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TITLE: Development of a Rugby Shoulder Function (RSF) Questionnaire: An online Delphi study.

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Title: Development of a Rugby Shoulder Function (RSF) Questionnaire: An online Delphi study.

Abstract

Objective: Develop a questionnaire to monitor symptoms of player perceived shoulder function/dysfunction.

Design: 3-Stage Online Delphi Study.

Methods: Participants: surgeons, sports and exercise medics, academic researchers, strength and conditioning coaches, therapists and athletes split by level of expertise/experience. Stage-1: experts (n=12) rated constructs/items from the steering group and made changes/proposed additional constructs/items. Stage-2: experts rated/amended new constructs/items from stage-1. Stage-3: experienced professionals (n=25) rated/ranked constructs/items from stage 2. Consensus thresholds were defined per stage ($\geq 50\%$ agreement / 4-5 rating on 1-5 Likert scale (stages 1-2), $\geq 68\%$ agreement, and items ranked for perceived importance (stage-3)).

Results: Stage-1, all four constructs (a. activities of daily living, b. range of motion, c. strength and conditioning, d. sports specific training and competition) and 26/42 original items achieved consensus. Twelve items were combined into five items. Four new items were also proposed. Stage-2, the combined items and three of the four new items achieved consensus. Stage-3 the four constructs and 22 items all achieved consensus.

Conclusions: Following a 3-stage online Delphi process, involving expert and experienced clinicians, practitioners and athletes, a new four construct, 22 item RSF questionnaire has been developed which can be used with rugby players, to monitor perceived shoulder performance and symptoms.

Keywords: Epidemiology, Sports Medicine, Athletic Injury, Shoulder, Contact Sport, Rugby

Highlights

- The RSF questionnaire may be used to monitor periodic shoulder health.
- The RSF questionnaire may help detect those athletes with variable shoulder function
- The RSF questionnaire provides information in four areas of perceived shoulder function
- The RSF questionnaire may be used to facilitate time sensitive interventions

Introduction

Understanding the prevalence of injuries in sport, forms the cornerstone of preventative medicine.¹ This longstanding concept becomes complex when reviewing the potential recursive nature of the injury process.² Musculoskeletal dysfunctions / complaints do not always result in the inability to train or play (e.g., a time-loss injury)³ and athletes may not present for treatment or assessment (e.g., a medical attention injury), thus the true number of injuries and sub-clinical dysfunctions may be underestimated.⁴ Comprehensive periodic health evaluation of an athlete may assist in detecting developing pathology (all complaints evaluation) but this is reliant on having a single or battery of tests that will give a true predictive assessment of the propensity for injury.⁵

Athletes with sub-clinical lower limb complaints have been shown to have a greater propensity to result in a time loss injury.⁶ The point at which these complaints start to impact perceived performance is when athletes refer to themselves as injured.⁷ Performance monitoring and early recognition of sub clinical complaints is therefore key to understanding functional changes in the early stages of time loss injuries and non-time loss complaints.

The incidence of shoulder time loss injury in different rugby competitions (4.5-12.7/1000h)^{8,9,10,11} and resultant burden (33-136 days)^{8,11} are consistently ranked within the top four most frequent body regions or specific injuries recorded in a range of different epidemiology studies.^{8,9,10,11} These statistics warrant further research to help understand the relationship between sub clinical shoulder complaints and time loss injuries. The shoulder complex includes a series of joints that are used through the largest range of motion, under considerable load from rotation, translational, compressive and distraction forces during contact sports.¹² The shoulder needs to have a high degree of function on return to play and

tolerate the forces exerted during high frequency events such as tackling.¹³ Structural integrity and dynamic coordination are therefore key for sports performance.^{12,14}

Modifications to the Oslo sport trauma research centre questionnaire using expert consensus³ have sought to provide a greater focus on overuse injuries under four self-reported 4-point Likert domains, but as a non-sports specific tool, this lacks specificity compared to tools designed for a particular sport. The Rugby Shoulder Score (RSS)¹⁵ is a single self-reported construct, specific to rugby, using 20, 7-point Likert questions. Whilst useful, it requires further validation to be used with 'uninjured athletes' who may have sub clinical complaints but continue to play, due to the original study being validated on athletes with chronic and or stable time loss shoulder injuries.¹⁶ Minimal clinically important difference (MCID) and minimal detectable change (MDC) in RSS scores are also required to allow medical teams to relate changes in RSS score. Long established shoulder specific¹⁷ or upper limb outcome measures^{18,19,20} have the benefit of established MCID and or MDC data, but often developed from the general not sporting population. These existing tools and questionnaires^{3,15,17,18,19, 20} were designed to be used with injured or non-sporting populations. The items and constructs used in these tools were chosen for suitability for the injured or non-sporting population. Further validation of these tools with the uninjured population of rugby players would remain a limitation in design. A categorised self-reported questionnaire, which captures perceived shoulder function in both the time loss injured and uninjured athletes, is therefore required to assist in the serial monitoring of self-reported athletic shoulder function.^{8,16,21}

The aim of this study was to use expert consensus groups (Delphi study) to develop a new rugby shoulder function questionnaire (RSF) to monitor reported signs and symptoms of shoulder function in athletes involved in rugby.

