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Rehabilitation after arthroscopic Bankart repair: a systematic scoping review identifying important evidence gaps

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Abstract

Background Evidence to develop best rehabilitation practices after Arthroscopic Bankart Repair (ABR) is lacking, leading to heterogeneity in rehabilitation approaches.
Objectives This systematic scoping review investigated current evidence for rehabilitation and associated outcomes following ABR, including rehabilitation parameters, evaluative approaches (outcomes/outcome measures, follow-up timing/duration).
Data sources A systematic search was performed of CINAHL, MEDLINE, and Embase databases in May 2019.
Study selection Prospective studies detailing rehabilitation protocols following ABR reporting at least one postoperative assessment within 1 year of surgery (to measure impact of rehabilitation) were included.
Data extraction and synthesis Two blinded reviewers independently selected studies using standardized criteria and extracted study characteristics and outcomes of interest. