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RETURN TO PLAY FOLLOWING A SHOULDER STABILIZATION SURGERY IN ATHLETES WITH ANTERIOR SHOULDER INSTABILITY. A SYSTEMATIC REVIEW OF SYSTEMATIC REVIEWS

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Practice Project (HEAL997), 2021

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A thesis submitted to Auckland University of Technology in partial fulfillment of the requirements for the degree of Master of Health Practice in Musculoskeletal Physiotherapy (AK3733)

Word count: 12126

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ABBREVIATIONS

ABR: Arthroscopic Bankart Repair

ACL: Anterior cruciate ligament

ASI: Anterior shoulder instability

AAI: Acute atraumatic instability

AAOS: American Academy of Orthopedic Surgeons

AMSTAR:

ASES: American Shoulder and Elbow Surgeons Shoulder Outcome Score

AUC: Appropriate Use Criteria

BJSM: British Journal of Sports Medicine

CKCUES: Closed kinetic chain upper extremity stability test

ER: External rotation

FEDS: Frequency, Etiology, Direction, Severity

HHD: Hand held dynamometry

HAGL: Humeral avulsion of the glenohumeral ligament

ICC: Intraclass correlation coefficient

ID: Isokinetic dynamometry

IFSPT: International Federation of Sports Physical Therapy

IGHL: Inferior glenohumeral ligament

IR: Internal rotation

PICO: Patient, Intervention, Comparator and Outcome

PRISMA: Preferred Reporting Items for Systematic Reviews and Metaanalyses

PRIS: Predicting Recurrent Instability of the Shoulder

PROM: Patient-reported outcome measures

RCT: Randomized controlled trial

RTP: Return to play

RTS: Return to sport

ROM: Range of motion

SARTS: Shoulder arm return to sports

SSV: Subjective Shoulder Value

StARRT: Strategic assessment of risk and risk tolerance

WOSII: Western Ontario Shoulder Instability Index

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ATTESTATION OF AUTHORSHIP

“I state that this thesis writeup is my work and that, to the best of my knowledge and belief, it contains no writings previously published or drafted by any another person, nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or any other institution of higher learning.”

CHAPTER 1: INTRODUCTION

Shoulder Instability

Shoulder injuries can be devastating to athletes, often causing a reduction in shoulder function and implications for an athlete's sporting career (Lau et al., 2021). Shoulder instability is one of the common injuries often seen in collision sports and can have debilitating consequences (Anderson et al., 2021; Goodman et al., 2019). Shoulder instability represents a spectrum of injuries influenced by the type of instability and direction of instability (Anderson et al., 2021). Many patients with shoulder instability may have symptoms predominantly related to pain but not necessarily instability whereas some patients can sublux their shoulder without any symptoms (Kuhn, 2010). Therefore, patients with shoulder instability can present with symptoms and feelings of looseness, slipping, or shoulder “popping out” to meet the definition of instability (Kuhn, 2010).

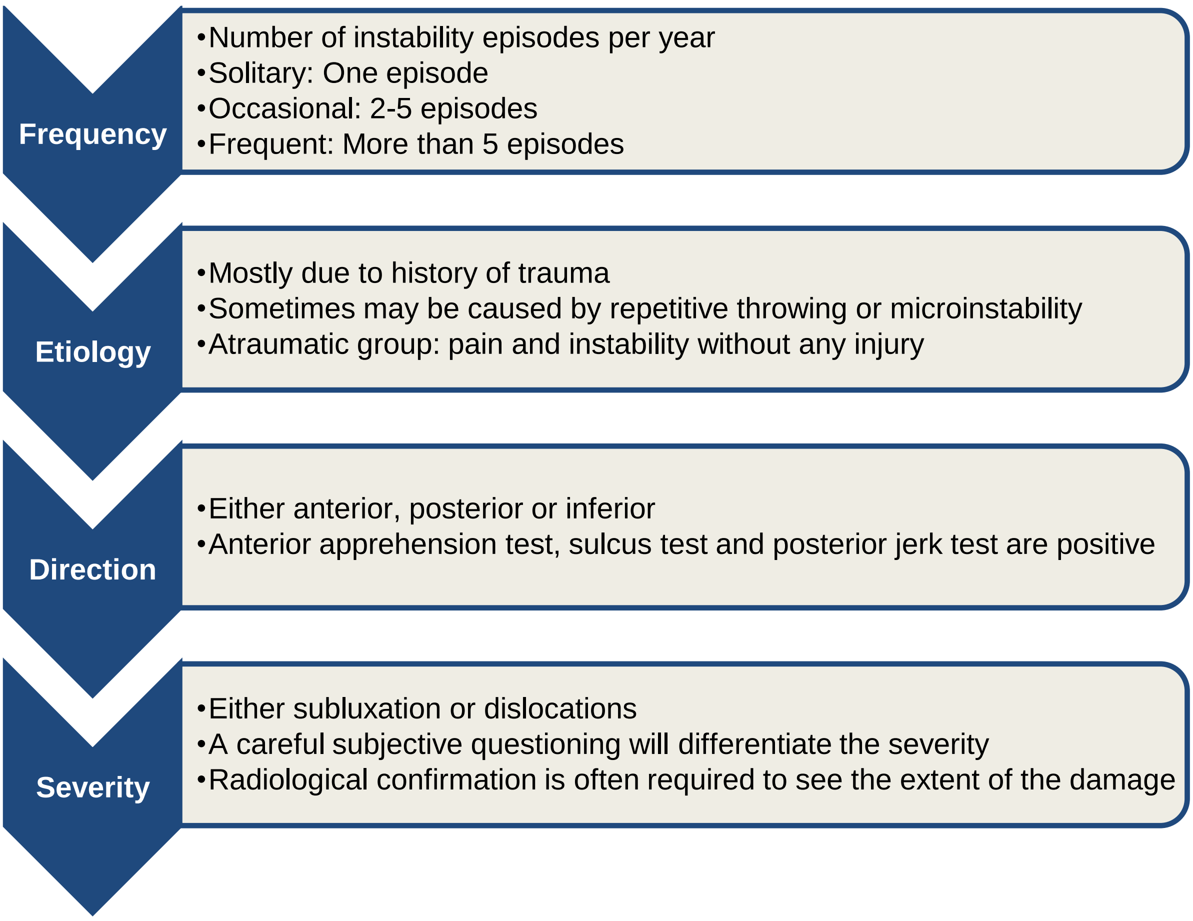
Classification of Shoulder instabilities

There is variation in the ability to classify shoulder instability within the current literature (Hettrich et al., 2019; Kuhn, 2010). Two classification systems commonly referred to are the FEDS system and the Stanmore system. The FEDS (figure 1) stands for F-Frequency, E-Etiology, D-Direction, and S-Severity (Kuhn, 2010). This classification system has good content validity and is highly reliable for classifying shoulder instability (Kuhn et al., 2011). The intra-rater and inter-rater reliability for the individual components of the FEDS classification system is found to be 84%-97% and 82%-90%, respectively (Kuhn et al., 2011). The second system, the Stanmore classification, allows shoulder instabilities to be separated into three groups based on the cause of instability (Danzinger et al., 2019).

Traumatic structural injuries are polar type I, while atraumatic structural injuries fall under polar type II shoulder instabilities (Danzinger et al., 2019). However, there is also a subtype of shoulder instability with predominately abnormal muscle activation patterns called polar type III (Danzinger et al., 2019; Lewis et al., 2004). Structural insufficiencies do not generally cause these polar type III subtypes, and they are often labeled as functional shoulder instability (Danzinger et al., 2019; Moroder et al., 2020).

Figure 1

Classification Of Shoulder Instability According to The FEDS System



***Note**:* This figure is adapted from Kuhn 2010 (Kuhn, 2010)

Anterior Shoulder Instability

Anterior shoulder instability (ASI) accounts for 80% of shoulder instabilities experienced by the athletic population characterized by both shoulder subluxation and dislocation (Owens et al., 2007, 2014). Shoulder subluxations and dislocations often present differently where subluxations self-reduce, while dislocations will not (Kuhn, 2010). ASI is widespread amongst athletes, most often caused by trauma that dislocates the humerus head anteriorly from the glenoid fossa with associated disruption of the anterior labrum and anterior capsule (Ialenti et al., 2017; Savin et al., 2017). The resultant shoulder anterior translation occurs during all elevation planes, resulting in recurrent ASI (An et al., 2016; Olds et al., 2015). ASI also comprises anterior shoulder dislocations with a reported prevalence as high as 1.7% in the general population (Hettrich et al., 2019; Nordqvist & Petersson, 1995). Anterior shoulder dislocations are 15.5 to 21.7 times more common than posterior dislocations, which occur at a rate of 1.1 per 100,000 population per year (Hettrich et al., 2019; Robinson & Aderinto, 2005). Hill Sach's lesion (compression fractures to humeral head) are commonly seen in 47% - 90% of all first-time anterior shoulder dislocators and can include glenoid bone loss when further recurrent ASI occurs (An et al., 2016; Boileau et al., 2006).

Biomechanical factors of anterior shoulder instability

Various biomechanical factors may predispose an athlete to develop anterior shoulder instability. These relate to the biomechanical forces during overhead movements, shoulder muscle imbalances, flexibility deficits, or a traumatic event. One of the most common factors is microinstability during overhead activity. Microinstability can lead to ASI from the acquired capsular laxity from tensile loading because of excessive scapular protraction or glenohumeral external rotation (Kibler & Thomas, 2012). The second factor is acute atraumatic instability (AAI) that also has a similar mechanism as microinstability, generally seen in pitchers (Bixby & Ahmad, 2021). The most common symptom in AAI is anterior shoulder pain, reduced pitch velocity, or “dead arm” during the late cocking phase of throwing (Bixby & Ahmad, 2021). Another factor is a trauma that typically occurs like an acute subluxation or a dislocation episode in activities such as diving for a ball, colliding with another athlete or a wall, or sliding on the ground with an outstretched arm (Bixby & Ahmad, 2021). These traumatic ASI injuries create anterior capsular tears and anterior labrum detachment, commonly known as Bankart lesions (Bixby & Ahmad, 2021). The scapular dyskinesis is also a common factor in most shoulder pain patients caused by an imbalance in the muscles around the scapular region that can alter the scapular position and hence the load on the various structures around it. In scapular dyskinesia, there is an inhibition of lower trapezius and serratus anterior and overactivity of the upper trapezius and pectoralis minor, leading to excessive scapular protraction and risk of developing ASI (Cole et al., 2021). The glenohumeral internal rotation deficit (GIRD), commonly found in the thrower’s arm, is caused primarily due to posterior capsule thickness that causes increased shoulder external rotation and tensile load on the anterior capsule leading to ASI (Burkhart et al., 2003; Cole et al., 2021). The last risk factor is the kinetic chain, a mechanism by which the force is generated through the proximal larger area of the core trunk muscle group, then transferred to the shoulder and towards the distal segments, mostly during overhead movements (such as throwing) (Kibler & Thomas, 2012). The thoracolumbar fascia is involved during the throwing motion that connects the lower limbs through the gluteus maximus muscle to the upper limb through the lattisimus dorsi muscle (Chu et al., 2016). It covers the deep back and trunk muscles, including multifidi, and connects to the internal oblique and transverse abdominis muscle (Sciascia et al., 2012). Any deficits in these kinetic chain links may predispose an athlete to compensate through the shoulder, creating a greater force on the anterior shoulder and developing ASI.

Surgical Management of anterior shoulder instability

There are numerous arthroscopic surgical techniques to restore mechanical shoulder stability, such as Bankart repairs, Latarjet or Bristow procedures, bone block procedures (including iliac crest and distal tibial allografts), and other procedures including inferior capsular shifts or remplissage procedures (Bixby & Ahmad, 2021). The arthroscopic Bankart repair (ABR) and the Latarjet bone block procedure are the most widely used surgical procedures to treat anterior shoulder dislocations (Bessière et al., 2014). The surgical stabilization of the Bankart lesion can be performed arthroscopically and via an open repair, where the torn anterior labrum is reattached to the glenoid, anatomically creating structural stability (Memon et al., 2018).

The Latarjet-Bristow procedure (also called coracoid bone transfer procedure) is commonly performed, indicated when the glenoid bone loss is more than 15%, and the patients are at high risk of recurrence (Hurley et al., 2019). In Latarjet-Bristow procedures, a part of the coracoid bone is transferred to the anterior glenoid rim, lengthening the distance of bone the humerus can track along before it becomes at risk for dislocating anteriorly (Bixby & Ahmad, 2021). This procedure restores glenoid concavity and blocks anterior translation of the humeral head while the conjoined tendon act as a dynamic sling (Glogovac et al., 2019). Supporters of the transposition of the coracoid justify their choice mainly based on a lower recurrence rate and a better RTP to pre-injury state, especially if the athlete participates in a collision sport (Bessière et al., 2014; Blonna et al., 2016). Similarly, the arthroscopic Bankart stabilization strategy restores the shoulder's anatomy, preserves the ROM, and, with modern instruments, is supposed to be as effective as the Latarjet procedure (Blonna et al., 2016; Cole & Warner, 2000). Several procedures have also been advocated to treat the engaging Hill Sach’s bone defect: bone graft, retrograde desimpaction, arthroplasty, partial humeral head resurfacing, humeral rotation osteotomy, and posterior soft tissue filling of the Hill Sach lesion, commonly called as Hill-Sach remplissage (Camus et al., 2018).

