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2022 Bern Consensus Statement on Shoulder Injury Prevention, Rehabilitation, and Return to Sport for Athletes at All Participation Levels

Professional and amateur athletes alike are burdened by shoulder injuries.[7,44,48,49,78,88] Shoulder pain affects athlete performance, training, and daily life.[61,64] More than half of elite collegiate American football players sustain at least 1 shoulder injury during their career.[48] Shoulder injuries are a problem for athletes in sports as diverse as rugby,[54] baseball,[34] handball,[20] diving,[73] water polo,[73] and kayaking.[41]

SYNOPSIS: There is an absence of high-quality evidence to support rehabilitation and return-to-sport decisions following shoulder injuries in athletes. The Athlete Shoulder Consensus Group was convened to lead a consensus process that aimed to produce best-practice guidance for clinicians, athletes, and coaches for managing shoulder injuries in sport. We developed the consensus via a 2-round Delphi process (involving more than 40 content and methods experts) and an in-person meeting. This consensus statement provides guidance with respect to load and risk management, supporting athlete shoulder rehabilitation, and decision making during the return-to-sport process. This statement is designed to offer clinicians the flexibility to apply principle-based approaches to managing the return-to-sport process within a variety of sporting backgrounds. The principles and consensus of experts working across multiple sports may provide a template for developing additional sport-specific guidance in the future.
J Orthop Sports Phys Ther 2022;52(1):11-28. doi:10.2519/jospt.2022.10952

KEY WORDS: *consensus statement, rehabilitation, return to sport, shoulder injury*

Yet, there is a lack of quality evidence to guide clinicians, athletes, and coaches in managing shoulder injury risk or return to sport (RTS) post injury. The absence of quality evidence hinders those who wish to produce clinical practice guidelines. Previous consensus statements have targeted specific shoulder pathologies[4,31,60,89] and the scapula.[50] However, questions remain:

- Which exercises are most appropriate for supporting primary prevention of shoulder injury in athletes?
- Does screening for muscle weakness, such as a loss of rotational strength in the shoulder, hold value for athletes?
- Which load management measures are relevant for the athlete with shoulder injury?

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- What is best-practice rehabilitation for the athlete with shoulder injury?
- Which criteria should guide quality RTS decisions?

Sportfisio Swiss (the Swiss Sports Physiotherapy Association), supported by the *Journal of Orthopaedic & Sports Physical Therapy* (*JOSPT*), convened a consensus development group to synthesize evidence and establish best practice in shoulder injury prevention, rehabilitation, and RTS. The group's remit was to develop a principle-based framework to guide people who contribute to managing shoulder injury in different sports. The framework covers 4 key concepts: (1) managing injury risk, (2) managing and progressing load, (3) rehabilitation, and (4) RTS.

Methods

This statement follows the principles outlined in the 2016 Bern consensus on RTS.[5] Fundamental definitions and principles that underpin RTS for athletes are contained in the original statement, and we encourage the reader to review the Bern consensus. Consistent with the Bern consensus recommendations, we developed our framework through the lens of RTS as a continuum, paralleled with rehabilitation.[5]

Consensus Process

We employed a modified Delphi process because (1) the approach afforded anonymity and (2) allowed us to include a large group of international experts.[65] We aimed to work toward agreement without forcing consensus. Therefore, we did not prespecify the number of rounds required for consensus. This is a normal part of a consensus process and allows important differences in clinical care to surface.[27]

We modified the standard Delphi process (**FIGURE 1**) to encompass a 2-step process: first, we conducted and completed 2 rounds of an online Delphi survey, where we established areas of consensus, nonconsensus (experts have mixed responses), and dissent (all experts are in consensus disagreement with a statement). Second, a smaller group of international experts (who had participated in the Delphi process) participated in an in-person meeting to discuss, elaborate, and provide further guidance on topics of nonconsensus. All in-person experts were invited speakers at the symposium "Shoulder & Sports" hosted by Sportfisio Swiss.

The in-person meeting took place on November 21, 2019 in Bern, Switzerland, 1 day before the symposium. Members of the in-person meeting participated in a 6-hour discussion, chaired by consensus committee organizers (A.S., P.B., and C.L.A.) and also hosted by Sportfisio Swiss. Experts at the in-person meeting received information on the points of consensus, nonconsensus, and dissent after Delphi round 2 (online survey). In-person discussion focused on crystallizing agreement from the Delphi survey and surfacing additional areas of nonconsensus to highlight for future research. There was no formal voting at the in-person meeting, and all points of consensus, unless otherwise stated, were formed from the wider Delphi survey.

Experts renowned for clinical and/or research excellence in shoulder conditions in athletes were invited to participate in the Delphi process (the 2 online surveys). There are different approaches to recruiting participants to Delphi panels, and no agreement on which method is best.[13] We aimed to balance research and clinical experience, sex, nationality, and professional representation. We identified and contacted people with a clinical and/or research profile (ie, those who had published in peer-reviewed scientific journals on topics related to shoulder injury in athletes or presented at sports medicine/sports rehabilitation conferences on topics related to shoulder injury in athletes); we constructed a long list of potential participants, then consulted sports physical therapy leaders in professional organizations for their input and feedback on our long list. Next, we contacted all people on the long list and invited them to participate. Invitations were sent via e-mail, with an information sheet detailing the purpose, commitment required by participants, and benefits of participation (a copy can be provided on request to the correspond-

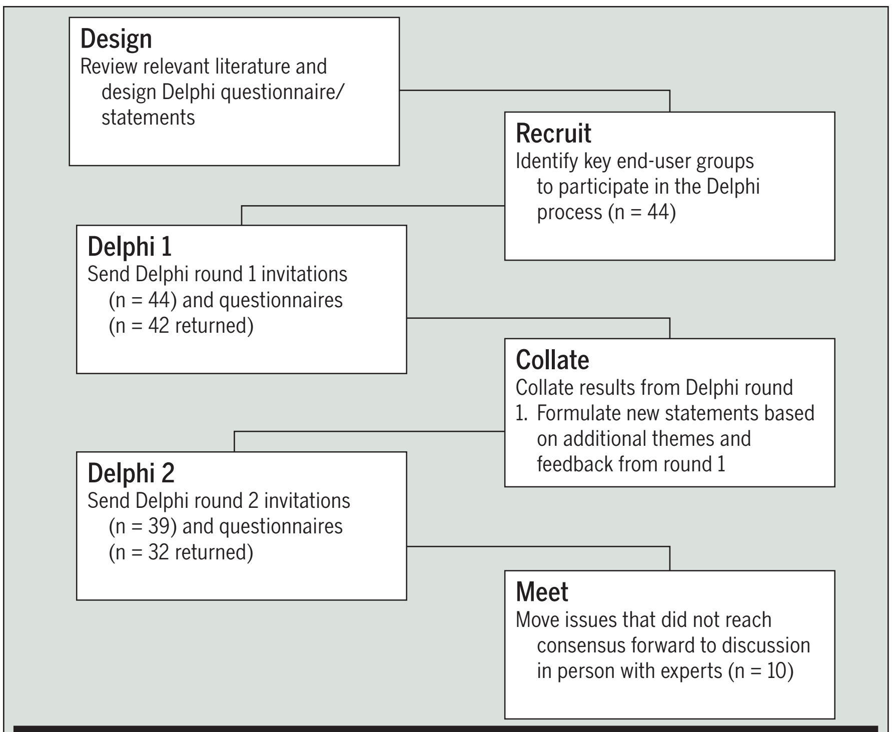

FIGURE 1. Flow chart depicting the modified Delphi process.

ing author). If anyone declined participation, we asked that person to nominate at least 1 other person whom we should approach to participate.

Participants for the in-person meeting were selected by the Sportfisio Swiss conference organizing committee as speakers for the 2019 conference.

Gathering Information

To obtain information required to construct the statements included in the first Delphi round, we reviewed evidence for managing shoulder injuries in athletes of all ages and participation levels. Database (Embase, MEDLINE, SPORTDiscus, Cochrane Database of Systematic Reviews, and Cochrane Central Register of Controlled Trials) and gray literature searches (Google Scholar, to July 2019) were conducted. Articles were extracted and reviewed by the consensus committee organizers (A.S., P.B., and C.L.A.), prioritizing systematic reviews, clinical practice guidelines, and original research (in that order). Search terms were purposefully broad, using "'shoulder' AND 'return to sport OR play OR activity.'" Articles that mentioned prevention, rehabilitation, or management of shoulder injuries in athletes were included for review. Articles with no mention of shoulder injury prevention or management in a sporting context and papers focused solely on surgical management of shoulder injuries in athletes were excluded.

