagnostic criteria of hip-related pain in young and middle-aged active adults from the International Hip-related pain research network, Zurich 2018. *Br J Sports Med* 2020;54:631–41.
38 Vicenzino B, de Vos R-J, Alfredson H, *et al*. Icon 2019-International scientific tendinopathy symposium consensus: there are nine core health-related domains for tendinopathy (core domains): Delphi study of healthcare professionals and patients. *Br J Sports Med* 2020;54:444–51.
39 Sawkins K, Refshauge K, Kilbreath S, *et al*. The placebo effect of ankle taping in ankle instability. *Med Sci Sports Exerc* 2007;39:781–7.
40 Semenick D. The t-test. *National Strength & Conditioning Association Journal* 1990;12:36–7.
41 Gabbett TJ, Kelly JN, Sheppard JM. Speed, change of direction speed, and reactive agility of rugby League players. *J Strength Cond Res* 2008;22:174–81.
42 Shrier I. Strategic assessment of risk and risk tolerance (StARRT) framework for return-to-play decision-making. *Br J Sports Med* 2015;49:1311–5.

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