Methods and Materials

Study Design

This study followed recommended guidance for undertaking Delphi studies^{22,23,24}. An anonymous online Delphi study was conducted under three stages with two groups of participants and a steering group (Table 1), using an online survey tool (Qualtrics^{XM} 2020). Two different participant groups²⁵ were defined using a range of metrics (Table 1) to delineate the highest level of expertise (Expert Group), who would add items and constructs in the early stages of the study, and those with defined expertise (Experienced Group) to increase the face validity of the tool for the end user. Given the breadth of professions included in the groups,²² two different thresholds levels of consensus were utilised.²⁵ During Stage 1 and 2 a $\geq 50\%$ consensus was used to allow more items / constructs to be retained for Stage 3 where a higher threshold was used ($\geq 68\%$) with a larger group size. Questions during Stage 1 and 2 were a mixture of binary (agree / disagree) and Likert 1-5. Likert responses of 4 or 5 were classed as agreement.

The aim of the study was to achieve consensus opinion ($\geq 68\%$)^{22,25} of constructs and items which were initially proposed by a steering group, to create the RSF questionnaire. The steering group proposed four constructs, and 42 items between all constructs to monitor changes in performance and lifestyle. In Stage 1, the *expert* group (Table 1) were provided with constructs and asked to agree, disagree, add or amend. The *expert* group were also provided with items and asked to rate (1 – 5 Likert scale, add or amend) to determine which constructs and items achieved consensus ($\geq 50\%$; agree / 4 – 5 rating). In Stage 2, the *expert* group reviewed any new constructs and items (1 – 5 Likert scale) and approved any modification to constructs and items ($\geq 50\%$; agree or disagree). Constructs and items which achieved consensus in Stage 1 or 2, were then reviewed by an *experienced* group of participants (Stage 3) to establish face validity. The *experienced* group of participants (Table 1) agreed or disagreed the constructs and items to an enhanced threshold ($\geq 68\%$ agreement)

and ranked the items within the constructs based on their importance for negatively impacting perceived performance and lifestyle (Figure 1). Constructs and items which achieved consensus through Stages 1 – 3 are presented in rank order, as the RSF questionnaire (Figure 2). Ethics approval was obtained through Leeds Beckett University.

Steering Group

The steering group consisted of three United Kingdom based academic researchers (Table 1), with expertise in the field of elite rugby and other contact sports, led by the chair (RP). The steering group, based on their professional and research experience, proposed four constructs which identified a perceived negative change in performance and lifestyle, due to shoulder dysfunction. Items were then proposed within each construct (n=42), from previous similar questionnaires^{3,15,17,18,19,20} or based on their professional and research experience. The analysis and feedback at each stage was conducted by the chair.

Participants

Thirty-six *expert* professionals and athletes from the United Kingdom, Ireland and mainland Europe, were invited via email and direct messaging, to participate as the *expert* group in Stages 1 and 2. Eighteen participants did not respond and a further six were excluded due to not meeting the *expert* criteria, creating a group of twelve *experts*. Thirty-six *experienced* professionals from the United Kingdom, Ireland and mainland Europe, were invited via email and direct messaging (including six participants excluded from the *expert* group), to participate in Stage 3. Ten participants did not respond, and one was excluded due to not meeting the *experienced* criteria, creating a group of 25 *experienced* professionals. The *expert* and *experienced* groups were purposefully recruited based on their professional experience within elite rugby and other contact sports or relevant scientific publications, to include the following professions: orthopaedic surgeons, sports and exercise medicine (SEM) doctors, therapists (physiotherapists, physical therapists, athletic trainers, sport rehabilitators or sports therapists) strength and conditioning coaches, academic researchers and professional athletes. Snowball sampling of potential participants was permitted, within the defined expert or experience

criteria (Table1). The *expert* group (n=12) participated in Stages 1 and 2 based on their level of expertise in the field, to establish the initial structure of the Delphi to ensure content validity at $\geq 50\%$ threshold of consensus.²⁶ The larger *experienced* group (n=25) participated in Stage 3, and reviewed the constructs and items to ensure face validity, using an enhanced consensus threshold ($\geq 68\%$).²⁶ The response rate of the *expert* and *experienced* group meeting the inclusion criteria in all stages of the study was 100% (Figure 1).