Designing and Revising the Delphi Statements for Each Round

We used thematic analysis to identify key themes from the literature search. The themes then informed the specific statements we constructed for the Delphi questionnaire (supplemental file). There was a need for separate statements due to the different demands placed on the shoulder by different sports. Therefore, we created 2 separate groups of questions focused on (1) athletes in overhead or throwing sports and (2) athletes in collision sports. The questionnaire was piloted by an experienced clinician-researcher (M.B.).

Round 1 of the Delphi process had 54 questions focused on:

- Risk factors and injury risk reduction
- Training load
- Rehabilitation and management of the scapula
- The rotator cuff, the postdislocation shoulder, or general instability
- Sport-specific rehabilitation and progression
- RTS criteria

To ascertain whether there was consensus agreement with a statement, we used an 11-point scale (0-10), with an average (mean) rating among experts of 7 of 10 set as the threshold for consensus. After analyzing the feedback provided by participants following round 1, we developed additional questions for round 2 and added them to the questions that failed to reach consensus in round 1. Round 2 comprised 25 questions; 39 experts participated. See the supplemental file for detailed statistics of respondent numbers and experts included in all Delphi rounds and the in-person meeting.

Terminology and Structure of the 2022 Consensus Statement

There is a wide variety of demands on the sporting shoulder. To account for these demands, we considered type of sport: above shoulder height, with or without throwing; below shoulder height, with or without throwing; and reverse chain. A reverse-chain sport is one where the upper limbs act primarily as the point of contact with the environment or playing surface, directly or indirectly (eg, climbing or rowing via use of an oar). We also accounted for whether sports involved contact or "collision" (**FIGURE 2**).

We intend the content of this consensus statement to apply to all sports and all athletes. The consensus is presented in 4 main sections: (1) managing injury risk, (2) managing and progressing load, (3) shoulder injury rehabilitation, and (4) evidence to inform RTS decisions.

We outline and highlight the points of consensus or dissent from Delphi round 1, Delphi round 2, and the in-person meeting in each section. All "consensus points" throughout the statement were derived from the larger Delphi survey.

Section 1: Prevention Is Better Than Cure—Managing Injury Risk in Athletes With or Without a History of Shoulder Injury

Approaches to injury prevention vary dramatically between sports and between injuries. Preventing further injury following an acute trauma (eg, dislocation) will differ from the approach to prevent an overuse injury. Therefore, we have attempted to outline principles rather than prescribe a "recipe." There is inevitable overlap between primary and secondary injury prevention. Applying the injury prevention principles in practice can help guide clinicians and coaches to the highest-priority risks, such as the need to address training load factors following an overuse injury versus the need to address a progressive return to collisions following a glenohumeral dislocation in a contact sport. In this section, we also address preinjury screening and shoulder injury prevention programs and their implementation.

Therefore, this section on managing shoulder injury risk comprises 4 subsections: (1) what is known and what is unknown about risk factors for shoulder injury in athletes; (2) screening the athlete's shoulder; (3) managing injury risk with primary and secondary prevention exercise programs; and (4) implementing injury prevention exercise programs.

What Is Known and What Is Unknown About Risk Factors for Shoulder Injury in Athletes

Knowing the risk factors for injury supports successful management of shoulder injuries in sport.[23,35] Attempts have been made to ascertain specific risk factors in sports such as handball,[8] and to predict who might suffer reinjury following acute trauma such as a dislocation.[67] Results are conflicting, with a consistent criticism being that studies too often base their risk of injury on a single measurement per season (predominantly in the preseason), which disregards the complex, ever-changing nature of injury risk.[7,52,66,94]

Despite these conflicts, some modifiable risk factors have been proposed. These include loss of (reduced) range of motion (ROM), rotational strength imbalance, muscle weakness compared to individual baseline or group normative values, changes in load (shoulder and sport-specific measures vary), player position, participation level (professional versus amateur), a previous history of shoulder pain, and psychosocial factors.[7,8,62,67] The role of load is fiercely debated and is considered to play an important role when it comes to overuse injuries (eg, in the throwing arm)[62,92] and in contact sports, where shoulder dislocations are common.[67]

All potential risk factors should be discussed in a shared decision-making framework involving athletes, coaches, and clinicians to identify the most relevant injury risk factors to the athlete and to decide whether mitigation strategies are warranted.[28]

Screening the Athlete's Shoulder

There is an absence of evidence to support screening for predicting which athletes will suffer a shoulder injury.[52,94] However, screening can help clinicians identify and address pre-existing problems to support athletes to RTS after shoulder injury, or to facilitate performance improvements.

The effectiveness of screening remains inconclusive.[10,72] Around half the Delphi group recommended to screen for scapular dyskinesis, whereas the other half was against it.

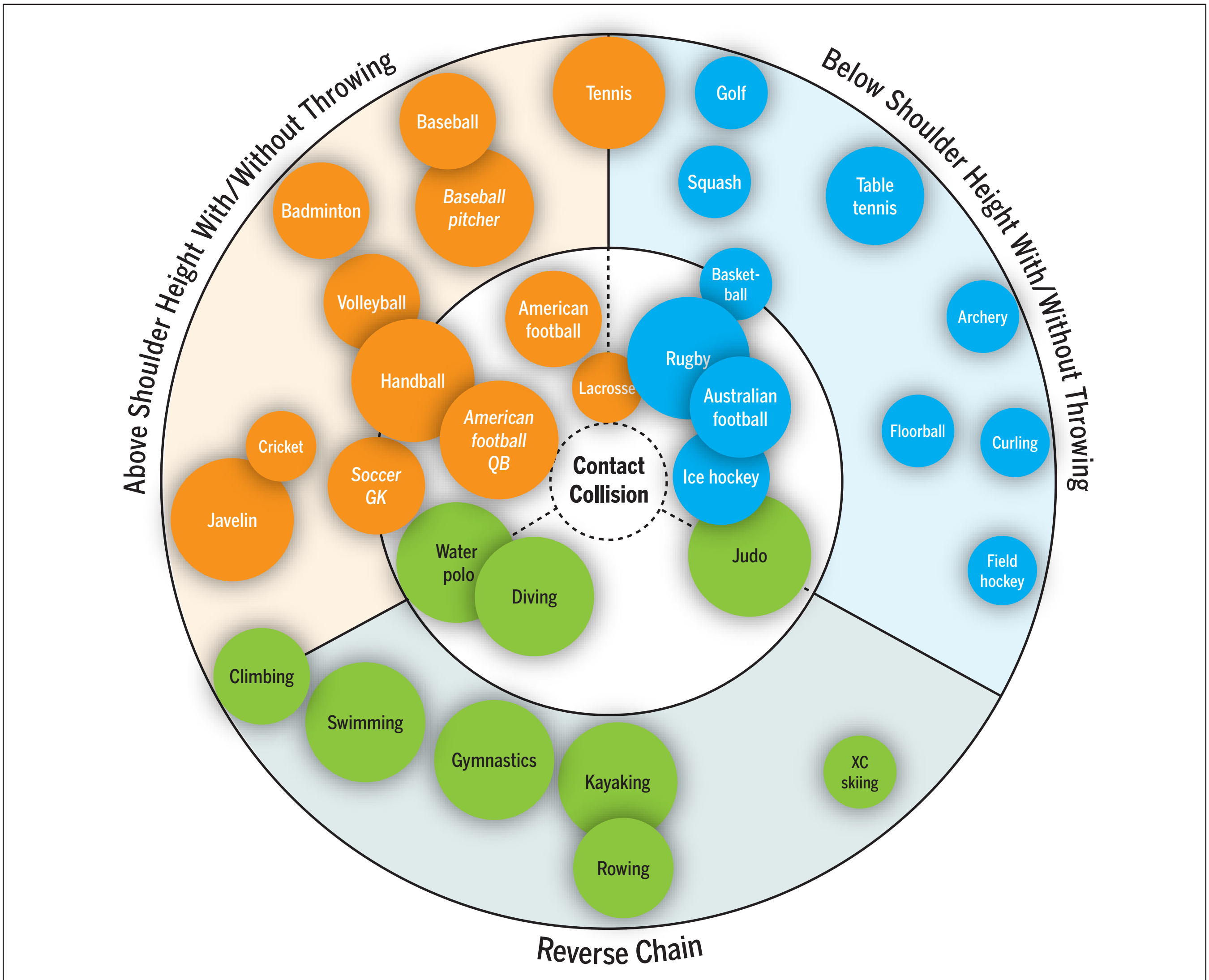

FIGURE 2. Representation of the demands of different sports, according to their degree of contact, whether they require play above or below the shoulder, and reverse-chain demands. The size of each circle reflects the relative burden of shoulder injury in each sport. Some sports involve specific position demands, represented in italics (eg, the American football QB, who experiences greater demand and suffers a higher occurrence of shoulder injuries compared to those playing other positions in American football). Abbreviations: GK, goalkeeper; QB, quarterback; XC, cross-country.