Return to play: A complex decision-making process

The return-to-play (RTP) decisions are made by sports clinicians daily, either on or off the field at the time of shoulder dislocation or following a surgical repair (Menta & D’Angelo, 2016). Guidelines are becoming more frequent for many sports-related medical conditions such as concussion, spinal cord injury, and cardiovascular abnormalities (Shrier et al., 2015). However, a vast range of conditions still lack well-established RTP guidelines, and athletes often have to depend on the clinician’s ability to assess complex factors responsible for RTP decision-making (Shrier et al., 2015). Establishing a protocol for returning an athlete to play is important in deciding when an injured athlete can safely return to practice or competition (Herring et al., 2002). In 2002, the American College of Sports Medicine published a consensus statement that included various RTP elements, such as establishing RTP process, evaluating or treating/rehabilitating injured athlete, or returning an injured athlete to play, to help clinicians make informed decisions about a safe return to play (Herring et al., 2002). However, the 2002 consensus statement failed to explain how or why those elements influence the medical decision-making process (Shultz et al., 2010).

In 2010, Creighton and colleagues proposed a three-step model for RTP decisions in sports medicine that provided the clinician structure and transparency within a complex process (Shultz et al., 2010). This decision-based RTP model provided a foundation for research into the individual factors and components that provided clinicians with an evidence-based rationale for RTP decision-making (Shultz et al., 2010). The first step in the decision-based RTP model is the evaluation of an athlete's health status. This first step corresponds to an athlete's physical, physiological, and functional status influenced by various medical factors. In other words, it is how much an injured tissue has healed that allows an athlete to progress further and participate in sporting activities. The second step is the evaluation of the participation risk since a high risk of reinjury can be detrimental and disadvantageous to the athlete. However, sport risk modifiers also affect the risk associated with participation. For example, it may be possible to protect the injury with padding or minimize risk by changing the player's position. Although the RTP decision is fundamentally based on the risks associated with participation, decision-making in all fields is based on a *risk-benefit balance* (Shultz et al., 2010). Therefore, the clinician’s role is to determine the most appropriate level of risk. This evaluation must occur within the context of the “decision modifiers,” which are essentially the factors that can change the decision made if the participation risk (step 2) had been considered alone. The third step, decision modification, has three important factors to consider. Firstly, unlike participation risk, these factors are not completely dependent on an athlete. Secondly, some clinicians may not consider all the factors that outline decision modifiers. Thirdly, decision modification is isolated from the other steps because participation risk does not influence any information about decision modification. Decision modification alone cannot determine the RTP readiness of an athlete except in the known participation risks.

The decision-based RTP model developed by Creighton et al. (2010) faced many challenges about how certain factors fit or do not fit within the model. Also, the question arose in the framework’s ability to account for very serious conditions such as a concussion or when there are simultaneous risks (short term re-injury risk or long term complication of arthritis) (Shrier, 2015). Therefore, Shrier et al. (2015) proposed a modified version of the originally developed decision-based RTP model, a Strategic Assessment of Risk and Risk Tolerance (StARRT) framework (Shrier, 2015). The StARRT framework considers that the basis of RTP decisions is a risk assessment of the outcome. The risk is then compared with one’s risk tolerance, where if the risk assessment is greater than one’s risk tolerance, then the athlete is not allowed to RTP (Shrier, 2015; Shultz et al., 2010). The StARRT framework considers a three-step process, the first relates to the tissue Health (Medical factors), the second relates to tissue stressors (Sport Risk Modifiers), and a final step known as risk tolerance modifiers (Decision Modifiers), where an athlete can RTP only when the *risk assessment* (tissue health and tissue stressors) is less than the acceptable risk tolerance (Shrier, 2015).

In recent years, there has been an increasing amount of literature on RTP test batteries and knee injuries (Barber-Westin & Noyes, 2011; Ellman et al., 2015; Roe et al., 2021). However, the research is sparse around RTP test batteries following an anterior shoulder stabilization surgery (Connor. S. Kasik et al., 2019; Kim & Saper, 2020; Lau et al., 2021; Nadeem et al., 2020; Stone & Pearsall, 2014). In 2015, the American Academy of Orthopedic Surgeons (AAOS) created the Appropriate Use Criteria (AUC) with seven criteria for RTP in patients operated with anterior cruciate ligament (ACL) reconstruction (Ellman et al., 2015; Roe et al., 2021). The AAOS recommends that athletes who meet at least six criteria out of seven are allowed to RTP, suggesting that enforcing these criteria will reduce any subsequent knee injury after RTP (Ellman et al., 2015; Roe et al., 2021). These criteria include assessing knee stability, ROM, strength, balance, functional ability, and confidence (Roe et al., 2021). The criteria from Roe et al. (2021) included factors such as joint stability, ROM, strength, balance, and functional ability, and fits well under the recent RTP guidelines, StARRT framework, and inform the tissue health status or the medical factors (Roe et al., 2021; Shrier, 2015). The criteria from Roe et al. (2021), also relate to the tissue stressors or the sport risk modifiers from the recent RTP guidelines (StARRT framework) and inform the activity risk or the psychological status (Roe et al., 2021; Shrier, 2015).

Psychological factors are also being increasingly recognized as an important determinant of the ability for RTP (Nwachukwu et al., 2019). In a systematic review by Nwachukwu et al. (2019) exploring psychological factors and RTP after ACL reconstruction, findings suggest that out of 795 patients who did not RTP, 514 patients (64.7%) did not return due to lack of psychological readiness (Nwachukwu et al., 2019). Fear of re-injury was the common reason for poor RTP performance and other psychological factors such as lack of confidence, depression, lack of interest/motivation (Nwachukwu et al., 2019). Psychological readiness is an important factor to consider during RTP decision-making that fits well under tissue stressors or the sport risk modifiers within the StARRT framework (Shrier, 2015).

The rationale of the study

Athletes often undergo a surgical procedure to repair the damaged shoulder structures if conservative treatment is unsuccessful (Blonna et al., 2016). For appropriately indicated patients, surgical management is standard, particularly in active athletes who are at the highest risk of recurrent instability if left untreated (Cannizzaro et al., 2020). Despite successful surgery, the athletes may not return to their pre-injury level of sport without suitable RTP criteria (Hurley et al., 2019). With respect to shoulder surgeries, many athletes fail to throw at full intensity despite full anatomic repair of the injured tissue leading to more extended RTP times and missed tournaments. Since athletes desire a quick return to play (RTP), there needs to be a clear protocol to RTP that is developed through evidence, which ensures a safe return to participation and minimal recurrence (Wagstrom et al., 2019).

Currently, there is insufficient literature around evidence-based RTP protocols and outcome measures for arthroscopic shoulder stabilization (Kim & Saper, 2020). The outcome reporting is not standardized following surgical Bankart repair in the adolescent age group

(Kasik et al., 2019; Kasik & Saper, 2018). Information is sparse regarding the RTP timelines and criteria to RTP in athletes operated with open Bankart repair (Stone & Pearsall, 2014). There is also considerable variability in how the outcomes are reported for high-impact traumatic ASI, with 28 different outcome tools used, making it challenging to select outcome tools for practical use (Kasik & Saper, 2018). Looking at the recent developments in the RTP decision-making (Shrier, 2015), there is a need to investigate RTP outcome measures following arthroscopic stabilization in ASI that can inform tissue health (Medical factors), tissue stressors (Sport Risk Modifiers), and risk tolerance modifiers (Decision Modifiers), within the StARRT framework.

The purpose of this systematic review was to appraise all the systematic reviews that have explored RTP outcomes following a shoulder stabilization surgery in athletes having ASI. This review has addressed the following question in a broader sense; what is the current evidence of the clinical and functional criteria to RTP in sports following a shoulder stabilization surgery in athletes with ASI? This review will address the following sub-questions: What is the evidence-based RTP time frame following a shoulder stabilization surgery in sports? What are the evidence-based criteria to RTP when considering strength measures following an anterior shoulder stabilization surgery in sports? Furthermore, what is the evidence for functional improvements using patient-reported outcome measures (PROM) following an anterior shoulder stabilization surgery in sports?

This review aims to take a broader view and synthesize all current evidence for their use and applicability to practice. The objective of this review was to assess the methodological quality of all the included systematic reviews by a measurement tool to assess the systematic reviews (AMSTAR-2) tool. AMSTAR 2 enables the critical appraisal of systematic reviews, including randomized controlled and non-randomized studies. Therefore, in this study, a systematic review of systematic reviews was performed to establish a higher-level overview of the current systematic reviews. A summary of new practice recommendations is proposed based on the results of this systematic review.

CHAPTER 2: SYSTEMATIC REVIEW

Introduction

Traumatic shoulder dislocations are prevalent in contact or collision sports, and a majority of them occur anteriorly, causing anterior shoulder instability (ASI) (Kim & Saper, 2020). ASI is a common sports injury that can cause pain, reduced function, time loss from sports and affect the quality of life (Abdul-Rassoul et al., 2018; Meller et al., 2007). Recurrent instability is also more common within two years after the first-time dislocation in male athletes younger than 25 years (Glogovac et al., 2019). In most cases, the incidence of traumatic shoulder instability in the general population is 1.7%, but most of these instabilities are due to sports participation (Abdul-Rassoul et al., 2018; Boone & Arciero, 2010). In an active military population group, the reported incidence is as high as 3% and increases to 5.7% per season in adolescent rugby athletes (Kawasaki et al., 2014; Lau et al., 2021).

ASI can be satisfactorily treated non-operatively in an older population through physical therapy and activity modification (Ialenti et al., 2017). Arthroscopic repair has been advocated to address ASI, mainly to prevent negative consequences of recurrent instability (Kim & Saper, 2020). Arthroscopic repair improves patient-reported outcomes, but the incidence of recurrent instability still exists, affecting athlete return to play (RTP) (Hovelius & Rahme, 2016; Kim & Saper, 2020). One important metric of a successful recovery post-shoulder stabilization is time to RTP with minimal time loss post-surgery (Abdul-Rassoul et al., 2018). Regardless of a surgical approach, the clinicians need to determine an accurate time frame to RTP at pre-injury levels post shoulder stabilization (Abdul-Rassoul et al., 2018). However, it remains unclear when an athlete should RTP after shoulder stabilization and what criteria the surgeons and physiotherapists should use to allow a safe and faster return to play in athletes (Fanning et al., 2020).

Rationale and objectives

The purpose of this systematic review was to appraise all the systematic reviews that have explored RTP outcomes following a shoulder stabilization surgery in athletes having ASI. This review has addressed the following question in a broader sense; what is the current evidence of the clinical and functional criteria to RTP in sports following a shoulder stabilization surgery in athletes with ASI? This review will highlight the following sub-questions: What is the evidence-based RTP time frame following a shoulder stabilization surgery in sports? What are the evidence-based criteria to RTP when considering strength measures following an anterior shoulder stabilization surgery in sports? Furthermore, what is the evidence for functional improvements using patient-reported outcome measures (PROM) following an anterior shoulder stabilization surgery in sports?

This review aims to take a broader view and synthesize all current evidence for their use and applicability to practice. The objective of this review will be to assess the methodological quality of all the included systematic reviews by a measurement tool to assess the systematic reviews (AMSTAR-2) tool. AMSTAR 2 enables the critical appraisal of systematic reviews, including randomized controlled and non-randomized studies. Therefore, in this study, a systematic review of systematic reviews was performed to establish a higher-level overview of the current systematic reviews.

Methods

Protocol and registration

A systematic review of the literature was performed using the Preferred Reporting Items for Systematic Review and Metaanalyses (PRISMA) framework (Moher et al., 2009). This review was exempt from any ethics committee approval. The review protocol was registered under PROSPERO, a prospective international register of a systematic review (registration ID: CRD42021254945). The review methods and research questions were established before the literature search, data extraction, and analysis.

Information sources

The primary researcher (AN) performed an electronic search of the literature using the EBSCO health database (MEDLINE, CINHAL COMPLETE, and SPORTDISCUSS), WEB OF SCIENCE, SCOPUS, AMED via OVID, and COCHRANE via OVID. The search was undertaken using a modification of keywords and MeSh terms based on ideas developed to answer the review questions. The full search strategy is available in Appendix 1 (supplementary material). The last search was performed on 25th May 2021 using the Auckland University of Technology library database. The reference list of the selected articles was manually searched to identify any additional records.