Constructs and Items

The four constructs included a) activities of daily living, b) range of motion, c) athlete conditioning, and d) match play and skills training. Items within the activities of daily living (ADL) construct, included typical personal, social and non-sporting activities. Items within the range of motion construct, included active movements performed by the athlete in typical single or combined planes of motion. Items within the athlete conditioning construct, included familiar body weight, free weights and combat tasks that were not replicating a specific tactical skills session. Items within the match play and skills training constructs, included common upper limb specific contact statements with opponents and the ground as well as throwing and passing related skills that could be in a training or competition environment.

Delphi process

Participants were sent an online survey for Stages 1-3 using the Qualtrics^{XM} (2020) system with replies anonymous. Each stage lasted four weeks and automatic reminders were sent at two weeks and 48-hours prior to the four-week deadline for participants who had not completed the survey (Figure 1). At Stage 1 and 2, 28/42 statements were supplemented with images to assist interpretation. Each construct was presented with a binary agree disagree question and each item was presented on a 5-point Likert scale with the descriptors 'not important' (1 point) to 'extremely important' (5 points). *Experts* were given the option to abstain from answering a question if the statement fell outside of their scope of expertise, but this did

not happen. During Stage 1 participants could suggest new constructs, items or alterations to any wording from the initial list presented by the steering group, to increase breadth of knowledge and experience used in the early stages of the Delphi study. Any changes were presented verbatim to the expert group in Stage 2 to establish consensus agreement ($\geq 50\%$). *Experienced* group participants in Stage 3 were asked to agree / disagree with proposed constructs and items from Stage 2, and rank items in order of perceived importance of their impact to negatively impact performance and shoulder function.

In the absence of agreed consensus thresholds in Delphi studies,²⁷ consensus threshold is recommended to be tailored to the sample demographics and the number of stages/rounds.²² Number of rounds of surveys is determined by the point at which no further changes are required.²² Consensus agreement was set at $\geq 50\%$ for Stages 1 and 2 to acknowledge the high level yet diverse expertise of the expert group during these stages. With the larger group of *Experienced* professionals during Stage 3 a $\geq 68\%$ threshold for consensus was applied, based on the process already undertaken in Stages 1 and 2.^{22,25,27} In Stages 1 and 2, constructs were evaluated using binary ratings, which required ≥ 6 experts ($\geq 50\%$) to agree to reach consensus. In Stages 1 and 2, items were evaluated using a 5-point Likert scale, requiring ≥ 6 experts ($\geq 50\%$) to rate items as 4 or 5 to reach consensus. In Stage 3, only binary ratings were used, with ≥ 17 *experienced* professionals having to agree ($\geq 68\%$) to reach consensus.

Data analysis

Percentage agreements were calculated for each construct and items at each Stage of the Delphi study using SPSS® version 28 (IBM®). Rank order of items in Stage 3 was calculated by adding up the scores allocated to each item by the *experienced* group, where a score of 1 represented the most important item in the construct. The lowest mean score represented the highest importance placed on the item.

Results

Constructs

Consensus was achieved for the four constructs ($\geq 68\%$ - 100% actual agreement) (Table 2). The four agreed constructs after Stage 2 were: a) activities of daily living, b) range of motion, c) strength and conditioning (modified from 'athlete conditioning' originally proposed by the steering group), d) sports specific training and competition (modified from proposed 'match play and skills training' originally proposed by the steering group). Constructs also achieved consensus during Stage 3 ($\geq 68\%$ - 100% actual agreement).

Items

During Stage 1, there were 26 of the original 42 items that achieved consensus (Table 2). Twelve of the 26 items were suggested to be combined. In the sports specific training and competition construct, items 1 and 2 were combined to create a general throwing item. Item 3-5 were combined to create a general landing on the upper limb item. Items 6-8 were combined to create a pulling, pushing, traction force item and item 10 and 11 combined to create a shoulder contact item. In the range of motion construct, items 2 and 3 were combined to create an overhead rotation item. Four additional items were proposed, two in the sport specific training and competition construct: 1. weight bearing through one arm in a tripod / poach / present a ball position (item 12), 2. grab / straight arm tackle (item 13). The other two additional items were in the ADL construct: 3. pain in the shoulder when relaxing (Item 8), 4. ability to carry or play with children (item 9).