Screening for risk factors entails challenges when interpreting the test results. No tests or test batteries could reliably be recommended to support either a primary (preinjury) or secondary (postinjury) screening process. As the literature and the Delphi group remained split, experts from the in-person meeting suggested that a generic musculoskeletal shoulder screen (ie, not injury specific and incorporating a mixture of ROM, strength, power, and other standardized measurements such as sport-specific internal rotation [IR]/external rotation [ER] ratios) may have a place. This could include an assessment of shoulder function over the whole season, with the frequency to be established for each individual sport and player position (risk level). However, the utility and recommended frequency of any screening process for the shoulder, both pre and post injury, require further investigation.

Information gathered during the screening process (eg, preinjury strength levels) may help to refine RTS decisions, which will be discussed further in the RTS section of this statement.

Managing Injury Risk With Primary and Secondary Prevention Exercise Programs

Primary prevention should be the focus of all programs and should begin from a young age (ie, in youth athletes). The high prevalence and persistence of shoulder problems in adolescent and senior elite overhead athletes underscore the need to focus on primary prevention in youth sport to establish lifelong practices for maintaining healthy shoulder function.[79,98] Structured, one-size-fits-all exercise programs appear to reduce the shoulder injury risk in handball athletes[79] and should be studied in other athletic populations to draw firm conclusions.

Secondary prevention exercise programs may begin immediately following shoulder injury or may become more of a focus as the athlete progresses toward a return to participation, sport, or performance.

Injury prevention programs (primary and secondary) have low risk of harm, are minimally intrusive to implement (eg, including exercises in warm-ups), and offer potential preventive effects to all athletes. The Delphi group agreed that all athletes should receive injury prevention exercise programs, irrespective of whether or not they have a history of shoulder injury. Depending on the resources available and the sport setting (eg, professional versus youth sport), it may be appropriate to devote additional preventive effort to athletes identified as having a higher risk for injury (eg, athletes who start the season with shoulder pain, with muscle strength deficits, or who play in a high-risk playing position such as the pitcher in baseball).

Consensus point

Injury prevention programs/exercises are appropriate to prescribe for athletes of all levels to prevent shoulder injury.

Fundamental components of exercise programs to manage shoulder injury risk in overhead and contact/collision sports are outlined in **TABLE 1**. The principles can be extrapolated to other cases, with the caveat that "recipe-style" approaches should be avoided. Each case should be taken on its own merit, and recommendations should be adapted to suit the individual and the sporting context within which RTS is being attempted. **TABLE 2** gives an example of a potential prevention program in overhead-throwing athletes, consisting of 3 exercises that target important variables such as shoulder ROM, plyometric capacity, and the kinetic chain.

Implementing Injury Prevention Exercise Programs

While injury prevention exercise programs work under controlled conditions (efficacy), the evidence for effectiveness (whether the programs work in the real-world sport environment) remains elusive.[2,35] The Del-

TABLE 1 Expert In-Person Meeting Recommended Components of Exercise Programs to Manage Shoulder Injury Risk in Overhead Sports

General Principles	Exercise Targets
• Exercises should be conducted in sport-specific positions • Exercises should cover multiple joints (ie, involve the kinetic chain) • Programs should require minimal equipment • Programs should involve a competitive element, ideally with partners where the sport is team based • Programs should be implemented at least 2 times per week and may form part of the warm-up routine before training or match play and part of resistance training • Programs should take no longer than 10 to 15 minutes in total, 5 minutes of which may focus on shoulder-specific activities	• Rotator cuff imbalances, with focus on external rotation strength through the range of motion • Shoulder girdle strength through the range of motion • Dynamic trunk function/capacity specific to sport • Control of eccentric deceleration of the arm (eg, external rotation in 90° of abduction)

TABLE 2 Example of a Prevention Exercise Program in Overhead-Throwing Athletes, Derived From the Authorship Group

Target	Exercise	Video[a]
Range of motion/motor control	External rotation through abduction	**VIDEO 1**
Plyometrics	Drop and catch in 90° of shoulder abduction	**VIDEO 2**
Open/closed kinetic chain	Y Balance Test exercises or adapted versions	**VIDEO 3**

[a]*Videos can be found at www.jospt.org/doi/10.2519/jospt.2022.10952*

phi group concurred that risk reduction can be achieved when the exercise programs are performed twice weekly (minimum dose). Effective prevention programs must support the education of coaches and athletes, target known barriers such as lack of compliance/adherence,[9,11,68] and improve attitudes and self-efficacy of individual athletes toward participating in injury prevention programs.[36,57,85,86] Implementing prevention programs also has the potential to improve sport performance (eg, throwing velocity).[3,70]

Consensus point
Plan to implement injury prevention programs at least twice weekly on a team level to ensure all athletes receive the minimum dose.

Section 2: Managing Shoulder-Specific Load in Athletes

Strategies for monitoring shoulder-specific load in overhead athletes lack reliability and validity, prompting calls for new technologies to be developed.[12] Shoulder-specific loads vary with the number of throws, playing position, type of training, and intensity of training. High overall shoulder-specific load exposure of more than 16 hours per week[55] (eg, high-speed throws in baseball) and large weekly increases in training and/or match load (greater than 60% increase compared with the average of the previous 4 weeks) are associated with an increased shoulder injury rate.[55,98]

Consensus point
The balance between capacity and load plays an important role in injury risk management, rehabilitation, RTS, and performance enhancement.

Recommendations based on total sporting exposure hours do not account for large variations in internal load (eg, the relative biological stress—physiological or psychological—placed on an athlete during training and competition) between training sessions of equal duration. Measuring load accurately may require multiple external (eg, any external stimulus applied to the athlete, such as laps swum in the pool, balls bowled in cricket, etc) and/or internal load measurements. Do not rely on playing time or distance covered as a sole measure.[59,69] Research remains unclear about what to measure and how to measure it, particularly for internal load in sport.[92]

There was no consensus about which type of load (internal or external) was more important to risk or injury management in the shoulder.

Consensus point
To obtain estimates of the applied load, measures should include the number of repetitions (eg, throws), the magnitude of load applied per repetition (eg, throwing velocity), and the distribution of load over tissue structures applied per repetition (eg, type of throw).

The practicality of collecting external load measurements varies between sports. For example, counting the number of pitches and measuring throwing velocity for each player are reasonable practices in baseball, but may not be possible in handball due to the chaotic nature of game play.

Experts at the in-person meeting suggested that an option for capturing internal load would be to have athletes rate their session or shoulder-specific rate of perceived exertion (RPE) following a session/match.[58] Practical examples include asking the throwing athlete, "On a scale from 0 to 10, how hard (exertion) was this session on your throwing arm?" or asking a swimmer, "On a scale from 0 to 10, how hard (exertion) was this session on your shoulders?" For the youth athlete, the clinician may ask the same question weekly rather than after each session; for example, "How hard (exertion) was the recent

TABLE 3 Measures to Monitor Workload in Different Athlete Populations

Example of Monitoring Workload	Youth Athletes	Adult Athletes[a]	Professional Athletes[b]
Overhead sports	• Shoulder-specific RPE • Pitch counts or serve counts in baseball, softball, cricket, and tennis • Number of laps in swimming/water polo • Number of training sessions and matches (or hours) played	• Session RPE • Shoulder-specific RPE • Strength assessment (eg, endurance and power testing using HHD or other equipment) • Wellness questions or questionnaires (eg, sleep, stress, recovery)	• GPS tracking • Number of strokes in swimming/water polo • Clinical recovery measurements (eg, blood sampling) • Strength assessment (eg, rate of force development analysis) • Pitch/throw velocity
Collision sports	• Shoulder-specific RPE • Number of training sessions and matches (or hours) in team sports • Number of tackles/checks per training in rugby, ice hockey, and lacrosse	• Session RPE • Shoulder-specific soreness NRS • Wellness questions or questionnaires (eg, sleep, stress, recovery)	• GPS tracking • Number of tackles • Clinical recovery measurements (eg, blood sampling) • Strength assessment • Pitch/throw velocity

Abbreviations: GPS, global positioning system; HHD, handheld dynamometry; NRS, numeric rating scale; RPE, rate of perceived exertion.
[a]*In addition to youth athletes.*
[b]*In addition to adult athletes.*

week on your throwing arm?" To support athlete education and calibration with the RPE scale, the modified Borg RPE scale (0 being no exertion/effort at all and 10 being the maximal imaginable exertion/effort) may be used. To date, it is unclear how well shoulder-specific RPE represents the psychophysiological construct of perceived exertion: fatigue, heaviness, and discomfort.[43] Session RPE is strongly correlated to summated heart rate zone measures within athletes in youth soccer, rugby, and field hockey.[81] However, RPE, session RPE, or shoulder-specific RPE may be moderated by factors such as training mode. For instance, RPE can increase in athletes who include collisions in training when compared with those running at the same velocity without collisions.[58] Combining RPE with the Rating of Fatigue scale[91] may help to capture a closer estimate of perceived exertion.[43]

Overall, both metrics (session RPE and shoulder-specific RPE) can help identify athletes who are struggling to maintain high levels of training, as they capture the subjective response to the physiological stimulus.