Search

The search strategy for EBSCO Health Database (MEDLINE, CINHAL, AND SPORTDISCUSS) is described in Table 1. A list of excluded studies and a complete search strategy are available as supplementary information.

Table 1

Search strategy for EBSCO health database

Search	Keywords
S1	"shoulder instability" OR "shoulder subluxation*" OR Bankart OR labrum OR labral OR "humeral avulsion of glenohumeral ligament" OR HAGL OR "glenohumeral instability"
S2	(shoulder or glenohumeral) N4 (dislocat*)
S3	S1 OR s2
S4	"shoulder stabili*" OR surg* OR arthroscop* OR "Bankart repair*" OR "coracoid transfer" OR Latarjet OR Bristow OR Remplissage OR "bone block" OR "bone graft" OR "open repair"
S5	S3 AND S4
S6	(return*) N4 (play* OR sport* OR athlet* OR performance OR Cricket OR Tennis OR baseball OR thrower* OR bowl* OR Basketball OR Volleyball OR Badminton OR Netball OR Handball)
S7	S5 AND S6
S8	"patient-reported outcome*" OR PROM OR "functional improvement*" OR "functional outcome*" OR strength* OR tim*
S9	S7 AND S8
S10	"systematic review*" OR meta-analysis

Study selection

Studies were eligible for inclusion if they were systematic reviews evaluating the RTP following arthroscopic shoulder stabilization. In particular, the studies were included if they had explored time to RTP, strength outcomes, and PROM following arthroscopic shoulder stabilization procedure. Only studies published in English that had no limit to the year of publication were included. Studies were excluded if they reported multi-directional, inferior, or posterior shoulder instability. A full list of inclusion and exclusion criteria is shown in Table 2.

Table 2

Inclusion and exclusion criteria

INCLUSION	EXCLUSION
Study design • Systematic reviews of randomized or non-randomized studies • Published in English • No year limit	**Study design** • All narrative reviews/scoping reviews • All biomechanical studies • Only abstracts • Unpublished research
Participants/setting • Patients of all ages • Patients had anterior shoulder instability, anterior dislocation, anterior subluxation, or recurrent anterior instability/dislocation	**Participants/Setting** • Patients diagnosed with multi-directional, inferior, or posterior shoulder instability • Patients with a SLAP tear, rotator cuff tears, or a diagnosis other than ASI
Intervention • Studies in which patients had undergone an anterior shoulder stabilization procedure	**Intervention** • Studies in which patients are operated with superior labral repair, posterior, inferior labral repair, and rotator cuff repair
Comparison • Anterior shoulder stabilization procedures (arthroscopic bankart repair, coracoid transfer, open repair, etc.)	
Outcomes • Studies reporting RTP time frame, strength measures, and PROMs following a shoulder stabilization surgery	**Outcomes** • Studies that did not report RTP outcomes

Note: SLAP – Superior Labrum Anterior Posterior, RTP – Return to play

In phase 1 of the selection process, one researcher (AN) screened the articles based on the inclusion and exclusion criteria. Initially, the title and abstract screening were undertaken to narrow the articles for final screening. Then the full-text articles are screened to identify the studies meeting the inclusion criteria for the analysis. The final selection of the studies was confirmed after the agreement with the second researcher (DR). The PRISMA framework was followed to screen articles, remove duplicates, full-text screening to final inclusion of studies for this systematic review. The PRISMA flow diagram illustrating the study selection process is shown in Figure 2.

Data collection process

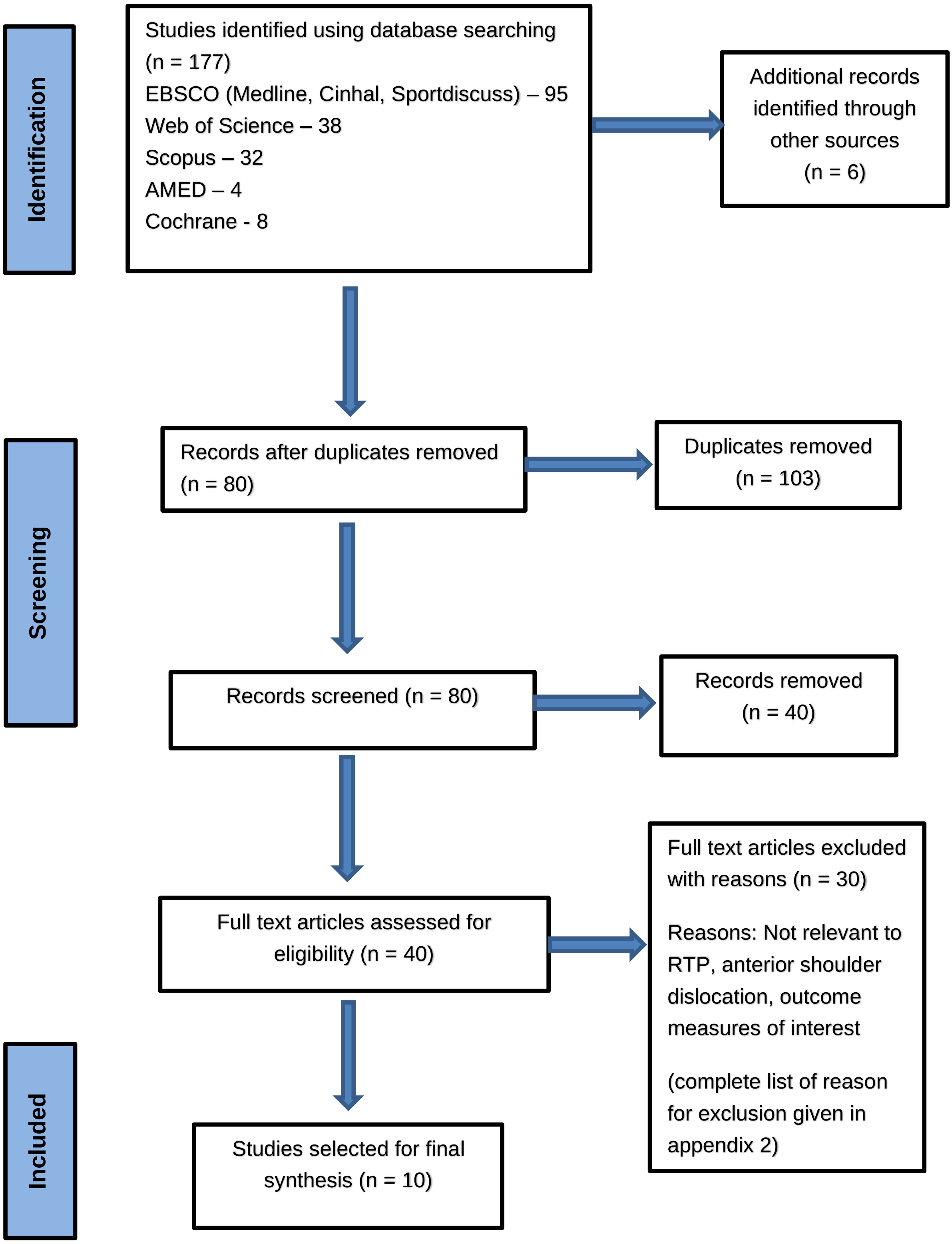
One researcher (AN) independently exported all retrieved articles into Mendeley reference manager, removed duplicates, and concurrently screened titles and abstracts using the inclusion and exclusion criteria. The articles that did not meet the inclusion criteria were excluded. Full texts were reviewed for reviews from which it was impossible to confirm the abstract's eligibility. The retrieved data was tabulated in the Microsoft Excel Spreadsheet by AN and verified by the second researcher (DR).

Data items

The data retrieved included the following information: patient demographics, intervention details, comparator interventions, outcomes (RTP time frame, strength measures, and PROMs), and any RTP criteria following a shoulder stabilization surgery. Only data that met the inclusion criteria were extracted if a review addressed multiple outcomes. The primary focus of data extraction was to identify the studies that explored RTP and outcomes following anterior shoulder stabilization surgery.

Figure 2

Search strategy using Preferred Reporting Items for Systematic Review and Metaanalyses (PRISMA) framework



Methodological quality

All systematic reviews that satisfy the inclusion criteria were independently appraised for their methodological quality using the most recent measurement tool to assess the systematic review, AMSTAR 2 tool (Shea et al., 2017). AMSTAR is considered a feasible, reliable, and valid tool to investigate the quality of systematic reviews (Shea et al., 2009). The original AMSTAR tool was developed to critically appraise the systematic reviews that have reviewed only randomized controlled trials (RCT) in their inclusion criteria (Shea et al., 2009). However, the authors of this systematic review have used an updated version of AMSTAR, AMSTAR 2, which enables the appraisal of both RCTs and non-RCTs (Shea et al., 2017).

The AMSTAR 2 reliability varies substantially across items and between the pairs of raters (Shea et al., 2017). Most values are acceptable between moderate and better agreement (46 of the 50 k scores). In contrast, most represent the better or good agreement (Shea et al., 2017). There are no significant differences between raters involved in AMSTAR 2 development and those not (Shea et al., 2017). The revised AMSTAR 2 retains 10 of the original questions and now has 16 items in total, has similar response categories than the original one, includes a more comprehensive user guide, and has an overall rating based on the weaknesses in the critical domains (Shea et al., 2017). The quality of the systematic reviews was established using the AMSTAR 2 checklist (Shea et al., 2017). The individual domains from the AMSTAR 2 tool were rated as either “yes,” “No,” and “Partial yes” for all the included systematic reviews for this study. After assessing all the domains, the final quality of the systematic review was calculated with no emphasis on the score but assessing which domains are satisfied (Shea et al., 2017).

Data Analysis

Both researchers (AN & DR) independently evaluated all eligible studies. After the evaluation, the assessors compared scores and discussed any differences. The final scoring was decided after the consultation and agreement with the senior researcher (DR) if any disagreements. The overall confidence in the selected reviews was rated as critically low quality, low quality, moderate quality, and high quality (Shea et al., 2017). A complete description of the AMSTAR 2 confidence ratings is presented in Table 3.

Table 3:

Rating overall confidence in the results of the review

Final rating	Description
High	• No or one non-critical weakness • The systematic review provides an accurate and comprehensive summary of the results of the available studies that address the question of interest.
Moderate	• More than one non-critical weakness • The systematic review has more than one weakness but no critical flaws • May provide an accurate summary of results
Low	• One critical flaw with or without non-critical weakness • May not provide an accurate and comprehensive summary
Critically low	• More than one critical flaw with or without non-critical weaknesses • Should not be relied on to provide an accurate and comprehensive summary

Note**:** Adapted from “AMSTAR 2: A critical appraisal tool for systematic reviews that include randomized or non-randomized studies of healthcare interventions, or both” by B. J. Shea, B. C. Reeves, G. Wells, M. Thuku, C. Hamel, J. Moran, D. Moher, P. Tugwell, V. Welch, E. Kristjansson, D. Henry, 2017, *The BMJ, 358,* p.6. Copyright 2017 by the BMJ publishing group Ltd.

Results

Search strategy

An electronic search of multiple databases identified 177 studies for initial screening. After the elimination of duplicates, a total of 80 articles were screened. After the initial screening, 40 records were excluded due to multiple reasons (Appendix 2). Overall, 40 studies were selected for full-text screening to assess their eligibility based on the pre-defined inclusion and exclusion criteria. A total of 30 articles were then excluded after the full-text screening. The studies were mainly excluded due to non-relevance of RTP, outcome measures unrelated, patient diagnosis different to ASI or anterior shoulder dislocation. A complete list of excluded studies and the reasons are detailed in Appendix 2. For the final analysis, ten studies were included. The detailed characteristics of all included studies are given in Table 5.

Study characteristics

All included studies were systematic reviews of a combination of level 1-level IV studies. The ten systematic reviews included 13,012 patients who underwent anterior shoulder stabilization surgery. The majority of athletes were adult males with a mean age greater than 18 years and between 11 and 69 years at the time of surgery. There was considerable heterogeneity in the type of sport in all included systematic reviews (Table 5). Athletes in the included reviews had a range of sports participation, including collision, non-collision, overhead, non-overhead, low-impact, and non-impact sport. The average follow-up of athletes differed across studies and ranged between 4 to 240 months.