During Stage 2, three of the new items ($n = 4$) achieved consensus with only 'ability to carry or play with children' (item 9) failing to achieve consensus. In total, 22 items achieved consensus and were presented in Stage 3.

During Stage 3, all 22 items achieved 100% consensus, creating the RSF questionnaire (Figure 2).

Discussion

The aim of this study was to develop a new questionnaire for monitoring and evaluating perceived shoulder function/dysfunction in contact sport athletes. This Delphi study involved 12 experts, 25 experienced professionals and a three-person steering group, based on consensus agreement achieved through the study. A four construct 22 item RSF questionnaire was developed which can be used by athletes to independently monitor perceived shoulder function or form part of existing periodic shoulder health screening.

Constructs

Shoulder function is multi-faceted whereby overall function can be impacted by changes in multiple sub constructs of the overall function. The four constructs relating to perceived shoulder function were unanimously agreed with only minor wording amendments and no additional constructs suggested by the expert group. Given the breadth of expertise recruited this provides a high level of content and face validity to the RSF questionnaire.²⁶ The RSS¹⁵ is the most comparable questionnaire tool but has only one construct specific to rugby and developed for those with injury. The design of the RSF questionnaire, to include use with the uninjured population, means that items and constructs have been considered for inclusion that may not have been considered in the RSS and other tools during their design process. The RSF questionnaire has four constructs akin to other scoring systems^{3,20} with the specificity to shoulder motion, strength and conditioning, rugby training / matches and ADL's. Some multi construct upper limb outcome measures report a composite score with overall MCID and MDC.²⁰ The RSF questionnaire has the potential to be used with individual construct scores

as well as composite score. Level of MCID and MDC will need to be calculated during further validation study of the psychometric properties of the RSF questionnaire.

Items

Item wording was evaluated at each stage, with minor adjustments made to provide greater clarity for the intended users. The multi-disciplinary nature of the *expert* and *experienced* groups, with the inclusion of athletes, enhances the usability of the final RSF questionnaire^{22,23,24}. The content validity for each item was evaluated using a Likert scale²⁶ and required $\geq 50\%$ agreement from the *expert* group in Stages 1 and 2 and $\geq 68\%$ agreement from the *experienced* group in Stage 3. Various agreement thresholds have been used in previous studies^{22,25} and seek to achieve the fine balance of retaining enough items, which have an appropriate level of validity.^{26,28} Retaining items with a high level of similarity can lead to overrepresentation from one problem. Experts identified during Stage 1, where similar items were proposed by the steering group in the sport specific skills and training construct. Different landing positions on an arm are reported to influence different types of injury patterns.²⁹ These positions were replicated in the original item list (Item 3-5 Table 2) but were felt to be too similar, and therefore an overrepresentation from this type of dysfunction. This was also the same for throwing actions (items 1-2) pulling/pushing actions (items 6-8) and force/contact tolerance (items-10-11) in the same construct, which were subsequently merged. It is acknowledged that these merged skills and movements place different biomechanical stresses on the shoulder and are considered when trying to establish a pathology-based diagnosis by a clinician.²⁹ Experts also recommended during stage 1 to combine items 2 and 3 in the range of motion category to create an item replicating combined overhead rotation. Considering the notion of overrepresentation from similar items when completed by an athlete, combining these items, whilst retaining the original images would allow for greater clarity and interpretation for the end user (Figure 2, Table 2).

During Stages 1 and 2, additional items were suggested relating to other epidemiological themes of shoulder injury mechanism, namely the poach position³⁰ and an identified weakness position, horizontal extension 'T' position.³¹ These new items were given contextualised descriptions and images to help the end user. With the inclusion of new items, combination of similar items and removal of items failing to achieve consensus, the RSF questionnaire consisted of three constructs of five items and one construct with seven items.

The balance of the sports specific skills and training category had proportionally more items ($n = 7$) achieving consensus and carried forward from Stages 1 and 2 to Stage 3. This is in comparison to the other three constructs, which had five items achieving consensus and carried forward from Stages 1 and 2 to Stage 3. The expert and experienced participants unanimously agreed ($\geq 68\%$ - 100% actual agreement) to maintain all 7 items in this construct rather than using rank order to create uniform construct balance in the final questionnaire, as it reflects the importance placed on shoulder function/dysfunction during sport specific skills and training activities. In practice, each item in the final RSF questionnaire is completed on a Likert scale for dominant and non-dominant upper limbs, reported as a construct and composite score, but the utility of these scores will require further validation (Figure 2).