Consensus point

Monitor load (shoulder-specific and athlete total load) on at least a weekly basis, with data collection carried out by both the performance team and individual athletes.

Where resources allow, such as where a team has access to data scientists or where athletes can self-monitor using questionnaires, daily monitoring may occur.

Example of How Baseline Strength Affects Load Capacity

A study of 679 handball athletes followed for 31 weeks assessed baseline and midseason strength and scapular control. Players with reduced ER strength or scapular dyskinesis could withstand smaller increments in weekly load (training/match participation measured in hours) compared with stronger players or those without scapular dyskinesis.[62]

These results need to be replicated by future studies that use measures of shoulder-specific load. However, if the findings are true, one could either adapt the load to the capacity of each player or improve the shoulder function of affected players to withstand greater loads, but preferably both.[93]

We suggest a minimum set of requirements for efficient workload monitoring for youth athletes in overhead and contact/collision sports, and a build-on for adult and professional athletes who may have additional resources available (**TABLE 3**). These suggestions guide clinicians, athletes, and coaches to extend the load monitoring principles, and are designed to be employed alongside clinical-reasoning principles for the specific individual or team situation. In professional sports, workload management is a constant part of athlete evaluation. Monitoring may be applied daily, using more resource-heavy measures where available. We anticipate that future research to establish the validity and reliability of specific measures of shoulder load will allow these recommendations to be refined.

Section 3: Road to Recovery—Key Principles for Quality Rehabilitation After Shoulder Injury in Athletes

Clinicians should consider athlete- and sport-specific factors when designing a rehabilitation program for the injured athlete. Aim for appropriate load and allow symptom response and irritability to guide treatment and progression.

Consensus point

Tissue-specific involvement may be considered, but the pathoanatomic diagnosis should not drive shoulder rehabilitation.

Athletes, especially elite-level athletes, regularly train and compete with asymptomatic tissue abnormalities[51] that often misdirect rehabilitation when observed on magnetic resonance imaging and other diagnostic imaging.

Experts at the in-person meeting agreed that clinicians supporting athletes post shoulder injury should aim to

1. Improve sport-specific biomechanics/technique
2. Increase rehabilitation intensity to challenge athletes at the limit of their capacity
3. Build resilience: increase capacity to load from physiological and psychological perspectives
4. Involve the multidisciplinary team in a shared decision-making process, including coaches and the athlete, to support integrating rehabilitation and performance measures that advance the ultimate goal of return to performance[5,28]

Seven Key Principles to Restore Strength and Sport-Specific Movement Patterns

Informed by the consensus points agreed to in the Delphi process, the in-person meeting team identified, discussed, and defined 7 key principles to guide rehabilitation planning and progress for athletes with shoulder injuries.

Key Principle 1: Let Irritability Guide Rehabilitation Progression Progress through rehabilitation is governed by the level of irritability and is unique to the patient; it has little to do with specific pathology. High irritability is considered as high pain at rest, night pain, or high disability. Low irritability includes low pain levels, pain that is limited to specific activities or movements, and no night pain.[23] A staged approach has been described for shoulder disorders, with a rehabilitation classification based on irritability.[56]

Consensus point

There is no specific order for when to include the kinetic chain or to promote scapular kinematics or to strengthen the rotator cuff. Instead, integrate these strategies simultaneously. The structure and timing of the rehabilitation program will be dictated by the driver (pain, weakness, irritability) of the dysfunction.

Key Principle 2: Address Clinically Relevant Glenohumeral ROM Deficits Using Active Exercise Therapy Evidence regarding the prospective relationship between preseason ER and IR ROM measures and subsequent shoulder injuries in overhead and throwing sports is inconsistent.[7,17,97] Range-of-motion loss or gain is common in athletes with current shoulder complaints. The term *glenohumeral internal rotation deficit* (GIRD)[76] elicits much confusion. Clear language is key when interpreting this alongside ER gain (ERG) and total rotational ROM.[96,97] Structural changes appear normal in the dominant arm of overhead and throwing athletes (eg, humeral torsion), leading to a perceived increase in ER ROM and a decrease in IR ROM within the dominant shoulder.[45]

Consensus point
Both GIRD and ERG are physiological tissue responses. Evidence is lacking to clearly differentiate physiological from pathological adaptation.

There was no consensus on whether to manage symptomatic GIRD with active or passive treatment.

Consensus point
External rotation gain, while a normal adaptation, should be managed (to ensure the athlete can cope with the additional joint range) using active exercise therapies to avoid future injury.

Clinicians may consider including strength-based exercises to restore ROM deficits. Pay attention to end-range flexion and abduction deficits that commonly present in overhead sports (eg, baseball, swimming, and volleyball). When the setting allows, clinicians may consider measuring humeral torsion when making decisions on whether an athlete has attained full ROM, or how much ERG and GIRD are present.[45,96,97]

Key Principle 3: Do Address the Scapula in Rehabilitation but Do Not Screen for Dyskinesis Screening for scapular dyskinesis in athletes without shoulder symptoms may provide little to no value. Dyskinesis is present in 53% of healthy people[71] and 61% of overhead athletes.[18] In overhead athletes, sport may contribute to muscle imbalance and asymptomatic scapular dyskinesis.

Consensus point
Consider the scapula as part of a holistic approach to rehabilitating the shoulder complex, for example, strengthening the kinetic chain to improve scapular mechanics.[75]

Consensus point
The effect of scapular dyskinesis on performance is unclear.[2,46,53,62,87]

Key Principle 4: Select the Appropriate Exercise (Open Chain Versus Closed Chain) Exercise selection will depend on the specific injury and rehabilitation phase. A safe place to begin for an athlete with anterior instability may be with low-load closed-chain exercises, while early open-chain exercises may be tolerated well by an athlete with acromioclavicular joint instability.

End-stage exercise selection should be guided by the demands of the sport.[99] A list of all the exercise suggestions made by experts during the Delphi process can be located in the supplemental file.

TABLE 4 EXAMPLES OF REHABILITATION EXERCISES SUGGESTED BY EXPERTS PRESENT AT THE IN-PERSON MEETING OR BY THE AUTHORSHIP TEAM

Target	Exercise Description	Video[a]
Early rehabilitation		
Range of motion, functional strength, strength training	Standing with the arm elevated and with the hand on a ball against the wall (resistance bands) Hand/foot: stretching for the last degrees of arm elevation and upward scapular rotation	VIDEO 4
Plyometrics	Sidelying ER plyometrics with ball	VIDEO 5
Open/closed kinetic chain	High plank with ER in 90°/90°	VIDEO 6
Progress in rehabilitation		
Range of motion, functional strength, motor retraining	Y raises with tube	VIDEO 7
Plyometrics	Overhead-throwing sports: fast concentric, slow eccentric ER in 90°/90°	VIDEO 8
Open/closed kinetic chain		
	Push-up and backward walk	VIDEO 9
	Collision sports: clap push-up	VIDEO 10

Abbreviation: ER, external rotation.
[a]*Videos can be found at www.jospt.org/doi/10.2519/jospt.2022.10952*

Consensus point

Include open- and closed-chain exercises in a rehabilitation program for overhead/throwing and contact-sport athletes.

Key Principle 5: Include Plyometrics Early in a Rehabilitation Program Including plyometric exercises is crucial to help athletes prepare for sport-specific load.