There was variability in the surgeries performed in individual review studies, including ABR, coracoid bone block transfer/a Latarjet procedure, and an open Bankart repair. Of the ten included systematic reviews, four had their patients operated on with a Latarjet procedure (Ciccotti et al., 2018; Glogovac et al., 2019; Hurley, Montgomery, et al., 2019;

Nadeem et al., 2020). Two studies had their patients operated on with ABR (Kasik et al., 2019; Kim & Saper, 2020). Three studies reviewed RTP in athletes who have undergone multiple surgical stabilization procedures (Abdul-Rassoul et al., 2018; Ialenti et al., 2017; Lau et al., 2021). In a review by Abdul-Rassoul et al. 2018 which included multiple surgeries, the outcomes were recorded on athletes operated with open Bankart, ABR, ABR with remplissage, Arthroscopic Latarjet, and an open Latarjet procedure. While Ialenti et al. 2017 reviewed 16 studies that included ABR, Latarjet, and open stabilization procedure, Lau et al. 2021 reported RTP outcomes following a revision anterior shoulder stabilization (7 arthroscopic, five open, 3 Latarjet, and three bone augmentation). The RTP outcomes following open Bankart repair were demonstrated in only one review (Stone & Pearsall, 2014). A detailed description of surgical and patient inclusion details is given in Table 5.

Methodological quality assessment

The AMSTAR 2 quality assessment for all ten studies ranged from critically low to moderate quality. None of the studies scored a high-quality confidence rating. Seven studies were rated as the moderate quality of evidence (Abdul-Rassoul et al., 2019; Glogovac et al., 2019; Hurley et al., 2019; Kasik et al., 2019; Kim & Saper, 2020; Lau et al., 2021; Nadeem et al., 2020), whereas the remaining three were of critically low quality of evidence (Ciccotti et al., 2018; Ialenti et al., 2017; Stone & Pearsall, 2014). A detailed AMSTAR 2 scoring is presented in Table 4.

Table 4

Methodological assessment of the quality of systematic reviews using AMSTAR 2 critical appraisal tool

	SR. NO	AMSTAR 2	Lau et al. 2021	Glogovac et al. 2020	Kim & Saper 2020	Hurley et al. 2019	Nadeem et al.. 2019	Abdul-Rassoul et al. 2018	Kasik et al. 2019	Ciccotti et al. 2018	Ialenti et al. 2017	Stone et al. 2014
	1	**Did the research questions and inclusion criteria for the review include the components of PICO?**	Yes	No	No	No	Yes	Yes	No	No	Yes	No
Critical domain	**2**	**Did the report of the review contain an explicit statement that review methods were established prior to the conduct of the review and did the report justify any significant deviations from the**	Yes	No	No	No	No	Partial Yes	No	No	Partial Yes	No

		protocol?										
	3	Did the review authors explain their selection of the study designs for the inclusion in the review?	No	No	No	No	No	No	No	No	No	No
Critical domain	4	Did the review authors use a comprehensive literature search strategy?	Partial Yes	Partial Yes	Partial Yes	Partial yes	Partial Yes	Partial Yes	Partial Yes	Partial Yes	Partial Yes	Partial Yes
	5	Did the review authors perform study selection in duplicate?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	6	Did the review authors perform data extraction in duplicate?	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Critical domain	7	Did the review authors provide a list of excluded studies and	Yes	Yes	Partial Yes	Partial yes	Yes	Partial Yes	Partial Yes	Yes	Yes	Yes

		justify the exclusions?										
	8	Did the review authors describe the included studies in adequate details?	Partial Yes	No	No	No	Partial Yes	Partial Yes	No	No	Partial Yes	No
Critical domain	9	Did the review authors use a satisfactory technique for assessing the risk of bias in individual studies that were included in the review?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
	10	Did the review authors report on the sources of funding for the individual studies?	No	No	No	No	No	No	No	No	No	No
Critical domain	11	If meta-analysis was performed did the authors use appropriate method for statistical combination	No meta-analysis conducted	No meta-analysis conducted	No meta-analysis conducted	No meta-analysis conducted	No meta-analysis conducted	No meta-analysis conducted	No meta-analysis conducted	No meta-analysis conducted	No	No meta-analysis conducted

		of results?										
	12	**If meta-analysis was performed, did the review authors assess the potential impact of ROB in individual studies on the results of the meta-analysis or other evidence synthesis?**	No meta-analysis conducted	No meta-analysis conducted	No meta-analysis conducted	No meta-analysis conducted	No meta-analysis conducted	No meta-analysis conducted	No meta-analysis conducted	No meta-analysis conducted	No	No meta-analysis conducted
Critical domain	**13**	**Did the review authors account for ROB in individual studies when interpreting/discussing the results of the review?**	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
	14	**Did the review authors provide a satisfactory explanation for, and discussion of, any**	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes

		heterogeneity observed in the results of the review?										
Critical domain	**15**	**Did the review authors carry out an adequate investigation of publication bias, and discuss its likely impact of the review?**	No meta-analysis conducted	No meta-analysis conducted	No meta-analysis conducted	No meta-analysis conducted	No meta-analysis conducted	No meta-analysis conducted	No meta-analysis conducted	No meta-analysis conducted	No	No meta-analysis conducted
	16	**Did the review authors report any sources of conflict of interest, including any funding they received for conducting the review?**	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		AMSTAR 2 REVIEW	**Moderate quality**	**Moderate quality**	**Moderate quality**	**Moderate quality**	**Moderate quality**	**Moderate quality**	**Moderate quality**	**Critically low quality**	**Critically low quality**	**Critically low quality**

Outcomes

The key outcomes of interest reported in this section are RTP time frame, strength, PROM following anterior shoulder stabilization surgery.

RTP timeframe

All the studies reported RTP time frame following anterior shoulder stabilization surgery (Abdul-Rassoul et al., 2018; Ciccotti et al., 2018; Glogovac et al., 2019; Hurley et al., 2019; Ialenti et al., 2017; Kasik et al., 2019; Kim & Saper, 2020; Lau et al., 2021; Nadeem et al., 2020; Stone & Pearsall, 2014). Of these ten studies, four reported a similar average RTP timeframe at approximately six months (Ciccotti et al., 2018; Glogovac et al., 2019; Hurley et al., 2019; Nadeem et al., 2020). Glogovac et al. 2019 reported the average time to RTP at 5.7 months (range 3.2 -8.1 months) (Glogovac et al., 2019). Hurley et al. 2019 also reported a somewhat identical mean RTP time frame at 5.8 months (range 3.2 – 8 months). Nadeem et al. 2019 reported a similar average RTP time at 5.38 months (range 21 days – 36 months) (Nadeem et al., 2020). Ciccotti et al. 2018 also identified the most commonly used criteria to RTP as RTP time frame at six months (range 1.5 – 12 months) (Ciccotti et al., 2018).

Two studies that reported RTP time frames show a considerable range (Kasik et al., 2019; Kim & Saper, 2020). Kim and Saper (2020) reported a range of RTP timeframe of 3-6 months in 12 studies out of a total of 17 studies included in the review (Kim & Saper, 2020). Similarly, Kasik et al. 2019 reported a slightly higher range of RTP timeframe of 3-10 months but a somewhat similar average time to RTP at 5.3 months (Kasik et al., 2019). In a review by Stone and Pearsall (2014), the RTP in the non-contact sport was much less than the RTP in the throwing/contact sport (2-16 weeks versus 24 weeks respectively) (Stone & Pearsall, 2014).

In studies that have patients operated with multiple surgical procedures, the RTP timeframes were inconsistently reported. In a review by Abdul-Rassoul et al. (2018), the RTP time frame appeared slightly more in athletes operated with open Bankart and ABR with remplissage (8.2 and 7 months, respectively) compared to athletes who have undergone ABR, Arthroscopic Latarjet, and an open Latarjet procedure (5.9, 5.86, and 5.7 months, respectively) (Abdul-Rassoul et al., 2018). However, in a review by Ialenti et al. (2017), the RTP timeframe was identified slightly higher at eight months following ABR (two studies) compared to six months following Latarjet and open stabilization (three studies) (Ialenti et al., 2017). In a review by Lau et al. (2021), the RTP timeframe was found to be 7.75 months (range 5.7 – 9 months) following arthroscopic revision studies (four studies) and 5.2 months (range 4 – 11 months) following the Latarjet revision study (one study) (Lau et al., 2021).

Strength

Of the ten studies included in this systematic review, there was a significant gap in the reported strength outcomes following anterior shoulder stabilization surgery. Only three systematic reviews reported strength outcomes following an anterior shoulder stabilization surgery (Ciccotti et al., 2018; Hurley et al., 2019; Stone & Pearsall, 2014). In the review by Hurley et al., 2019, only 4/36 studies identified strength as an RTP criterion, where the strength of the operated shoulder was required to be equal to that of the contralateral side (Hurley et al., 2019). In the review by Ciccotti et al., 2018, out of 58 studies, only 11 reported different strength criteria to RTP, such as “full strength (1 study),” “strength recovered (1 study),” “strength equal to the contralateral side (1 study),” “equal shoulder abduction and external rotation strength (3 studies),” “equal isokinetic internal and external rotation strength (1 study),” “nearly normal strength (2 studies),” and “strength 80% compared to normal arm or the contralateral side (2 studies)” (Ciccotti et al., 2018). Of the 29 studies reviewed by Stone et al., 2014, only three studies report the strength outcomes as “comparable strength to the opposite side,” “strength ≥ 80% of the opposite side”, and strength ≥ 75%-80% of the opposite side (Stone & Pearsall, 2014).

Patient-reported outcome measures (PROMs)

Of the ten studies in the systematic review, only four reported patient-reported outcome measures following an anterior shoulder stabilization surgery (Glogovac et al., 2019; Ialenti et al., 2017; Nadeem et al., 2020; Stone & Pearsall, 2014). The Rowe score was the most commonly used PROM of all four studies. Glogovac et al., 2019 reported the average Rowe scores between 78%-94%, indicating good to excellent score, Western Ontario Shoulder Instability Index (WOSII) score between 223.6 – 534.3, and Subjective Shoulder Value (SSV) score between 75 – 90 (Glogovac et al., 2019). Nadeem et al., 2020 reported a mean post-operative Rowe score of 89 (range, 10-100), indicating a good score, mean post-operative SSV score of 89.1% (range, 5-100%), and Walch Duplay score of 87.5 (range, 15-100), indicating good stability, in patients operated with the coracoid bone block transfer. Ialenti et al., 2017 reported the Rowe score of 86 in studies with open stabilization procedures, Rowe score of 79.5 in studies with ABR, and Rowe score of 82 in studies with a Latarjet procedure (Ialenti et al., 2017). Stone et al., 2014 reported the Rowe score of 86.9 (range, 63 – 90), Constant score of 92, and American Shoulder and Elbow Surgeons Shoulder Outcome Score (ASES) of 83 in studies with open Bankart repair.

Table 5

Detailed characteristics of studies included in the review in a PICO framework

Sr. No	**Author details**	**Study characteristics**	**Patient characteristics**	**Intervention**	**Comparator**	**Outcomes (RTP time frame, strength, and PROMS)**			
						RTP Time frame	**PROMs**	**Strength Measures**	**Return to play criteria**
1	**Lau et al. 2021***	Systematic review 18 studies (1 Level 2, 17 Level IV)	Mean age: 27.9 ± 3 years 84.1% were male Mean follow up: 52.5 months Total 564 revision cases Sport: collision, overhead, non-collision, non-overhead, martial arts	Revision anterior shoulder stabilization (7 arthroscopic, 5 open, 3 Latarjet, and 3 bone augmentation)	NA	Only five studies reported RTP timeframe **Weighted mean average 4 arthroscopic revision studies** 7.75 months (range, 5.7 - 9 months) **1 Latarjet**	Not reported	Not reported	Not reported

						study 5.2 months (range 4-11 months)			
2	**Glogovac et al 2020***	Systematic review 14 studies 4 level III, 10 level IV	Athletes undergoing coracoid transfer for recurrent anterior shoulder instability 883 patients Majority Male (88%) Age at the time of surgery: 18.9 - 37.2y Mean length of follow up: 18-	Coracoid transfer	N.A.	Average time to RTP: 5.7 months (reported from 8 studies Range: 3.2-8.1 months	Outcome measures were reported in 12 studies (Rowe commonly used) Rowe's (8 studies) - 78%-94% WOSII (4 studies) - 223.6 - 534.3 SSV (4 studies) - 75 - 90	Not reported	Not reported

			144 months Sport: low-impact contact, high-impact contact, overhead, forced overhead, no-risk, high-risk forced overhead, collision, non-collision				all average values		
3	**Kim & Saper 2020***	Systematic review 17 studies (4 level III retrospective, 3 level II prospective, 10	675 patients (690 shoulders) Average age: 18.3 y (range 11-25 years) Minimum 1-year follow-up	Arthroscopic Bankart Repair	NA	Time range 3-6 months Out of 17 studies, 12 studies listed a specific time to	Not reported	Not reported	4 studies: RTP criteria based on a return to normal strength, endurance, and ROM, comparison to

		level IV studies case series)	(range 12 -120 months) Sport: Not mentioned			RTP			contralateral limb, or completion of specific sports training and activity demands. 1 study: RTP based on completion of a dedicated rehab protocol
4	**Nadeem et al. 2020***	Systematic review 52 studies 5 level II, 17 level III, 30 level IV	2888 patients 2953 shoulders Mean age: 26.2 (range 14-69 years) 2129 of 2551 were males Mean follow up:	Coracoid bone block transfer	Open capsuloplasty, Arthroscopic Bankart, conservative treatment, Magnusson-Stack, Putti	Mean-time: 5.38 months (range 21 days - 36 months)	Three most commonly reported PROMs Rowe, SSV and Walch-Duplay score **Rowe**	Not reported	Not reported