Monitoring perceived shoulder function/dysfunction

Criterion validity of shoulder function/dysfunction is difficult to ascertain in the absence of an agreed gold standard in rugby players with an absence of time loss injury. The RSS exists as a single construct designed to evaluate injured athletes in rugby,^{15,16} and the Oslo sport trauma research centre questionnaire³ collects similar information pertaining to overuse injuries without the specific contact focus. Psychological readiness to return to play³² has been shown to be impacted in rugby players even in the presence of restoration of physical capabilities. This further emphasises the gaps in our ability to rely on functional testing alone to gain full understanding of the perceived level of function/dysfunction present in contact sport athletes

with or without perceived injury. The RSF questionnaire can be used to monitor the ongoing shoulder health of rugby players, providing practitioners with early information, which would support early intervention, potentially enhancing the career longevity, and improving the overall long-term health of athletes.

Strengths, limitations and recommendations for future research

The aim of this study was to create a new RSF questionnaire by a Delphi study design with experts and experienced participants. Expertise is often limited to a single or ill-defined metrics in Delphi studies.^{22,24,27} This study offers comprehensive detail about participant criteria bespoke to each profession. However, by not compromising on the design of the study to involve these different participant groups and multi-faceted inclusion criteria, the total participants per group may be smaller than some Delphi studies with homogenous expert groups.²⁵ The total number of participants in this study and number of experts is more comparable to those studies with heterogenous expert groups.^{3,22,23} Differing thresholds of agreement at different stages of the study help when dealing with multiple professional opinions to retain more items, but this could also mean more items have been retained than needed per construct. Raw agreement data percentages have been reported (Table 2) to help the reader interpret the strength of consensus per item. Factor analysis would need to be employed to further evaluate the effectiveness of each item per construct in future studies.

Future research is also required to ascertain if the intended analysis by construct or composite score offers greater clinical utility than single construct tools^{15,20}. The time point of completion of any monitoring tool may be impacted by a micro or macrocycle of sport participation.² Standardising the day of data collection for longitudinal serial monitoring to take place on a 'reduced load day' (match day-1)¹⁶, may represent good practice for this type of use. However future research may also consider the usefulness of the RSF questionnaire in evaluating the level of perceived function post high load training or matches to help guide micro cycle training

load. The RSF questionnaire asks players to estimate how their performance and symptoms would be on the day of completion (Figure 1). This immediate reporting of performance and symptoms reduces symptom recall issues but requires the athletes to estimate and anticipate for items which they have not performed that day. Recall of 7-days is often used, but it is recognised that athlete monitoring may need to be over shorter time periods to monitor change³. Future research is therefore indicated to understand the stability of the RSF over short test-retest time periods. The RSF questionnaire will quantify levels of perceived function but to enhance the interpretation of results it should be compared to known specific or proximal measures of shoulder and upper limb function. Future research investigating the relationship between changes in RSF questionnaire scores and upper limb performance metrics^{31,33} may help with period health evaluation of the rugby shoulder¹⁴.

Expert opinion is often used to create new tools in the absence of a gold standard.²² The RSF questionnaire offers quantifiable data for perceived shoulder function for the first time in four constructs designed for injured and uninjured rugby players. Future research using the RSF questionnaire prospectively across a range of playing levels will help with further validation of its utility. The RSF questionnaire has not been evaluated for its predictive ability in relation to measurable performance markers and time loss injury events. Generating thresholds for MCID and MDC would also allow the RSF questionnaire to be used when evaluating therapeutic interventions and monitoring athletes over their career.

Conclusions

A Delphi study consisting of 37 participants from six professions evaluated new constructs and items, proposed to evaluate shoulder function/dysfunction in contact sport athletes. This Delphi study created the RSF questionnaire, consisting of 4 constructs with 5-7 items per construct, providing practitioners with a practical tool to monitor the shoulder

function/dysfunction of rugby players. This can provide valuable information to help practitioners implement appropriate interventions to enhance athlete career longevity and the overall long-term health of athletes, in relation to shoulder health.