Clinicians may start with low-load plyometric exercises.[83,95] These may include small-amplitude drop-and-catch movements in sidelying or fast concentric, slow eccentric elastic band ER in supine. Progress exercises by adding resistance and changing the body position to either place more focused load on the shoulder or resemble sport-specific movements.

Consensus point

Plyometric exercises should be included at the start of a shoulder rehabilitation program, in both throwing and contact sports.

Key Principle 6: Train the Brain Injury provokes changes in the cortical area of the brain that outlast the injury itself.[42] During rehabilitation, there is an opportunity to capitalize on the brain's plasticity to reverse the brain changes that occur after injury. Clinicians may apply principles from anterior cruciate ligament rehabilitation to the shoulder through use of external focus of attention, implicit learning, differential learning, self-controlled learning, and contextual interference.[39] Gradual exposure to fearful movements that provoke anxiety for the athlete, and use of motor imagery and mirror neurons with mimicking and adapted cognitive-compartmental therapies, can be incorporated.[14,77,84] Some practical examples may include completing a task while counting backward, giving external cues rather than internal cues (eg, "bring the ball to the upper line on the wall" instead of "raise your arm"), having an athlete imagine the movement while still wearing a sling, and performing a task to the rhythm of a metronome or music.[14,39,84]

Key Principle 7: Sport-Specific Exercises Incorporate single-plane exercises at any point to achieve a specific goal (eg, addressing specific strength, power, or endurance deficits). However, clinicians must ensure that athletes progress to complex, multiplane exercises and ultimately sport-specific movements (with good quality) as soon as it is appropriate. Consider power (including rate of force development) for exercise selection from a joint-protection and performance perspective in preparation for sport. Examples of rehabilitation exercises can be found in **TABLE 4**. A detailed list of exercise suggestions from the Delphi survey is in **APPENDIX A** (available at www.jospt.org).

Regular Testing and Repeatability of Measures in Rehabilitation

Regularly test and monitor the athlete throughout rehabilitation, using standard measures that are reliable and easily repeatable. An ideal testing kit for clinicians may include items that are portable and require little time to complete.

1. Handheld dynamometer for measuring strength
2. Inclinometer or goniometer for measuring ROM
3. Questionnaires or patient-reported outcome measures

Lists of suggested patient-reported outcome measures from the Delphi survey are included in **APPENDICES B** and **C** (available at www.jospt.org).

Consensus point

Testing will be dictated by an athlete's specific impairments and should be conducted on a weekly basis (minimum).

Testing isometric strength at the start of each session will help the clinician to assess the athlete's response and recovery from a previous rehabilitation or training session. The results guide treatment planning. The regularity of testing may be resource and budget dependent.

There was no consensus about whether isokinetic assessment or isokinetic exercises are necessary during rehabilitation.

Isokinetic dynamometry is helpful, but not essential, to measure rehabilitation progress. Unanswered questions include which positions, movements, and planes are best to collect shoulder-specific rehabilitation measurements. The information gained by testing individual muscles in isolation has limited overall utility, as shoulder movement, strength, and function are the cumulative result of the kinetic chain.

Aim to include the same relevant subjective and objective measures in rehabilitation that the athlete performs with the team (eg, well-being/pain questionnaires, strength measures, sport-specific throw/attack counts). These data can be benchmarked against preinjury levels to measure progress and act to facilitate the transition along the RTS continuum.[5] Advances in technology have created opportunities for clinicians to measure ROM, perform video analysis, and receive feedback from athletes from anywhere in the world.

Section 4: RTS Decisions

Return to sport occurs along a continuum: from return to participation, to RTS, to return to performance (**FIGURE 3**).[5] These are not separate categories, and should be interpreted as a progressive flow.

The following definitions provide helpful context:

FIGURE 3. The 3 elements of the return-to-sport continuum. Republished with permission from BMJ Publishing Group Ltd.[5]

- Return to participation: the athlete participating in rehabilitation, training (modified or unrestricted), or sport, but at a level lower than his or her RTS goal. The athlete is physically active, but not yet "ready" (medically, physically, and/or psychologically) to RTS. It is possible to train, but this does not automatically mean RTS.
- Return to sport: the athlete returning to his or her sport, but participating below his or her previous or "desired" level of performance.
- Return to performance: the athlete playing a full game without restrictions or throwing the number of pitches in a game at the same velocity as he or she did before injury.

In this section, we frame 6 domains of body structure and function that affect the success of an athlete during RTS after shoulder injury. Case examples illustrate how clinicians and athletes can work together to consider and act on information gathered from the body structure and function domains prior to RTS.

The cases reflect the variable demands of sport (**FIGURE 2**): above shoulder height, with or without throwing; below shoulder height, with or without throwing; and reverse-chain demands. Contact sports carry added risk for the athlete and clinician to consider when making RTS decisions. The cases are exemplars for clinical reasoning, not a recipe. Clinical reasoning during RTS is complex and often influenced by external factors (context) beyond the control of the clinician or athlete. We illustrate the ideal scenario, where the athlete is liberated from external pressures to RTS early.

There is currently no valid single test or battery of tests for informing RTS decisions following a shoulder injury. Clinicians must employ clinical reasoning and select tests that are specific to the task, sport, and athlete when planning RTS. For a list of recommended tests, see **TABLE 5**.

Consensus point
Use a battery of sport-specific tests to determine when the athlete is ready to return to unrestricted sports participation.

RTS Criteria: 6 Domains to Consider for the Athlete Who Is Returning to Sport After Shoulder Injury

The 6 domains are not intended as a hierarchy. Depending on the sport and the specific injury, a domain may be more or less relevant. The criteria in each domain may also differ depending on where the athlete is on the RTS continuum (**FIGURE 3**). Agreement on the 6 domains was reached by consensus during the Delphi survey, and the content informed the survey and the in-person meeting as well as discussions among the authors.

TABLE 5 Sport-Specific Tests Recommended by the Delphi Group for Overhead (With or Without Throwing) Athletes and Collision-Sport Athletes

Performance Test	ROM/Strength Test	Kinetic Chain	Sport-Specific Test Example
CKCUEST[25] **VIDEO 11**[a]	90°/90° concentric/eccentric rotator cuff testing	Push-up test: assessing for ability, quality of movement, control, and endurance	Number of pain-free throws/serves at or above previous speed
PSET[32,33,63] **VIDEO 12**[a]	Isometric rotation strength ER/IR at 90°/0°	Side plank endurance	Throwing at full speed
Shoulder Endurance Test (SET) (endurance test for ER in ABD/ER, 90°/90°)[26]	Total rotational ROM within 10% of the contralateral side	Plyometric push-up	Visual assessment of the "smoothness" of the throwing technique
The Athletic Shoulder Test (ASH-Test)[6]	ER force measured with HHD in prone at 90°/90° and 90°/0° **VIDEO 13**[a]	Single-leg squat test	Wrestling drills
Y Balance Test for the upper and lower extremities[40] **VIDEO 14**[a]	ER/IR ratio: sport-specific numbers apply	Thoracic spine rotation	Tackle replication (eg, for American football or rugby) **VIDEO 15**[a]
Seated medicine-ball throw[25] **VIDEO 16**[a]	IR/ER ratio at 90°/90° in sitting (break test, HHD) **VIDEO 17**[a]	Bench press	Tackle replication with leg grab **VIDEO 18**[a]
Ball abduction-ER test **VIDEO 19**[a]	IR/ER ratio in sitting at 90° of abduction and neutral rotation **VIDEO 20**[a]	Upper-limb rotation test[25]	…
Ball taps on wall test **VIDEO 21**[a]	…	…	…
Prone ball-drop test **VIDEO 22**[a]	…	…	…

Abbreviations: CKCUEST, closed kinetic chain upper extremity stability test; ER, external rotation; HHD, handheld dynamometry; IR, internal rotation; PSET, posterior shoulder endurance test; ROM, range of motion.
[a]*Videos can be found at www.jospt.org/doi/10.2519/jospt.2022.10952*

Domain 1: Pain Gradual-onset shoulder injuries[7] are poorly defined, but the presence of long-lasting pain may hinder athletes from fully participating in training and competition. The consensus group found it difficult to reconcile differences in the irritability of pain levels between athletes with the importance of mental readiness to play with or without pain. Therefore, we recommend that athletes in overhead/throwing sports should be pain free when they are expected to perform at their previous level (or above). However, there are likely situations where this is not possible.

Consensus point
Overhead/throwing athletes can return to participation with pain, but should be pain free when attempting to return to performance.