			73.2 months (range, 4-24 months) 89.8% patients were sportsmen (2592 of 2888) Common sport was Rugby (n=288)		platt		Mean pre-op Rowe score was 44.7 (range, 5-75), amongst 804 patients Mean post-op Rowe score was 89 (range, 10-100) indicating a good score (amongst 1341 patients) **SSV** Mean SSV pre-op 50.4% (range not given) amongst 119		

							patients Mean SSV post-op 89.1% (range, 5-100%) amongst 648 patients **Walch Duplay score (reported in 9 studies)** Mean pre-op score 45.3 (range, 10-70) in 136 patients Mean post-op score 87.5 (range, 15-100) in 547 patients,		

							indicating good stability			
5	**Hurley et al 2019* (AJSM/CJSM)**	Systematic review 36 studies 10 level III, 26 level IV	2134 cases Male (86.9%), 2134 cases Mean age - 25.4 years (range, 14-69y) Mean follow up - 83.5 months Sport: collision, non-collision, overhead athletes	Latarjet surgery	N.A.	Mean-time 5.8 months Range 3.2 - 8 months	Not reported	Strength equal to the contralateral side (criteria reported in 4 studies)	The majority of studies reported specific RTP criteria (69.4 %). Time to RTP was most commonly used (66.7%). Three months being most commonly used time point (35.4%) Other criteria were C.T. imaging to assess bone union (25%),

									clinical examination or decision (11%), strength (11%), pain (8.3%), ROM (5.6%) were less commonly reported. The mean score for quality of RTP criteria was 2.2 (range 0-4)
6	**Abdul-Rassoul et al. 2018***	Systematic review and meta-analysis 16 studies 2 level III, 14 level IV	609 patients Age range: 14-51 years Mean follow up of 1 year with most having >/=2 years	122 open Bankart 238 arthroscopic stabilizations	NA	Arthroscopic Bankart: 5.9 months Open Latarjet: 5.7 months Arthroscopic Latarjet: 5.86	Not reported	Not reported	Not reported

			Sport: Collision, contact or overhead sports	89 minimally invasive arthroscopic Latarjet 116 open Latarjet 44 arthroscopic Bankart with remplissage		Open Bankart: 8.2 months Arth Bankart with remplissage: 7mos			
7	**Kasik et al 2019***	Systematic review 11 studies 3 level IV (case series), 4 level III (retrospective cohort), 1 level II (prospective	461 athletes Mean age: 15.7 years (range, 11-19 years) Average follow up 48.8 months (range, 22-85.2 months)	Arthroscopic Bankart repair (392 patients, 400 shoulders) Open repair (69 patients, 69 shoulders)	N.A.	Average time to RTP: 5.3 months (Bankart repair), range 3-10 months	Not reported	Not reported	Cited in 3 out of 7 studies Study 1: ROM and shoulder muscle strength return to normal Study 2: ROM

		comparative)	Sport: collision, contact, limited, non-contact						and strength guidelines dictated by the contralateral shoulder Study 3: Full ROM, Restoration of muscular strength, power, endurance, and balance; neuromuscular control
8	**Cicotti et al. 2018***	Systematic review 58 studies 40 level IV, 5 level III, 10 level II, 3 level I	3850 patients Mean age > 18 years (range 18.2-44 years) Follow up range: 20.6 to	Latarjet Procedure	Arthroscopic Bankart repair	The most commonly used time to RTP was six months (range 1.5 - 12 months)	Not reported	Specific strength criteria for RTP, percentage of included studies, and number of studies "Full" - 9.1% (1)	7 categories were identified Time from surgery (89.6%), Strength (18.9%), ROM

			240 months Average follow up: 38.7 months Sport: Not mentioned					"strength recovered" - 9.1% (1) " Equal to contralateral side" - 9.1% (1) "Equal abduction and external rotation" - 27.3% (3) "Equal isokinetic internal and external rotation" 9.1% (1) "Nearly normal" 18.2% (2) "80% of the nonoperated arm" - 9.1% (1) "Atleast 80% of the contralateral side" - 9.1% (1)	(13.8%). Pain, stability, proprioception, and post-op radiographic evaluation were also used.
9	**Ialenti et al. 2017***	Systematic review and Meta-analysis	Arthroscopic Bankart repair 545 patients	Arthroscopic Bankart repair Latarjet	N.A.	Arthroscopic Bankart repair: 8 months on	Open stabilization studies	Not reported	Not reported

		16 studies Mostly level IV, and a few levels III	(438 male, 72 female, 35 not reported) Mean age: 27.6 years Follow up: 32 to 82 months Latarjet Procedure 353 patients (329 male, 24 female) Mean age: 26.5 years Open shoulder stabilization 138 patients 113 male, 25 female	Procedure Open shoulder stabilization		avg (2 studies) Latarjet and open stabilization: 6 months each (3 studies each)	Rowe score: 86 (3 studies) Arthroscopic Bankart repair studies Rowe score: 79.5 (3 studies) Latarjet studies Rowe score: 82 (2 studies)		

			150 shoulders Sport: reported inconsistently						
10	**Stone et al. 2014***	Systematic review 29 studies 13% RCTs level I, 20% level II, 13% level III, 54% level IV	50 patients (range 12-162) Mean follow up 51.7 months (8-162 months) Mean age: 25.9 years (21-31 years) Sport: All sport, throwing, non-contact, contact	Open Bankart repair	N.A.	Return to non-contact sports 12-16 weeks Return to throwing/contact sports: 24 weeks	Average Rowe score: 86.9 (range, 63-90) (n=15) Constant score - 92 (n=1) ASES - 83 (n=1)	Three studies reported strength outcomes "Comparable strength to opposite side", "strength ≥ 80% of opposite side", and strength ≥ 75%-80% of opposite side	38% authors reported sports specific criteria to RTP

Discussion

Summary of evidence

The primary goal of this systematic review was to synthesize all current evidence by appraising all the systematic reviews that looked at the RTP outcomes following an anterior shoulder stabilization surgery. This systematic review highlighted the current evidence of the clinical and functional criteria to RTP in sports following a shoulder stabilization surgery in athletes with ASI. The RTP time frame was the only outcome reported in all the ten studies in this review. A significant gap exists in the reported PROM and strength outcomes. The methodological quality and evidence synthesis was performed using the AMSTAR 2 tool. The majority of studies showed a moderate quality of confidence rating. Overall, the literature is insufficient and lacks high-quality systematic reviews exploring RTP outcomes (time, strength, and PROM) following anterior shoulder stabilization surgery.

RTP time frame

The first question in this review sought to determine the evidence-based RTP timeframe following anterior shoulder stabilization surgery. Although all studies reported RTP timeframes, a significant variation existed across all ten studies. Most studies reported an average RTP timeframe of around five to six months. However, some contrasting timeframes were also reported where the time to RTP exceeded six months, and in some of them, it was as low as 1.5 months. A significant variation in the range of the RTP timeframes in individual studies was also observed. However, some of the similarities exist in the average RTP timeframes following Latarjet procedures (Ciccotti et al., 2018; Glogovac et al., 2019; Hurley et al., 2019; Nadeem et al., 2020), but no similarity is apparent in the studies reporting timeframes following ABR (Ialenti et al., 2017; Kasik et al., 2019; Kim & Saper, 2020). The study results indicate a considerable variation in the reviews that compared RTP timeframes across multiple surgeries (Abdul-Rassoul et al., 2018; Ialenti et al., 2017; Lau et al., 2021; Stone & Pearsall, 2014). Contrary to the expectations, this study did not find an overall consensus on RTP timeframes, demonstrating significant variation that may affect the RTP decision-making process.

Comparison of the findings with those of other studies that have looked at RTP times in weight-bearing joints shows a different trend. A recent systematic review by Ross et al., 2020 in RTP in American footballers following ACL reconstruction demonstrated a mean RTP time frame of 11.6 months (range, 35.8 -55.8 months) (Ross et al., 2020). A similar systematic review by Lai et al., 2017 in RTP after ACL reconstruction in elite athletes showed a mean RTP time frame between 6-13 months with significant variations (Lai et al., 2018). Similarly, Blanchard et al., 2020 undertook a systematic review of studies that looked at isolated meniscus repaired athletes and found a mean RTP timeframe at 8.7 months (range, 3.4 – 30 months) (Blanchard et al., 2020). It can be seen that the mean RTP timeframe is slightly longer in post-surgical weight-bearing joints.

Compared to RTP timeframes of the non-weight bearing joints of the upper limb, mean RTP times are variable to the findings demonstrated in this review. In a systematic review by Verstift et al., 2019, on return to sport post-surgically repaired high-grade acromioclavicular joint dislocation, authors found an RTP timeframe at four months (Verstift et al., 2019). In another systematic review by Matar et al., 2020, on post-surgical RTP outcomes for posterior shoulder instability, the authors demonstrated an average RTP time of 6.1 months with a varied range between 4.3 – 7.7 months (Matar et al., 2020). In a review by Coughlin et al., 2019, the mean RTP timeframe among pitchers after ulnar collateral ligament reconstruction of the elbow was 19.8 ± 13.5 months. The mean RTP timeframe to return to competition was 17.3 ± 2.4 months (Coughlin et al., 2019). The authors of this study attribute higher RTP times in baseball pitchers to the sports-specific requirements that the pitchers often need to possess. Considering greater loads on the elbow during pitching, it is not surprising to see greater timeframes to rehabilitation and RTP at competitive levels to match the athlete-specific demands. Overall, the findings from the other studies are similar to the results of this review in terms of the variations that can be seen in the range of the RTP time frame. Several factors can be responsible for these differences in the results. They can be related to varied definitions of a successful RTP, different surgical approaches, the efficiency of the surgical technique, rehabilitation methods, time of injury during a season, the time between injury and surgery, rehabilitation facilities, exercise compliance, or sports specific requirements.

Strength outcomes

This review also set out to explore strength outcomes following anterior shoulder stabilization. Surprisingly, only three systematic reviews reported strength measures (Ciccotti et al., 2018; Hurley et al., 2019; Stone & Pearsall, 2014). Of all three studies, the "strength of the operated shoulder equal to the contralateral side" or "comparable to the normal side" was the most commonly used criterion to decide RTP. However, these reviews could not detail precisely how these strength measures were recorded. The objective methods to quantify the strength outcomes increase the reliability of tests as a marker for deciding criterion-based RTP. However, relying solely on the strength normalization to the other side is insufficient as sports-specific demands differ, impacting the strength testing methods. Movement demands at each sport are different, so strength testing methods need to be designed according to the movements that an athlete is required to perform. Generally, strength tests using a dynamometer, for example, were performed with slower velocities. However, often athletes are required to perform at faster speeds in their sport. An athlete is likely to return safely and show better performance if tested in movements that directly reflect his sport.

The reliability and validity of a strength test are also paramount when applied to athletes from different sporting backgrounds. Often athletes demonstrate strength and power in multi-complex movements, thus requiring optimal physical performance in a multiple set of planes. The shoulder arm return to sports (SARTS) battery was developed, a series of open (ball abduction external rotation, drop catches, ball taps, overhead snatch), and closed chain functional performance tests (push up claps, line hops, side hold rotations, modified closed kinetic chain upper extremity stability test) that look at side-to-side differences to aid RTP decision making (Olds et al., 2019). Of the eight tests from the SARTS battery, six tests showed good psychometric properties and readability for clinical use (Olds et al., 2019). The authors of this study promote a battery of sports-specific strength tests that show adequate reliability and validity before they can be used in clinical settings. Looking at the significant variations in the sport played by the athletes in this review and the reported strength outcomes, the authors of this study cannot stratify strength outcomes according to the sport played. Also, there is insufficient evidence on which exact strength tests to use as criteria to RTP. The results of this study demonstrate insufficient evidence on the specificity of the strength measures in deciding RTP.

PROM's

The third question in this study was to look at PROMs following anterior shoulder stabilization. Although only four studies reported PROMs, the Rowe score was the most common outcome measure. In almost all the studies that reported Rowe scores, the post-operative scores indicated reasonably satisfactory outcomes (Glogovac et al., 2019; Ialenti et al., 2017; Nadeem et al., 2020; Stone & Pearsall, 2014). Even if these excellent outcomes provide some insight into the athlete's recovery perspective, they do not inform sufficiently to decide RTP in athletes following anterior shoulder instability. PROMs and the reported outcomes in current literature provide limited information. They can be misleading because RTP decision-making is multifactorial (Ardern, Glasgow, et al., 2016). One crucial factor determining athlete readiness to competitive RTP is psychological readiness (Ardern et al., 2016; Forsdyke et al., 2017). None of the PROMs in these review studies identified psychosocial factors as a criterion to RTP.