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Declaration of interest

There is no conflict of interest with the authors of this article

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SUPPLEMENTARY MATERIAL

Tables and Figures

Table 1: Academic, clinical and playing experience of steering, expert and experienced groups

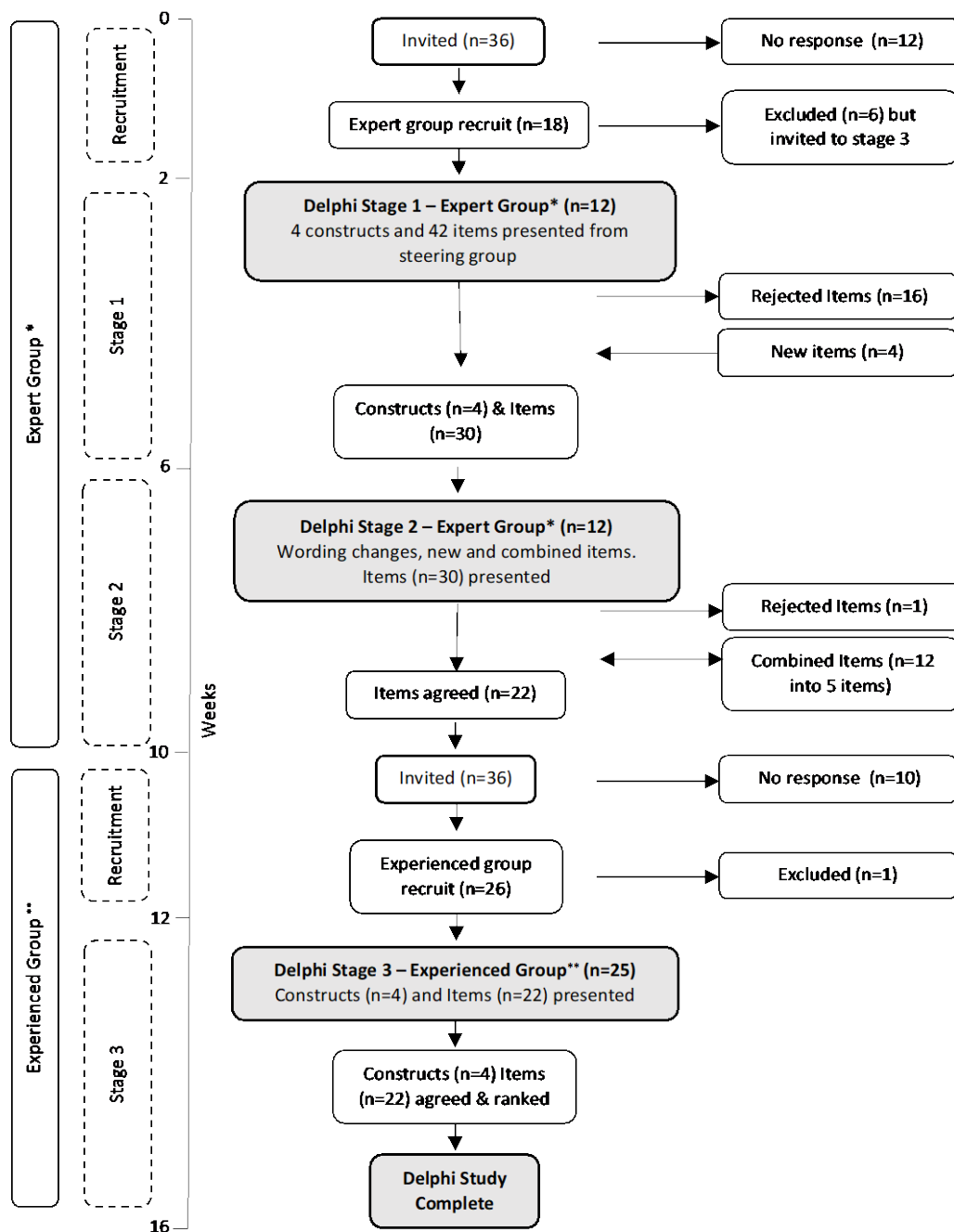
| <i>Academic</i> | | Steering Group (n=3) | | | | <i>Clinical</i> |
|--|---|--|--|--|--|-----------------|
| 272 (90.7) publications* | | Years 41 (12.7), Sports 9 (3), Elite club teams 16 (5.3) International teams 4 (1.3) | | | | |
| Expert Group (n=12) | | | | | | |
| Athletes (n=2) | S&C Coach (n=2) | Therapist (n=2) | SEM Dr (n=2) | Shoulder Surgeon (n=2) | Academic Researcher (n=2) | |
| <i>5 years playing experience and a history of a shoulder injury causing absence from playing or training greater than 28days</i> | <i>UK/ International Registration, 5 years club experience, international experience or related research background.</i> | <i>UK / International registration, 5 years club experience, researching within the field</i> | <i>UK / International registration, 5 Years club experience across multi contact and collision sports</i> | <i>5 years shoulder specialist experience & publication history</i> | <i>5+ topic specific publications</i> | |
| Summary of Expertise Recruited | | | | | | |
| 850 club (425) 35 international (17.5) appearances† | 6 elite (3) 4 International (2) teams. 12 (6) publications* | International Upper limb specialists 27 (13.5) publications* | 11 elite sports (5.5) 41 (20.5) years | 45 (22.5) surgical years. 88 (44) publications* | 96(48) publications* | |
| Experienced Group (n=25) | | | | | | |
| Athletes (n=10) | S&C coach (n=2) | Therapist (n=8) | SEM Dr / Surgeon (n=1)‡ | Academic Researcher (n=4) | | |
| <i>5 years playing experience and a history of a shoulder injury causing absence from playing or training less than 28 days</i> | <i>UK/ International Registration, 5 years club experience</i> | <i>UK / International registration, 5 years club experience</i> | <i>UK / International registration, 5 years club experience. / 5 years surgical experience</i> | <i>1-4 topic specific publications</i> | | |