For return to participation and RTS, there was no consensus on whether overhead/throwing athletes should be pain free, but contact-sport athletes were expected to be pain free. We recommend the Strategic Assessment of Risk and Risk Tolerance framework[82] for additional guidance. **TABLE 6** is designed to help support the reader to identify some examples of decisions around athletes in pain.

Consensus point
Contact-sport athletes can return to participation with pain, in a controlled environment, but should be pain free before RTS or return to performance is attempted.

Domain 2: Active Shoulder Joint ROM The relevance of regaining full shoulder joint ROM is extremely sport specific and crucial to address early in the RTS continuum (ie, return to participation) (**TABLE 7**). Many sports do not require full ROM to compete; however, others have specific end-range demands that are prerequisites for return to performance (eg, throwing sports such as baseball or swimming). Following some injuries (eg, surgical repair of traumatic shoulder instability), full preinjury ROM is often not achieved—here, consider the requirements of the sport more than the athlete's preinjury capabilities.

Consensus point
Overhead/throwing athletes do not need full ROM prior to return to participation, but full ROM should be restored before RTS.

For contact-sport athletes, full shoulder joint ROM is likely a lower priority; however, this is likely sport dependent. The lack of expectation for full ROM was stronger among athletes involved in sports played below shoulder height, in which the loss of ROM is less likely to impact performance.

Consensus point
There is no expectation to achieve full ROM at any stage of the RTS continuum in contact-sport athletes.

Domain 3: Strength, Power, and Endurance All sports with demands on the shoulder have a shoulder strength requirement (**TABLE 8**). Strength, power, and endurance encompass many components, such as peak force, rate of force development, fatigue resistance, velocity of contraction, etc. Shoulder strength requirements are sport and position specific.

In throwers and other sports with a rapid movement of the shoulder, such as tennis and badminton, speed is essential. So, too, is decelerating the arm during the follow-through phase. In sports such as rugby and gymnastics, bracing

TABLE 6 CASE EXAMPLES ILLUSTRATING HOW PAIN MAY IMPACT THE RETURN-TO-SPORT DECISION-MAKING PROCESS POST SHOULDER INJURY

Pain	Case 1	Case 2	Case 3
Characteristics	Below shoulder height, with or without throwing: rugby. Posttraumatic shoulder instability	Above shoulder height, with or without throwing: handball. Throwing-arm rotator cuff tear (grade 2)	Reverse chain: gymnastics. Gradual-onset rotator cuff tendinopathy
What might the athlete report?	Pain is likely not an important feature unless it reduces the athlete's confidence and willingness to perform sport-specific movements (ie, to perform actions without "guarding")	Given the insidious onset of the injury, the player may have reported increasing discomfort and pain during throwing, especially during competition. Minor shoulder soreness post training may be acceptable during return to training, with controlled throwing in elevation angles not causing pain and limited contact with opponents. Monitoring the posttraining pain is important. The athlete should be pain free for return to competition	The gymnast is likely to have pain during specific actions or in certain positions (hanging or standing on hands, with or without high-speed impact). For an all-around gymnast, return to training should be limited to the disciplines not provoking pain. For a professional athlete who specializes in a specific discipline (eg, still rings), promote progressive return to sports by limiting the impact of body weight during the swing, or by the position of the hands, for instance, a neutral grip rather than an L grip. A return to performance is only likely once the athlete is pain free
What might you measure?	Worst pain (NRS) during training activities	Pain NRS during direct contact (from the therapist initially), with padding in place as planned to use in training and games	Pain NRS during training (including specific exercises), after training, and the day after

Abbreviation: NRS, numeric rating scale.

and stability in the presence of external perturbation are more important than rapid shoulder movements. Power is important in weight lifting, while strength and endurance are important in swimming.

Most sports have more than 1 type of strength requirement (eg, handball includes speed, power, and stability, and there is a complex interplay between these variables). In the remainder of this section, we use the term *strength* without further clarification. We invite clinicians to differentiate based on the individual athlete's requirements.

Shoulder strength can be reliably assessed with a handheld dynamometer. However, strength values depend on the mode of testing (eg, isometric versus eccentric or break testing), the experience and skill of the clinician and athlete, the position of testing, and the sport.[22,24]

Consensus point

The ER/IR strength ratios are important for athletes in overhead/throwing sports, but should not be used in isolation. Absolute strength values also need to be considered to determine functional shoulder capacity.

There was no consensus on the use of ER/IR ratios in collision sports. In this athlete population, it may be pref-

TABLE 7 Case Examples Illustrating How to Consider Shoulder Range of Motion During the Return-to-Sport Continuum

Active ROM	Case 1	Case 2	Case 3
Characteristics	Below shoulder height, with or without throwing: rugby. Posttraumatic shoulder instability	Above shoulder height, with or without throwing: handball. Throwing-arm rotator cuff tear (grade 2)	Reverse chain: gymnastics. Gradual-onset rotator cuff tendinopathy
What might the athlete report?	Shoulder stiffness; the athlete may not regain (or need to regain) full preinjury ROM	End-range pain in full elevation or abduction-ER; articular ROM deficits are not to be suspected, except limited IR ROM as a sport-specific adaptation (GIRD)	No ROM limitations for some disciplines (for instance, pommel horse), but needs unrestricted, "more-than-normal" ROM for other disciplines, such as rings. In particular, the L grip requires full ROM into elevation and IR
What might you measure?	With nonsurgical treatment, the player will likely lose active ROM in shoulder elevation. Active movement may be accompanied by painless crepitus. Reassurance regarding noise in the absence of pain or a sensation of instability can be provided	ROM with special focus on IR and ER in a 90° abducted position. Common criteria are a side-to-side difference of <20° of IR in favor of the nondominant side, +5° to 10° of ER in favor of the dominant side, and a side-to-side difference of <10° of total ROM (IR + ER) in favor of the nondominant side	ROM into elevation, under different demands/positions, with full ER or IR

Abbreviations: ER, external rotation; GIRD, glenohumeral internal rotation deficit; IR, internal rotation; ROM, range of motion.

TABLE 8 Case Examples Illustrating How to Consider Upper-Limb/Shoulder Strength, Power, and Endurance During the Return-to-Sport Continuum

Strength	Case 1	Case 2	Case 3
Characteristics	Below shoulder height, with or without throwing: rugby. Posttraumatic shoulder instability	Above shoulder height, with or without throwing: handball. Throwing-arm rotator cuff tear (grade 2)	Reverse chain: gymnastics. Gradual-onset rotator cuff tendinopathy
What might you ask the athlete about?	Athlete-reported confidence during collisions and while performing usual weight training exercises, especially the bench press and shoulder fly	Athlete-reported stability, ability to load and to change speed and direction with arm movements (should not give symptoms of pain/ache afterward)	Athlete-reported confidence during hanging and high-impact swinging, handstanding, and high-impact tumbling
What measures of strength, power, or endurance might you use?	Isometric strength in all planes Countermovement plyometric press-ups The Delphi process suggested isokinetic (if available) values for an ER/IR strength ratio at 60°/s of approximately 0.7 for rugby	Isometric strength, mainly into ER and IR, with the following criteria for the ER/IR ratio: 0.70 to 0.75 when measured in neutral supine; 0.90 to 1.00 when measured seated, with 90° of abduction and neutral rotation; and 0.60 to 0.85 when measured seated, using abduction with ER[24] In professional players, consider measuring eccentric strength with an isokinetic dynamometer, with a dynamic ratio (eccentric ER/concentric IR) of 1.00 Consider endurance testing with the shoulder endurance test (endurance test for ER in abduction-ER)[26]	General shoulder strength in all directions. In gymnastics, symmetric strength values are to be expected, with a slight advantage for the dominant side

Abbreviations: ER, external rotation; IR, internal rotation.

erable to compare absolute strength to preinjury test results.[29] Due to the heterogeneity of ratios suggested for different sports, we are unable to recommend specific values. Absolute or raw values for ER and IR strength and power are more important than a universal ER/IR ratio, as ratios alone do not indicate readiness to RTS (ie, an athlete who is weak could still have a perfect ER/IR ratio if he or she is weak into both movements).

Clinicians choosing to use raw values should normalize the results to body weight for between-athlete comparison. Collecting baseline data (eg, in the preseason) helps to establish within-athlete norms and can inform the RTS process with individual athletes, as opposed to relying on population norms.