The majority of PROMs assessed domains related to activities of daily living, symptoms, stability, functional or sports-specific status, movement levels, strength, subjective feeling of the shoulder, lifestyle, and some aspects of emotional factors. In a systematic review by Nwachukwu et al., 2019, the authors concluded that “fear avoidance” was the significant factor that impeded athlete's RTP following ACL reconstruction (Nwachukwu et al., 2019). PROMs must be augmented with other vital domains that enable clinicians to predict whether the athlete will succeed in rehabilitation without recurrence. Some of the recent work done by Olds et al., 2020 on the first-time anterior shoulder dislocators, although not explicitly done in post-surgical ASI patients, authors demonstrate the psychometric properties of predicting the recurrent instability of the shoulder (PRIS) by establishing a PRIS tool (Olds et al., 2020). The authors conclude that the PRIS tool has a specificity of 95%, an accuracy of 80%, and a sensitivity of 35% (Olds et al., 2020). Authors predict that the tool identifies the athletes who are not likely to get recurrent shoulder dislocation with 80% accuracy (Olds et al., 2020). Although psychological readiness was not the outcome of interest in this review, it is apparent that there is a significant gap in psychosocial outcomes concerning RTP decisions. Further research may be warranted in developing a PROM that also identifies psychosocial barriers in athletes that are explicitly returning from anterior shoulder stabilization surgery.

Methodological quality

Overall, the AMSTAR 2 scoring results showed a moderate confidence rating in the systematic reviews. A considerable inconsistency was observed in the methodological framework among all ten studies (Table 4). Five studies did not include all the components of PICO in their inclusion criteria (question 1, Q1), of which the comparator group was missing in all these studies. Before conducting the review, most studies did not have a specific protocol established or registered with an independent verification board (question 2, Q2). Only two studies had their written protocol which described a review question, a search strategy, inclusion/exclusion criteria, and a risk of the bias assessment method. However, their protocol was not registered with an independent registration body. Only one study had a written protocol, registration with an independent body, and a complete "yes" from the checklist on Q2. None of the studies could score a "yes" on Q3 as they lacked the strategy for inclusion of studies and did not justify the inclusion of both RCT and non-randomized controlled studies (NRSI). All included studies scored a "partial yes" on Q4 by searching at least two databases, mentioning keywords, and justifying publication restrictions. None of the studies searched for the reference lists, trial registries, grey literature, or consulted subject experts to include studies in their review. All studies stated that article selection was made independently by two reviewers after achieving their consensus (Q5). In most studies, data extraction was done in duplicate, except three studies that did not state data extraction performed by two independent assessors (Q6). All provided a list of potential excluded studies. However, only six of them justified the exclusion of studies from the review (Q7).

Most studies failed to describe the study characteristics adequately due to a lack of comparator groups and inadequate population details (Q8). Studies also lacked an adequate framework to study heterogeneity in intervention effects. Not a single study could score a complete "yes" to Q8, whereas four scored a "partial yes." Most studies could score a "yes" to Q9, which relates to the specific use risk of a bias assessment tool for critical appraisal. However, three studies did not assess the risk of bias using a specific tool. Not a single review reported the funding sources for each study included in the review (Q10); hence it could not analyze the commercially and independently funded studies separately.

The meta-analyses were not performed in most studies; hence there was no statistical comparison of results (Q11). There was only one study in which meta-analysis was performed (Abdul-Rassoul et al., 2019). The authors lacked justification and an appropriate method of combining data or effect estimates when RCTs and non-randomized controlled studies (NRSI) were included. Therefore, no single study could assess the potential impact of risk of bias on the meta-analysis results since there was no estimation of the pooled effect sizes (Q12). However, seven studies did account for the risk of bias when discussing the interpretations of the review results (Q13). Overall, nine studies also discussed the possible sources of heterogeneity, such as different study designs, varied analysis, different populations, and interventions (Q14). None of the studies could perform any statistical test or a graphical display to estimate a publication bias (small study bias) and its likely impact on interpretation and discussion of the review results (Q15). All the studies scored yes on the potential sources of conflict of interest or any funding sources they received (Q16). The majority of the studies had no competing interests, which was mentioned in the study accordingly.

Practice Implications

This systematic review has established the need to focus on the RTP protocols following arthroscopic stabilization in ASI. The published research examined in this review indicates that athletes from various sporting backgrounds have ASI and have undergone shoulder stabilization surgery. Hence there is a need to shift the RTP decision-making strategies from a generalized approach to more of a sports-specific approach to allow faster and an efficient RTP at the highest level. Since there is no consensus on the RTP time frame following shoulder stabilization surgery in ASI, using timeframe solely as a criterion to RTP seems challenging and can mislead the RTP decision-making process. Looking at the gap in the reported strength outcomes following shoulder stabilization surgery in ASI, there is scope for the researchers to select the strength tests that give objective strength markers, are designed to match the movement/velocity-specific demands of a particular sport, and are individually described as a criterion to RTP. An ideal development of a battery of sports-specific strength tests with good validity and reliability can be considered a future research scope. PROMs in post-surgical ASI patients should be augmented with some psychosocial assessment. The current PROM does not inform an athlete's psychological readiness to RTP, thus also influencing the RTP decision-making process. Future research should also focus on consistent reporting outcomes following arthroscopic anterior shoulder stabilization to combine results across all studies and perform a meta-analysis. Overall, the results of this systematic review highlight moderate-quality evidence. However, the evidence is insufficient and warrants further research to refine the RTP decision-making process.

Strength of the study

This systematic review of systematic reviews on the RTP outcomes following ASI surgery has not been previously undertaken. This review was designed and reported using the PRISMA guidelines and framework to ensure good consistency in reporting and comparability with future studies. The search strategy was robust with all major databases searched and a comprehensive keyword strategy for selecting studies. The most updated version of the methodological quality assessment tool, AMSTAR 2, was used to assess the quality of the included systematic reviews. AMSTAR 2 is a reliable, valid, and feasible tool that assesses the quality of systematic reviews of both randomized and non-randomized studies.

Limitations of the study

There may be some limitations to this systematic review. The strength of evidence of most systematic reviews was moderate as per the AMSTAR 2 checklist, while some were critically low quality. Therefore, the readers are suggested to use the study results with caution. In this study, no meta-analysis could be performed due to the variability of the data collected from the studies.

Conclusion

The current systematic review synthesized all the evidence with respect to RTP outcomes following a shoulder stabilization surgery in athletes having ASI. Overall, there seems to be moderate-quality evidence of the findings of this systematic review. The most commonly reported RTP outcome were the RTP timeframes. However, there is no consensus on exactly when an athlete generally returns to his competitive sport. The most common strength criteria to RTP was “strength normal to the contralateral side.” However, it lacked sports specificity and objectivity, challenging its applicability in a practical setting. The use of PROM provides limited information and lacks other vital domains that can significantly influence RTP decisions. The findings of this systematic review warrant a validation of multi-level RTP criteria that addresses physical, functional, psychosocial, and other important contextual factors that influence the RTP of an athlete at a competitive level.

CHAPTER 3: PRACTICE RECOMMENDATIONS

Introduction

The primary goal of this systematic review was to synthesize all current evidence by appraising all the systematic reviews that looked at the RTP outcomes (strength, PROMs, and RTP timeframe) following an anterior shoulder stabilization surgery. The RTP time frame was the only outcome reported in all the ten studies in this review. A significant gap exists in the reported PROM and strength outcomes. The methodological quality and evidence synthesis was performed using the AMSTAR 2 tool. The majority of studies showed a moderate quality of confidence rating. There is a lack of high-quality systematic reviews exploring RTP outcomes (time, strength, and PROM) following anterior shoulder stabilization surgery. Therefore, it is imperative to recommend practice strategies to enhance the RTP process using the available evidence.

Strength outcomes

This review explored strength outcomes following anterior shoulder stabilization. Surprisingly, only three systematic reviews reported strength measures (Ciccotti et al., 2018; Hurley et al., 2019; Stone & Pearsall, 2014). Of all three studies, the "strength of the operated shoulder equal to the contralateral side" or "comparable to the normal side" was the most commonly used criterion to decide RTP. Restoration of muscle strength, function, and dynamic stability of the shoulder is the main rehabilitation goal for patients seeking RTP or activity at preinjury levels after shoulder surgery (Popchak et al., 2017). Various strength testing methods and protocols are recommended below.

Isokinetic Dynamometry

Strength assessment of the shoulder muscles with dynamometers is a useful method for clinicians to assess muscle strength, quantify the degree of impairment objectively, guide treatment, and evaluate the treatment efficacy (Edouard et al., 2011). Isokinetic dynamometry (ID) is an objective method to evaluate muscle strength deficits (Schrama et al., 2014). The ID can measure muscle strength with resistance at a constant angular velocity and assess the maximal torque production throughout a prescribed ROM (Rabelo et al., 2016). The ID can evaluate muscle strength in isometric, concentric, or eccentric modes across a wide range of speeds (Edouard et al., 2011). In a systematic review by Sorenson et al. (2020), the reliability of ID was overall sufficient for all positions, velocities, and modes of strength, with the majority of intraclass correlation coefficient (ICC),≥ 0.70 (Sørensen et al., 2017). The isokinetic torque of the internal rotators (IR) and the external rotators (ER) muscles and the ER/IR ratio may represent the dynamic stabilizers component of the shoulder stability (Codine et al., 2005; Edouard et al., 2012). In a case series by Rhee et al. (2021), patients operated with arthroscopic capsulolabral reconstruction in ASI, at one year after surgery, IR peak torque on the involved side recovered (0.40 ± 0.20 N.m/kg), whereas ER peak torque remained weak (0.30 ± 0.13 N.m/kg) relative to the baseline value (Rhee et al., 2021). However, there are many practical challenges in using isokinetic equipment for strength assessments. Firstly, they consume much space and are not portable. Secondly, they consume more time setting up the process and require patients to get familiarized prior to its application. This method may not always be feasible practically as it requires significant cost to set up.

Hand-held dynamometer

One such feasible method to assess the strength deficits and generate reliable and objective measurements is using a hand-held dynamometer (HHD). HHD’s are portable, small, easy to use, minimally-time consuming, and relatively inexpensive compared to ID (Trudelle-Jackson et al., 1994). We, therefore, strongly recommend using an HHD device to assess and monitor strength deficits during the RTP process and use the strength markers as one of the RTP criteria. In a systematic review by Stark et al. (2011), a comparison was made correlating the ID with the HHD, where authors established the validity of HHD for measuring muscle strength (Stark et al., 2011). In another recent systematic review by Chamorro et al. (2021), the ICC between HHDs and IDs was 0.94 for shoulder IR and 0.92 for shoulder ER (Chamorro et al., 2021). A very high correlation was found for shoulder torque assessment between HHDs and IDs (Chamorro et al., 2021). In strength tests using HHD, the therapist holds the instrument where the patient generates a muscle force for the desired movement (Bohannon, 1990). Two techniques have been described in the literature. The "break test" requires that the examiner pushes against the patient's extremity until the maximum muscle force is overcome, thereby producing an eccentric contraction (Bohannon, 1990). In the "make test," the examiner holds the dynamometer stationary. The patient exerts a maximal force against it and produces an isometric contraction (Bohannon, 1990). Both techniques can be used but are not interchangeable because the "break test" produces higher forces (Bohannon, 1988).

RTP strength criteria

Edourad et al. (2002) suggested that RTP can be safer at six months by demonstrating a return to full rotator cuff strength six months postoperatively (Edouard et al., 2012). However, it has to be determined whether post-operative weakness directly results from the surgical intervention or post-operative immobilization, causing disuse atrophy (Murphy et al., 2019). If weakness is due to postoperative immobilization, it would be logical to limit the immobilization period, reducing the extent of weakness postoperatively and the time required to restore the rotator cuff strength (Murphy et al., 2019).

Traditional RTP criteria after Bankart repair mostly included subjective assessment of strength and ROM and the passage of time, which is around 5-6 months (Junior et al., 2021). However, a recent study by Wilson et al. (2020) developed an objective protocol for assessing RTP in clinical settings, suggesting an objective assessment of strength and function may be more effective than clinical examination findings in identifying potential hidden deficits before RTP (Wilson et al., 2020). Wilson et al.'s (2020) protocol used isokinetic ER and IR rotation strength measurements at 60 deg/sec and 180 deg/sec, ER endurance testing, and two functional assessments, Closed Kinetic Chain Upper Extremity Stability Test (CKCUES) and the Unilateral Seated Shot-put test. The use of this protocol revealed significant deficits in patients planning RTP at six months post shoulder stabilization (Wilson et al., 2020). However, in this study, the psychometric properties of this protocol, such as validity and reliability, were not established (Popchak et al., 2021). Therefore, in a recent reliability-validity study by Popchak et al. (2021), authors demonstrated a battery of tests such as isokinetic shoulder ER and IR rotators at 60 deg/sec and 180 deg/sec, isometric ER and IR at 0 deg and 90 deg abduction, scaption plane abduction at 90 deg elevation, and repetition to failure assessment for ER at 0 and 90 deg, and horizontal abduction at 120 deg was performed. In addition, two functional assessments were included, CKCUES and the unilateral seated shot-put test (Popchak et al., 2021). Authors found good to excellent intra-rater reliability in all isokinetic (ICC – 0.88-0.94), isometric (ICC – 0.80-0.92), and functional assessments (Popchak et al., 2021). The inter-rater reliability of the isometric assessments was moderate to excellent (ICC: 0.71 – 0.92) across movements.