Key: ‡Indicated both categories, *Research gate full text publications (mean) accessed 28/11/22
† www.itsrugby.co.uk accessed 28/11/22 **Bold text** identifies key differences between expert / experienced criteria

Table 2: Constructs (n=4) and items (n=42) proposed and those achieving consensus and not achieving consensus, with agreed wording, new (n=4) and combined items presented in rank order

| | | <i>Constructs</i> | | | |
|--|--|--|---|---|---|
| | | Activities of Daily Living | Range of Motion | Strength & Conditioning (Athlete Conditioning) | Sports Specific Training & Competition (Match Play Training and Skills) |
| Consensus (≥50%) stage 1-2& rank order stage 3 | 1. (92%) Does your shoulder allow you to sleep? | 1. (67%) Can you elevate your arm above your head? | 8. (75%) Can you grapple/wrestle upright or on the ground holding an opponent to prevent motion? | 3. (83%), <u>Can you land on your hand,</u> (4. (75%)) <u>elbow or</u> (5. (92%)) <u>point of shoulder with the potential for additional force from an opponent, without shoulder problems?</u> | |
| | 6. (58%) Can you complete all personal hygiene tasks e.g., washing hair / put on a jumper? | 2. (58%) & 3. (50%) <u>Can you fully laterally rotate your shoulder when out to the side and move to full medial rotation?</u> | 14. (50%) Can you perform a plyometric press up – a press up with a flight phase on pressing back up? | 1. (92%) Pass across the body, 2. (75%) Pass in front) <u>Does your shoulder allow you to throw/pass a ball without problems?</u> | |
| | 8. (60%) *Can you relax the shoulder without hesitation pain or dysfunction? | 9. (50%) Is your shoulder loose (lax) or are you fearful of it popping out? | 1. (58%) Can you overhead press with arms out to the side? | 10. (75%) <u>Can you tolerate typical and</u> (11. (92%)) <u>high force contact through your shoulder?</u> | |
| | 2. (67%) Can you drive or commute without shoulder problems? | 4. (58%) Can you fully laterally rotate your shoulder when by your side? | 12. (58%) Can you prone pull -lying on your stomach on a surface with a bar or dumbbells? | 6. (75%) <u>Can you pull or</u> (7. 75%)) <u>be pulled</u> (8. (83%)) <u>fend or push without shoulder problems?</u> | |
| | 5. (50%) Can you cook and shop without shoulder problems, including carrying bags? | 7. (50%) Can you stretch your arm across your body? | 10. (58%) Do you have shoulder problems with sprinting without carrying an object in the hands? | 9. (83%) Can you catch a ball without shoulder problems? | |
| | | | | 13.(100%) *Can you perform a straight arm grab or tackle? | |
| | | | | 12.(80%) *Can you weight bear through one arm in a tripod/poach position or 'present a ball' position? | |
| | | | | | |
| | | | | | |
| | | | | | |
| Did not achieve Consensus (<50%) | 3. (42%) Perform housework? | 5. (25%) Can you reach your hand behind your neck? | 2. (25%) Pull up? | | |
| | 4. (42%) Perform D.I.Y and Gardening? (Including manual paid work in this category) | 6. (33%) Can you reach your hand behind your back fully? | 3. (17%) Overhead squat with arms in a straight position? | | |
| | 7. (25%) Perform office work? | 8. (8%) Can you extend your arms back fully behind you? | 4. (33%) Olympic snatch? | | |
| | 9. (40%) *Carry or play with children? | 10. (42%) Does your shoulder make noises on movement such as clunks, clicks or grinding? | 5. (33%) Olympic clean? | | |
| | | | 6. (8%) Upright row? | | |
| | | | 7. (42%) Punch? | | |
| | | | 9. (33%) Deadlift? | | |
| | | | 11. (42%) Supine Press? | | |
| | | | 13. (42%) Press up? | | |
| | | | | | |

Key: Original Items numbered (actual % agreement stage 1-2) displayed before each item description/question. Multiple original item % displayed with agreed final wording after stage 2 underlined *New item added after stage 1.