Domain 4: Kinetic Chain Hitting and throwing biomechanics vivify the kinetic chain: linked segments that operate in a proximal-to-distal sequence of energy transfer,[30] where velocity produced at the most proximal segment progresses to the distal segments (**TABLE 9**).[74] An efficient kinetic chain generates, aggregates, and facilitates controlled mechanical energy transfer along the entire chain, contributing to enhanced performance (velocity, force).[19] Inefficiency in any of the links proximally in the chain could increase distal demands, requiring other constituent parts of the chain to increase their contribution to avoid energy loss.

Identifying inadequate movement strategies wherever they occur along the length of the kinetic chain, and addressing them, is central to quality rehabilitation.[47]

Domain 5: Psychological Readiness Addressing psychological readiness to RTS is critical when supporting athletes to RTS (**TABLE 10**). The athlete must feel comfortable before progressing to the

TABLE 9 Case Examples Illustrating How to Consider the Kinetic Chain During the Return-to-Sport Continuum

Kinetic Chain	Case 1	Case 2	Case 3
Characteristics	Below shoulder height, with or without throwing: rugby. Posttraumatic shoulder instability	Above shoulder height, with or without throwing: handball. Throwing-arm rotator cuff tear (grade 2)	Reverse chain: gymnastics. Gradual-onset rotator cuff tendinopathy
What might you observe?	Inability to adequately position the legs and trunk prior to making contact in a tackle may place the athlete in an at-risk position. This can be related to reduced leg strength and/or reduced aerobic fitness	Reduced leg and trunk strength may leave the player vulnerable to "losing" routine collisions and falling onto the shoulder	Athletes with a "reverse" kinetic-chain demand often lack core stability and dynamic lower-limb stability in an upright position, and have an imbalance in development of muscle volume and strength between the upper and lower quadrants
What might you measure?	Squat-predicted 1RM (leg strength), 30-15 intermittent running test (aerobic capacity of the legs)	Squat-predicted 1RM[15] (leg strength), 30-15 intermittent running test,[16] side-to-side jumps and lateral jumps (aerobic capacity of the legs) Variations of dynamic side planks	Functional tests in the closed chain, such as the YBT-UQ and ULRT[25]

Abbreviations: 1RM, 1-repetition maximum; ULRT, upper-limb rotation test; YBT-UQ, Y Balance Test upper quadrant.

TABLE 10 Case Examples Illustrating How to Consider the Psychological Component of Athlete Readiness During the Return-to-Sport Continuum

Psychological	Case 1	Case 2	Case 3
Characteristics	Below shoulder height, with or without throwing: rugby. Posttraumatic shoulder instability	Above shoulder height, with or without throwing: handball. Throwing-arm rotator cuff tear (grade 2)	Reverse chain: gymnastics. Gradual-onset rotator cuff tendinopathy
What might you ask the athlete about?	The player should feel comfortable with shoulder impact situations (eg, falling on the shoulder, tackling and wrestling)	The player should feel comfortable with shoulder impact situations (eg, falling on the shoulder, tackling and wrestling), as well as throwing in unexpected situations (direction of throwing, impact from an opponent)	The gymnast should feel comfortable with maximum-speed hanging, swinging, and high-impact tumbling
What might you use to measure?[a]	SIRSI[37] Tampa Scale of Kinesiophobia[90] I-PRRS[38]	Tampa Scale of Kinesiophobia I-PRRS	Tampa Scale of Kinesiophobia I-PRRS

Abbreviations: I-PRRS, Injury-Psychological Readiness to Return to Sport scale; SIRSI, Shoulder Instability Return to Sport after Injury scale.
[a]The scales and outcome measures suggested are examples; other options to capture this concept exist.

next phase of the RTS continuum. Before return to participation, no apprehension during resistance training in the end range of shoulder motion or throwing at a specified intensity may support psychological readiness to RTS. Before RTS and return to performance, no apprehension during contact with opponents and low fear of reinjury may support psychological readiness to RTS.[5,37]

Domain 6: Sport Specific We intend the sport-specific examples to illustrate a framework that supports clinical reasoning (**TABLE 11**). Knowing the demands of the athlete's sport is crucial to supporting successful RTS, especially in return to performance.[5] In some sports, the shoulder-specific demands differ substantially across different playing positions, which must be considered when deciding on RTS criteria. As covered in domain 3 (strength, power, and endurance), compare to the athlete's preinjury values for the key demands of the sport, which may entail specific performance tests such as swimming 50 m in a set time or throwing a specific distance or velocity in training. If preinjury data are unavailable, sport-specific population norms could be a reasonable substitute, although these data must be interpreted and applied cautiously and should always be tailored to the level of the athlete (ie, norms for throwing velocity in professional athletes are unlikely to apply to the weekend warrior).

Limitations

Education was not discussed explicitly in either of the Delphi rounds or at the in-person meeting. Much of what we have laid out implicitly signals the need for education (eg, in load management). We recognize that education is an important consideration during the RTS of an athlete; however, this was not included by any of our experts during the Delphi statements in round 1 or 2, and was not considered at the in-person meeting in Bern.

This consensus process was initiated due to a lack of underpinning research in the area of RTS post shoulder injury. Our recommendations, therefore, come primarily from expert opinion. More prospective longitudinal studies with greater sample sizes are needed to refine our knowledge of the RTS process following shoulder injury.

Priorities for Future Study

The areas of nonconsensus from our Delphi process and expert meeting indicate priorities for future research. We present them here.

- How effective are early/youth prevention programs at reducing overuse shoulder injuries among adult elite and amateur athletes?
- Are there individual sports where specific shoulder screening is recommended due to the high demands placed specifically on the shoulder joint?
- Which are the best measurements of internal and external loads to capture for supporting return to training, sport, and performance post shoulder injury?
- Do strength or power measurements explain capacity to tolerate load in different sports?
- Does scapular dyskinesis increase the risk of pain following a shoulder injury in sport?

TABLE 11 Case Examples Illustrating How to Consider Sport-Specific Demands During the Return-to-Sport Continuum[a]

Sport Specific	Case 1	Case 2	Case 3
Characteristics	Below shoulder height, with or without throwing: rugby. Posttraumatic shoulder instability	Above shoulder height, with or without throwing: handball. Throwing-arm rotator cuff tear (grade 2)	Reverse chain: gymnastics. Gradual-onset rotator cuff tendinopathy
What data might you gather?	Reported confidence (ie, no apprehension) on resuming sport- and position-specific attacking and defensive drills Reported confidence in completing all training, especially strength and conditioning	Reported confidence (ie, no pain) on resuming sport- and position-specific attacking and defensive drills Reported confidence in completing all training, especially strength and conditioning and throwing	Completion of a progressive return to gymnastics, with full confidence Ability to efficiently execute all technical elements of the gymnastic techniques in all disciplines required
Which tests might help you decide whether the athlete is ready to return to sport?	CKCUEST[25] (**VIDEO 11**[b]) Collision practice completed Power tests (eg, press jump, countermovement plyometric press-up, box land), with no issues on return to contact drills Completion of at least 2 high-level trainings Consider using position-specific drills Consider testing the athlete when fatigued	CKCUEST (**VIDEO 11**[b]) Push-ups with claps (**VIDEO 10**[b]) Seated medicine-ball throw[25] (**VIDEO 16**[b]) Consider using position-specific drills Consider testing the athlete when fatigued Posterior shoulder endurance test[32,33,63] (see **TABLE 5**) (**VIDEO 12**[b]) Hop tests for the lower limb to establish effective power production and assess the ability to transfer force	CKCUEST (**VIDEO 11**[b]) ULRT YBT-UQ[40] (**VIDEO 14**[b]) YBT-LQ (**VIDEO 14**[b])

Abbreviations: CKCUEST, closed kinetic chain upper extremity stability test; ULRT, upper-limb rotation test; YBT-LQ, Y Balance Test lower quadrant; YBT-UQ, Y Balance Test upper quadrant.
[a]*See* **TABLE 5** *for sport-specific return-to-sport test recommendations.*
[b]*Videos can be found at www.jospt.org/doi/10.2519/jospt.2022.10952*

Summary

When supporting athletes to manage shoulder injury (including avoiding primary injury, designing appropriate rehabilitation, and supporting shared RTS decisions), we encourage clinicians to start by identifying the individual demands of the sport. Such an approach will form a solid base from which to effectively apply the principles we describe in this consensus statement in practice.

This statement sets out expert consensus-level guidance on how to frame the key decisions when supporting athletes to return to their sport. Load and risk management underpin primary and secondary prevention efforts, as well as the RTS continuum after an injury. We provide 7 key principles to consider when guiding an athlete through shoulder rehabilitation. We finish by outlining the 6 domains to consider as part of the RTS decision-making process: pain; active shoulder joint ROM; strength, power, and endurance; the kinetic chain; psychology; and return to sport-specific activities.