Physical performance tests must be easy and inexpensive to perform in the clinic, demonstrate good psychometric properties, and have normative data and cut-off values generated before clinical use (Ardern et al., 2016). The shoulder arm return to sports (SARTS) battery was developed, a series of open (ball abduction external rotation, drop catches, ball taps, overhead snatch), and closed chain functional performance tests (push up claps, line hops, side hold rotations, modified closed kinetic chain upper extremity stability test) that look at side-to-side differences to aid RTP decision making (Olds et al., 2019). Of the eight tests from the SARTS battery, six tests showed good psychometric properties and readability for clinical use (Olds et al., 2019). The authors of this study promote a battery of sports-specific strength tests that show adequate reliability and validity before they can be used in clinical settings (Olds et al., 2019). The HHD can be of significant value since it correlates with the isokinetic assessments and is a feasible and cost-effective method that any clinician can use at multiple setups, either in a clinic or a sports ground.

Patient-reported outcome measures (PROMs)

One of the other questions in this review was to look at PROMs following anterior shoulder stabilization. Although only four studies reported PROMs, the Rowe score was the most common outcome measure. In almost all the studies that reported Rowe scores, the post-operative scores indicated reasonably satisfactory outcomes (Glogovac et al., 2019; Ialenti et al., 2017; Nadeem et al., 2020; Stone & Pearsall, 2014). The Rowe score is an internationally accepted scoring system for the post-operative period of Bankart repair (Rowe, 1988). It has demonstrated acceptable internal consistency (Cronbach's alpha for the total score between 0.81 and 0.88), acceptable inter-rater reliability (ICC > 0.7), adequate intra-rater reliability for stability and total score, and adequate discriminant validity for patients with recurrent anterior dislocations (Skare et al., 2011). The Rowe score assesses patients in three domains: stability, ROM, and function, and an overall score is calculated out of 100 (Dawson et al., 1999). In a retrospective study of 26 patients having anteroinferior glenohumeral instability and operated with arthroscopic bone block grafting combined with a standard Bankart repair, results showed excellent outcomes (Walch-Duplay score 93.2, Rowe score 96.4, SSV score 87.4) (Taverna et al., 2018). In this study, the rate of RTS was high even among competitive, overhead, and “at-risk” athletes (Taverna et al., 2018). Similar findings were observed in a case series by Hoshika et al. (2021) in rugby or American football players who underwent ABR or a bony Bankart repair with selective augmentations for traumatic ASI (Hoshika et al., 2021). The mean Rowe and SSV scores post-surgery were 96 and 92, respectively (Hoshika et al., 2021). In a cohort study comparing ABR and open Latarjet patients with recurrent ASI, the open Latarjet group showed a higher Rowe score (90.5 ± 12.2 vs. 82.2 ± 20.8 for ABR), whereas the SSV scores were similar in both groups (Hurley et al., 2021). It can be expected for athletes to have significantly higher PROM scores as one of the RTP criteria. Looking at the evidence and the increasing trend of using the Rowe score due to its acceptable reliability and feasibility, we recommend using the Rowe score as one of the outcome measures during RTP decision-making.

Other PROMs are also commonly used as outcome measures post anterior shoulder stabilization. The SSV scale measures shoulder function as a percentage of a healthy shoulder can be easily administered and is a valid measure of shoulder function (Gilbart & Gerber, 2007). The Walch-Duplay scale is similar to the Rowe scale. However, it measures four domains instead of three: daily or sports activity level, stability, pain, and mobility; each item is worth 25 points (Nadeem et al., 2020). The European Society for Surgery for the Shoulder and Elbow has adopted and endorsed the Constant Score as an official tool for assessing the shoulder and is a valid measure of shoulder function (Constant, 1986). The WOSI assesses stability subjectively and ranges between 0 and 2100 points (Buckup et al., 2020). The WOSI is also a valid and reliable disease-specific quality of life outcome measure that can be used in a clinical setting in monitoring an individual patient’s progress (Kirkley et al., 1998).

RTP time frame

The RTP time frame was the only outcome reported in all the ten studies in this review. Although maximum studies reported RTP timeframes, a significant variation existed across all ten studies. Most studies reported an average RTP timeframe of around five to six months (Glogovac et al., 2019; Hurley et al., 2019; Lau et al., 2021; Nadeem et al., 2020). However, some contrasting timeframes were also reported where the time to RTP exceeded six months (Abdul-Rassoul et al., 2018), and in some of them, it was as low as 1.5 months (Ciccotti et al., 2018). Overall, no consensus exists between the systematic reviews studied in this review. No systematic review has mentioned the timeframes consistently, which can assist clinicians in making RTP decisions within the recently developed StARRT framework (Shrier, 2015). With step 1 of the StARRT framework, the health risk assessment is dependent on the clinical status postoperatively. The RTP timeframe is likely to affect if the clinical criteria post-surgery or health risk assessment (step 1 of StARRT) is not fully complete. In the rehabilitation stages, from the immediate postoperative phases, the RTP timeframe is likely to change based on how the rehab has been progressed. When RTP begins, the periodized exercise and skill progressions run through various training blocks, requiring a specific timeframe. However, the current systematic review could not establish adequate information on the timeframes for achieving the clinical milestones, rehab exercise duration, or when the athlete resumes his RTP. Hence, a new model of RTP milestones is proposed (Table 6), which explains the timeframe specific to clinical, functional, and sports-specific milestones that can inform the RTP timeframe more clearly and help decision-making easier. Since the evidence is unclear when an athlete can safely RTP, this new proposed model can help clinicians make more informed decisions based on specific clinical, functional, and sports-specific criteria. We strongly recommend not to use only timeframe as a sole criterion to RTP following arthroscopic shoulder stabilization.

Table 6

A new proposed individualized criterion-based RTP plan: An exemplar to plan criterion-based RTP based on injury severity, surgery, and rehabilitation to allow clinicians to make informed decisions.

Criteria	Criteria	Goal	Expected Timeframes
Clinical goals	Symptoms	No pain or any giving away	2-4 weeks
	Stability	No instability in performing any exercises	4-6 weeks
	Activities of daily living	No pain in ADL activities	4-6 weeks
Strength goals	Isometric strength (HHD)	Equal ER & IR at 0 & 90 deg, Horizontal abduction at 90 deg & 120 deg scaption plane	12 weeks
	Isokinetic strength	Equal ER & IR at 60 deg/sec & 180 deg/sec	16 weeks
	Fatigue	ER, IR endurance test equal BL Isometric endurance in ER and IR using an HHD	16 weeks
Other goals	Functional tests	CKCUES, Unilateral Seated Shot-Put test, SARTS battery	16 weeks
	PROMS	Rowe: >90	12-14 weeks
	Psychological readiness	Injury-Psychological Readiness to Return to Sport Questionnaire or Tampa Scale of Kinesiophobia	16-20 weeks
Sports specific goals	Return to skill training	Unrestricted participation in all skill activities	16-20 weeks
	Practice game	Play a practice game without any restrictions and at 100% intensity	20-24 weeks

Return to Play: A three-step Continuum

In recent years, the issues related to the resumption of sports participation following injury have often been labeled as a return to play (RTP). Although the RTP term is commonly applied to any team sport athlete, recent guidelines suggest a new term, return to sport (RTS), instead of RTP, as RTS is relevant to and applicable to all sports and all athletes (Ardern et al., 2016). The *Swiss Sports Physiotherapy Association*, along with *the International Federation of Sports Physical Therapy (IFSPT)* and the *British Journal of Sports Medicine* (*BJSM)*, hosted the first international RTS congress to present current evidence and guidelines to the clinicians (specially physiotherapists and physicians) who play a major role in RTS decisions after any sports injury (Ardern et al., 2016).

According to the 2016 consensus guidelines, the RTS can be viewed as a continuum paralleled with recovery and rehabilitation – not simply isolated decision-making when the recovery and rehabilitation process ends (Ardern et al., 2016). RTS continuum has three elements that emphasize a graded, criterion-based progression suitable to any sport and aligned with RTS goals (Figure 3):

1) **Return to participation**: The athlete may be participating in his or her sport or training in the gym and have resumed conditioning, but at a lower level than his or her RTS goal. The athlete is physically active but not yet fully ready (either medically, physically, or physiologically) to RTS (Ardern et al., 2016).
2) **Return to sport**: The injured athlete has returned to his or her sport but not performing at his best in this stage. Many may still consider this successful RTS (Ardern et al., 2016).
3) **Return to performance**: At this stage, the athlete has regained his or her performance levels above or similar to the pre-injury levels (Ardern et al., 2016).

Figure 3

Three elements of return to sports continuum

Note: This figure is modified and *adapted from the recent RTP consensus* (Ardern et al., 2016).

Psychological readiness to return to sport

It is uncertain from the findings of this systematic review that the outcomes (time, strength, and PROMs) inform sufficiently to decide RTP in athletes following anterior shoulder instability. RTP timeframe lacks consensus following arthroscopic shoulder stabilization. PROMs and the reported outcomes in current literature provide limited information because RTP decision-making is not solely based on patients' subjective feelings of recovery but is a multifactorial process (Ardern et al., 2016). One crucial factor that most PROMs lack to establish is determining athlete psychological readiness to competitive sports (Ardern et al., 2016; Forsdyke et al., 2017). Psychological readiness forms an important element within the biopsychosocial model that can assist clinicians in RTP planning and shared decision-making.

In a cohort study by Rossi et al. (2021) of 208 athletes who underwent ABR for isolated ASI, authors tried to evaluate the reasons why competitive athletes can't RTS (Rossi et al., 2021). Authors found that 74% of the athletes could not RTS primarily due to fear of reinjury (Rossi et al., 2021). Characteristics of an athlete who is psychologically ready for RTS are multifaceted and include realistic expectations, high self-efficacy, and low anxiety levels (Forsdyke et al., 2016; Podlog et al., 2015). Many social agents and contextual factors (coaches, sports medicine practitioners, personality traits, performance level) influence psychological readiness, thus requiring multi-dimensional monitoring (Forsdyke et al., 2016; Podlog et al., 2015). It is recommended to use multiple tools to monitor an athlete's psychological readiness. Some of the tools are the “Re-injury Anxiety Inventory,” “Injury-Psychological Readiness to Return to Sport Questionnaire,” or “Tampa Scale of Kinesiophobia” (Forsdyke et al., 2017). However, the practitioner should not be overreliant on these tools as the athlete may be psychologically ready for RTS, but the working knowledge of the athlete might indicate something else (Forsdyke et al., 2017). In a retrospective study by Gerometta et al. (2016), the Shoulder Instability Return to Sport after Injury scale (SIRSI) was performed in a group of rugby athletes operated for chronic post-traumatic ASI (Gerometta et al., 2018). The authors demonstrated a good correlation of SIRSI with the reference questionnaires, WOSI and Walch-Duplay Scales. The mean score was significantly higher in patients who returned to play rugby (60.09 ± 26.6% vs. 38.1 ± 25.6%). The authors concluded that the SIRSI has a high consistency (α =0.96) and an excellent test-retest reproducibility in identifying patients ready to RTP after shoulder surgery (Gerometta et al., 2018).

RTP: In a Nutshell

“When will I be able to play again?” is usually the reflex question when an athlete suffers an injury. When making RTP decisions, clinicians (including physiotherapists, strength and conditioning specialists, and physicians) and athletes might engage in a risk-benefit analysis to determine the risks associated with participation and the extent to which those risks can be tolerated (Ardern et al., 2016). A multistage fitness test or a battery of clinical, functional, or strength tests is performed to assess the physiological and physical preparedness looking at the requirements to qualify for match fitness. However, the physical performance tests may only serve as milestones along the RTP pathway and inform whether an athlete can be allowed to play or not. For example, with a knee injury, an athlete can hop. However, it may still be unclear whether they can be declared match fit and fully prepared to participate in the competition. In a sport having multiple formats, the return to the shorter format of the game is ideally allowed first after the surgery to assess the match response at shorter volumes. The medical team generally informs the team management about the short-term risks of performance detriment, recurrence risk, consequences, and long-term prognostic outcomes after return to play. However, the clinician who waits for tissue healing as the only criterion to RTP faces many challenges and will probably find a short-lived career in a sporting team (Ardern et al., 2016).