*Expert criteria: **Academics** with >5 publications, **Players** with a history of severe shoulder injury (>28days), **S&C Coaches** and **Sports & Exercise Medicine Drs** with experience of different contact sports, **Upper limb specialist therapists**, and **Shoulder Surgeons** all with >5years professional club and international experience researching within the field.

Experienced criteria: **Academics with 1-4 publications, **Players** with a history of shoulder injury (<28days), **S&C coaches**, **Sports & Exercise Medicine Drs**, **therapists**, and **Surgeons** all with >5years professional club experience with special interest in the field.

Figure 1: Schematic representation of the Delphi study.





Rugby Shoulder Function (RSF) Questionnaire

Please use the RSF questionnaire to report your perceived shoulder performance under 4 categories for your dominant (D) and non dominant (ND) shoulders. If you do not regularly perform the movement, exercise, skill or task, you should estimate how you would expect your shoulder to feel whilst performing the task today. Typical problems may include: pain, restriction, laxity or fear to perform. Add up each section for each shoulder and transfer your score to the RSF questionnaire total scores table

| Athlete Details: | Final RSF Questionnaire Total Scores | | | | | | D | ND |
|------------------|---|--|--|--|--|--|---|----|
| | Activities of Daily Living Totals | | | | | | | |
| | Range of Motion Section Totals | | | | | | | |
| | Strength and Conditioning Section Totals | | | | | | | |
| | Sports Specific Training and Competition Totals | | | | | | | |

| Activity of Daily Living | | none | Slight | Moderate | Significant | Severe | unable to | Scores |
|--|-------------------|------|--------|----------|-------------|--------|-----------|--------|
| Does your shoulder allow you to sleep? | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | |
| | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | |
| Can you complete all personal hygiene tasks e.g. washing hair / put on a jumper? | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | |
| | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | |
| Can you relax the shoulder without hesitation pain or dysfunction? | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | |
| | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | |
| Can you drive or commute without shoulder problems? | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | |
| | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | |
| Can you cook and shop without shoulder problems, including carrying bags? | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | |
| | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | |

Activities of Daily Living Total (Max 25)

| Range of Motion | | none | Slight | Moderate | Significant | Severe | unable to | Scores | |
|---|-------------------|--------------|--------|----------|-------------|--------|-----------|--------|--|
|  Can you elevate your arm above your head? | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | | |
|  Can you fully laterally rotate your shoulder when out to the side and move to full medial rotation? | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| Shoulder Stability: Is your shoulder loose (lax) or are you fearful of it popping out? | | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | |
| Non dominant (ND) | | 0 | 1 | 2 | 3 | 4 | 5 | | |
|  Can you fully laterally rotate your shoulder when by your side? | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | | |
|  Can you stretch your arm across your body? | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | | |

Range of Motion Section Total (Max 25)











| Strength and Conditioning | | | none | slight | Moderate | significant | severe | unable too | Scores | |
|---|---|--|------|--------|----------|-------------|--------|------------|--------|--|
|  | Can you grapple/wrestle upright or on the ground holding an opponent to prevent motion? | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | | |
|  | Can you perform a plyometric press up (a press up with a flight phase on pressing back up)? | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | | |
|  | Can you overhead press with arms out to the side? | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | | |
|  | Can you prone pull -lying on your stomach on a surface with a bar or dumbbells? | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | | |
|  | Do you have shoulder problems with sprinting without carrying an object in the hands? | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | | Strength and Conditioning Section Total (Max 25) | | | | | | | | |
| Sports Specific Training and Competition | | | none | slight | Moderate | significant | severe | unable too | Scores | |
|  | Can you land on your hand, elbow or point of shoulder without shoulder problems? (with the potential for additional force from an opponent) | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | | |
|  | Does your shoulder allow you to throw/pass a ball without problems? | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | Can you tolerate typical and high force contact through your shoulder? | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | | |
|  | Can you pull or be pulled, fend or push without shoulder problems? | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | Can you catch a ball without shoulder problems? | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | | |
|  | Can you perform a straight arm grab or tackle? | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | | |
|  | Can you weight bear through one arm in a tripod/poach position or 'present a ball' position? | Dominant (D) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | | Non dominant (ND) | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | | Sports Specific Training and Competition Total (Max 35) | | | | | | | | |

Figure 2: RSF questionnaire