The additional resources provided with this statement are designed to support clinicians, coaches, and athletes at all levels of sports participation to select from a range of potential prevention exercises, appropriate rehabilitation exercises, patient-reported outcome measurements, and performance tests. These can be applied purposefully across different practice contexts. Our recommendations should be updated as further evidence emerges to facilitate improved decision making for managing shoulder injury in sport.

We encourage clinicians, researchers, athletes, coaches, and others involved in protecting athlete health to build on our consensus development processes in their future work, and to provide guidance that is tailored to the individual sport and playing position. ◉

STUDY DETAILS

AUTHOR CONTRIBUTIONS: Ariane Schwank, Paul Blazey, and Dr Ardern led the development of the full Delphi process (article selection, question formation, survey collation, and feedback), cochaired the in-person meeting in Bern, and led the development of the manuscript. Drs Møller, Asker, Andersson, Hägglund, Skazalski, Horsley, Whiteley, Cools, and Bizzini and Suzanne Gard all participated in the Delphi feedback and presented key findings at the in-person meeting. Drs Møller, Asker, Andersson, and Hägglund led the drafting of the risk and load management sections of the manuscript. Suzanne Gard and Dr Skazalski led the drafting of the rehabilitation section. Drs Horsley, Asker, and Whiteley led the drafting of the return-to-sport section of the manuscript. Drs Cools and Bizzini contributed to refining the overall manuscript and to production of the figures.

DATA SHARING: The full list of Delphi responses and the list of papers that informed the Delphi survey are available from the authors on request.

PATIENT AND PUBLIC INVOLVEMENT: There was no patient or public involvement in the production of this statement.

Acknowledgments

List of All Who Consented to Participate in the Delphi Process

We thank all the shoulder experts whose effort and time in answering questions and providing valuable feedback during the Delphi process provided the substrate for this consensus statement. Those who consented to be named are: Cornelia Albrecht, Stig Andersson, Ben Ashworth, Martin Asker, Mario Bizzini, Ben Clarsen, Ann Cools, Todd Ellenbecker, Edel Fanning, Hilde Fredriksen, Suzanne Gard, Jo Gibson, Martin Hägglund, Ian Horsley, Anju Jaggi, Fredrik Johansson, Kajsa Johansson, Kevin Kuppens, Jeremy Lewis, Karen McCreesh, Lori Michener, Milena Mirkovic, Merete Møller, Andrea Mosler, Steven Mutch, Margie Olds, Tania Pizzari, Babette Pluim, Mike Reinold, Amee Seitz, Vincent Singh, Chris Skazalski, Filip Struyf, Sarah Warby, Rod Whiteley, Kevin Wilk, and Alexis Wright.

Those involved in the in-person meeting in Bern were: Clare Ardern (cochair), Martin Asker, Mario Bizzini (host), Paul Blazey (cochair), Ann Cools, Suzanne Gard, Martin Hägglund, Ian Horsley, Merete Møller, and Ariane Schwank (cochair).

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APPENDIX A

EXERCISE RECOMMENDATIONS FOR INJURY PREVENTION AND REHABILITATION FROM THE DELPHI SURVEY (ROUND 1)

Low Load

Range of Motion/Strength Training	Plyometrics	Open/Closed Kinetic Chain
Isometric ER strength	Drop catches/release and catch of ball (eg, sidelying with a weighted ball or standing IR/ER in 90°/90°) (**VIDEO 2**)	Plank with arm movements
Posterior cuff activation in various planes (eg, hitchhiker: resisted external rotation supported in the 90°/0° or 90°/90° plane)	Anterior cuff activation (eg, ball taps in 90°/90°)	Resisted wall slides
Variations of glenohumeral ER • In 45° of abduction/flexion • In 90° of abduction/flexion • Overhead height with an eccentric focus	Elastic bands (fast concentric to slow eccentric) in 90°	Push-up variations (including hands in line with head, push-up back drop, sling, etc) Push-up with a plus
Prone, weighted ER in 90°/90°	Plyometric weighted ER in sidelying	Deep neck flexor exercises (supine and standing)
Integrated upward scapular rotation control, with well-controlled ER	Supine plyometric ER in 90°/90°	Closed kinetic chain exercises (eg, Y Balance Test exercises) (**VIDEO 14**)
Scaption with low load and a focus on scapular control	Variations of plyometric catch and release with a long lever	(Preactivation) "stick push" partner exercise (both in the ready position)
IR in the abduction-ER position	End-range shoulder flexion with small oscillations (elastic/ball against the wall/manual resistance)	(Preactivation) dynamic trunk rotations, with stable upper extremities
ER activation in different body positions, with progressively less support • Prone • Tabletop • Prone plank	...	Prone (gluteus-hamstring machine) single-arm Y isometric hold
Weighted ER in side plank	...	...

Abbreviations: ER, external rotation; IR, internal rotation.

High Load

Range of Motion/Strength Training	Plyometrics	Open/Closed Kinetic Chain
(Preactivation) IR/ER in 90°/90° with tubing in a squat position	Prone end-range throwing position with rotator cuff on/off (ER/IR): speed isometrically	Bear crawls
Standing with the arm elevated and with the hand on a ball against the wall (resistance bands) Hand/foot: stretching for the last degrees of arm elevation and upward scapular rotation (**VIDEO 4**)	Posterior shoulder deceleration drills (0.5- to 1.0-kg medicine ball)	Unilateral shoulder press (dominant arm) in combination with a step-up (explosive strength)
Weighted ER in 90° of abduction	Fast concentric, slow eccentric ball throw in the abduction-ER position/plyometric ball catch-and-release exercises (**VIDEO 8**)	W-V exercises: plank on an exercise ball with ER
Overhead elastic shoulder flexion with ER activation	Clap push-up/plyometric press-up (**VIDEO 10**)	Turkish get-up
Y raises with tubes or dumbbells (**VIDEO 7**)	Catching exercises with a plyoball in side or prone planking	Resistance-band throwing technique with pelvic drive
Long-lever resisted/weighted horizontal abduction and flexion with ER	Control of position in cocking	Overhead squats
Y exercise: supine, wall, standing (posterior cuff facilitation through the scaption/flexion plane)	Derby shoulder stability program	...
Cable catches (T position) for anterior shoulder protection	Throw/catch from behind	...
Overhead shoulder diagonals (PNF, diagonal 2: manual resistance/elastic/light dumbbells)	...	...

Abbreviations: ER, external rotation; IR, internal rotation; PNF, proprioceptive neuromuscular facilitation; V, position with extension of the elbows; W, position with flexed elbows and arms parallel to the body.

APPENDIX B

SPORTING ENVIRONMENT–APPROPRIATE PATIENT-REPORTED OUTCOME MEASURES SUGGESTED BY THE DELPHI GROUP FOR SUPPORTING RETURN-TO-SPORT DECISIONS

The following table is a list of patient-reported outcome measures collected from the online Delphi survey (rounds 1 and 2) and the in-person meeting. Suggestions are not sport specific.

Function, Disease Specific	Psychological PROMs Related to Sports
Kerlan-Jobe Orthopaedic Clinic overhead athlete scores[1]	Injury-Psychological Readiness to Return to Sport scale[38]
Shoulder Instability Return to Sport after Injury scale[37]	Shoulder Instability Return to Sport after Injury scale[a]
Oslo Sports Trauma Research Centre Overuse Injury Questionnaire[21]	Psychological readiness/confidence score/self-efficacy score[b]
Functional Arm Scale for Throwers[80]	

Abbreviation: PROM, patient-reported outcome measure.
[a]*Psychological readiness subscale.*
[b]*Using a 0-to-10 numeric rating scale.*

APPENDIX C

SHOULDER-SPECIFIC PATIENT-REPORTED OUTCOME MEASURES SUGGESTED BY THE DELPHI GROUP FOR SUPPORTING RETURN-TO-SPORT DECISIONS

The following table is a list of patient-reported outcome measures collected from the online Delphi survey (rounds 1 and 2) and the in-person meeting. Suggestions are not sport specific.

General Shoulder Function	Disease Specific
Shoulder Pain and Disability Index	Western Ontario Shoulder Instability Index
American Shoulder and Elbow Surgeons standardized shoulder assessment form	Melbourne Instability Shoulder Scale
Disabilities of the Arm, Shoulder and Hand questionnaire	
Constant-Murley score	
Penn Shoulder Score (satisfaction, function, pain)	
Patient-Specific Functional Scale	
Simple shoulder test	