The athlete is also responsible for making an informed decision and predicting his readiness and confidence to play, considering his personal, environmental, and psychosocial factors. In a practical scenario, players expect themselves to be available for the selection at the earliest, sometimes compromising their bodies due to lack of complete readiness. Factors such as fear of litigation or future selection risk and vast amounts of financial losses that the athletes often compromise due to time loss may be the reasons for such inclinations. A positive psychological response or psychological readiness is strongly related to successful RTP at pre-injury levels. A psychological assessment tool along with a PROM will indicate how much an athlete finds himself ready to progress to the desired sport. Besides, the coach's perspective of an athlete concerning sport-specific context and the information provided by the medical & support staff to the management regarding the match readiness forms a critical component of the RTP pathway. The family members can provide valuable information about behaviors away from the sport (Forsdyke et al., 2017). Both perspectives help build a picture of the athlete's psychological readiness to RTS (Forsdyke et al., 2017).

Therefore, the RTP decision-making is not in isolation. Instead, it is a shared decision between health care professionals, athletes, and coaches.

PRACTICAL IMPLICATIONS

This systematic review of systematic reviews has synthesized the current evidence pertaining to the RTP outcomes (timeframe, strength, and PROMs) following anterior shoulder stabilization surgery. RTP timeframe is the only outcome commonly seen in all the reviews in this study. However, the RTP timeframe may not be ideal for use solely in RTP decision-making, as RTP is always multi-factorial. The second outcome of interest was the strength outcomes following anterior shoulder stabilization. This systematic review indicated minimal reporting of strength outcomes and less clarity in strength tests that identify strength deficits in post-operative patients. The third RTP outcome was the PROMs following anterior shoulder stabilization. Although the Rowe score is commonly reported in the study, there is also a considerable variation in PROMs in this systematic review. These variations only make the RTP decision-making trickier due to a lack of consistent reporting.

Looking at the variations seen in RTP timeframe reporting, we recommend clinicians adopt an individualized criterion-based approach to RTP decision-making and not just rely on the time post-surgery. There is a need to develop better strength testing methods that are consistent, reliable, and practically feasible in any setting. We encourage using HHD in clinical practice and research settings to identify athlete readiness during RTP stages. The use of PROM in RTP decision-making is recommended. However, PROMs need to be combined using other tools to identify the athlete’s psychological status within the biopsychosocial model.

We strongly recommend using the StARRT model, which helps an athlete transition by estimating the risks between the biomedical factors and participation levels and establishing the acceptable risk tolerance of an athlete with the given context (Shrier, 2015). Integrating RTS decisions is essential where roles and responsibilities within the decision-making team should be determined as soon as possible and shared among all relevant stakeholders (Ardern et al., 2016). We promote RTP decisions as a shared decision-making process. The physiotherapist plays a significant role in establishing an athlete's health status, rehabilitation, and communication to relevant stakeholders (Dijkstra et al., 2017). A summary of practice recommendations is given in Table 8.

Table 8

Summary of practice recommendations in RTP decision-making

Practice Recommendations
❖ Individualized criterion-based approach to RTP in ASI instead of timeframe ❖ Need to advance strength testing methods, HHDs for practical use ❖ PROMS use recommended, and to be combined with psychological assessment tools ❖ The use of the StARRT framework and biopsychosocial approach strategies is recommended. ❖ RTP decisions are shared across relevant stakeholders.

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APPENDIX 1: A COMPLETE SEARCH STRATEGY FOR ALL DATABASES

EBSCO HOST (MEDLINE, CINHAL, AND SPORT DISCUSS) 1868-2021

S1: ("shoulder instability" OR "shoulder subluxation*" OR Bankart OR labrum OR labral OR "humeral avulsion of glenohumeral ligament" OR HAGL OR "glenohumeral instability") 16236 articles

S2: (shoulder or glenohumeral) N4 (dislocat*) 13814 articles

S3= S1 OR S2 (26187 articles)

S4: ("shoulder stabili*" OR surg* OR arthroscop* OR "Bankart repair*" OR "coracoid transfer" OR Latarjet OR Bristow OR Remplissage OR "bone block" OR "bone graft" OR "open repair") 4890177 articles

S5= S3 AND S4 (18729 articles)

S6: (return*) N4 (play* OR sport* OR athlet* OR performance OR Cricket OR Tennis OR baseball OR thrower* OR bowl* OR Basketball OR Volleyball OR Badminton OR Netball OR Handball) 23239 articles

S7= S5 AND S6 (1426 articles)

S8: ("patient reported outcome*" OR PROM OR "functional improvement*" OR "functional outcome*" OR strength* OR tim*) 6806489 articles

S9= S7 AND S8 (817 articles)

S10: ("systematic review*" OR meta-analysis) 519722 articles

S11= S9 AND S10 (95 articles)

Total articles: 95

WEB OF SCIENCE (1900-2021)

S1: (“shoulder instability” OR “shoulder subluxation*” OR Bankart OR labrum OR labral OR “humeral avulsion of glenohumeral ligament” OR HAGL OR “glenohumeral instability”) 9356 articles

S2: (shoulder or glenohumeral) Near/4 (94thlete94e*) 3428 articles

S3= S1 OR S2 (11662 articles)

S4: (“shoulder stabili*” OR surg* OR arthroscop* OR “Bankart repair*” OR “coracoid transfer” OR Latarjet OR Bristow OR Remplissage OR “bone block” OR “bone graft” OR “open repair”) 1948532 articles

S5= S3 AND S4 (6879 articles)

S6: (return*) Near/4 (play* OR sport* OR athlete* OR performance OR Cricket OR Tennis OR baseball OR thrower* OR bowl* OR Basketball OR Volleyball OR Badminton OR Netball OR Handball) 12383 articles

S7= S5 AND S6 (596 articles)

S8: (“patient reported outcome*” OR PROM OR “functional improvement*” OR “functional outcome*” OR strength* OR tim*) 9865605 articles

S9= S7 AND S8 (324 articles)

S10: (“systematic review*” OR meta-analysis) 361181 articles

S11= S9 AND S10 (38 articles)

Total articles: 38

SCOPUS

S1: ("shoulder instability" OR "shoulder subluxation*" OR Bankart OR labrum OR labral OR "humeral avulsion of glenohumeral ligament" OR HAGL OR "glenohumeral instability") 10912 articles

S2: (shoulder or glenohumeral) N4 (dislocat*) 11273 articles

S3= S1 OR S2 (11332 articles)

S4: ("shoulder stabili*" OR surg* OR arthroscop* OR "Bankart repair*" OR "coracoid transfer" OR Latarjet OR Bristow OR Remplissage OR "bone block" OR "bone graft" OR "open repair") 3461045 articles

S5= S3 AND S4 (6334 articles)

S6: (return*) W/4 (play* OR sport* OR athlet* OR performance OR Cricket OR Tennis OR baseball OR thrower* OR bowl* OR Basketball OR Volleyball OR Badminton OR Netball OR Handball) 17598 articles

S7= S5 AND S6 (451 articles)

S8: ("patient reported outcome*" OR PROM OR "functional improvement*" OR "functional outcome*" OR strength* OR tim*) 14739984 articles

S9= S7 AND S8 (251 articles)

S10: ("systematic review*" OR meta-analysis) 488289 articles

S11= S9 AND S10 (32 articles)

Total articles: 32

AMED via OVID (FROM 1985-APRIL 2021)

S1: ("shoulder instability" OR "shoulder subluxation*" OR Bankart OR labrum OR labral OR "humeral avulsion of glenohumeral ligament" OR HAGL OR "glenohumeral instability") 396 articles

S2: (shoulder or glenohumeral) adj4 (dislocat*) 161 articles

S3= S1 OR S2 (494 articles)

S4: ("shoulder stabili*" OR surg* OR arthroscop* OR "Bankart repair*" OR "coracoid transfer" OR Latarjet OR Bristow OR Remplissage OR "bone block" OR "bone graft" OR "open repair") 20189 articles

S5= S3 AND S4 (209 articles)

S6: (return*) adj4 (play* OR sport* OR athlet* OR performance OR Cricket OR Tennis OR baseball OR thrower* OR bowl* OR Basketball OR Volleyball OR Badminton OR Netball OR Handball) 938 articles

S7= S5 AND S6 (37 articles)

S8: ("patient reported outcome*" OR PROM OR "functional improvement*" OR "functional outcome*" OR strength* OR tim*) 52666 articles

S9= S7 AND S8 (26 articles)

S10: ("systematic review*" OR meta-analysis) 6084 articles

S11= S9 AND S10 (4 articles)

Total articles: 4

COCHRANE via OVID

S1: ("shoulder instability" OR "shoulder subluxation*" OR Bankart OR labrum OR labral OR "humeral avulsion of glenohumeral ligament" OR HAGL OR "glenohumeral instability") 24 articles

S2: (shoulder or glenohumeral) adj4 (dislocat*) 15 articles

S3= S1 OR S2 (28 articles)

S4: ("shoulder stabili*" OR surg* OR arthroscop* OR "Bankart repair*" OR "coracoid transfer" OR Latarjet OR Bristow OR Remplissage OR "bone block" OR "bone graft" OR "open repair") 6496 articles

S5= S3 AND S4 (23 articles)

S6: (return*) adj4 (play* OR sport* OR athlet* OR performance OR Cricket OR Tennis OR baseball OR thrower* OR bowl* OR Basketball OR Volleyball OR Badminton OR Netball OR Handball) 56 articles

S7= S5 AND S6 (8 articles)

S8: ("patient reported outcome*" OR PROM OR "functional improvement*" OR "functional outcome*" OR strength* OR tim*) 15423 articles

S9= S7 AND S8 (8 articles)

APPENDIX 2: DETAILED LIST OF ALL EXCLUDED STUDIES WITH REASONS

SR. NO	AUTHORS	Reason to exclude
1	**Shanmugaraj et al 2019**	The purpose was to assess the surgical techniques, indications outcomes and complications for pediatric patients (≤ 19 years old) undergoing shoulder stabilization procedures for anterior shoulder instability. No RTP time, strength and PROMs reported
2	**Coughlin et al 2018**	This article includes studies involving patients diagnosed with MDI, posterior instability and anterior instability. Also the surgery performed is rotator interval closure
3	**Longo et al 2016**	Only recurrence rate is being reviewed
4	**Braun and Robert 2019**	This review is about conservative management for traumatic anterior shoulder dislocation
5	**Nassiri et al 2015**	Abstract only
6	**Hurley et al 2020**	Outcomes reported were: recurrent dislocation, subsequent surgery and return to play. But time to RTP was not pooled in this review.
7	**Adam et al 2018**	Outcome measures were failure rates (dislocation, subluxation, and instability) and revision rates
8	**Huxel et al 2018**	Only abstract is available
9	**Kraeutler et al 2020**	NO outcomes like time to RTP, strength and PROM's were reported

10	**Cannizzaro et al 2020**	This study explored the effect that sex has on ASI following primary arthroscopic anterior shoulder stabilization. Also clinical outcomes were inconsistently reported and PROMS objective values were not reported.
11	**Lazzarides et al 2019**	The study mentions improvement of PROMs post arthroscopic remplissage, but doesn't report any relation with the RTP.
12	**Hohmann et al 2017**	PROMs weighted mean scores were not reported and was not related with RTP
13	**Rollick et al 2017**	Only PROMs measured, however return to play and PROM relationship is not mentioned anywhere
14	**Kasik and Saper 2018**	This study didn't looked at strength outcomes, PROMs scores and return to play time frames. Only variablility in reporting was explored.
15	**Lau et al 2020**	This study focused on revision rates and recurrent instability. PROMs were just mentioned and RTP was not discussed
16	**Lukenchuk et al 2016**	This study looked at variability of outcome reporting and didn't mention RTP time frames, strength measures or any RTP criteria. However, only frequency of these outcomes were reported
17	**Ali et al 2020**	RTP was not the aim of this study
18	**Hurley et al 2020 (BHJD)**	RTP was not the aim of this study
19	**Murphy et al 2019**	RTP was not the aim of this study
20	**Hohmann et al 2017**	RTP was not the aim of this study

21	**Camus et al 2017**	RTP was not the aim of this study
22	**Gilat et al 2021**	RTP was not the aim of this study
23	**Hurley et al 2020 (JSES)**	RTP was not the aim of this study
24	**Bozzo et al 2017**	RTP was not the aim of this study
25	**Fanning et al 2020**	RTP was not the aim of this study
26	**Patel et al 2020**	RTP was not the aim of this study
27	**Assuncao et al 2019**	RTP was not the aim of this study
28	**Vincent et al 2016**	RTP was not the aim of this study
29	**Buza et al 2014**	RTP was not the aim of this study
30	**Lenters et al 2007**	RTP was not the aim of this study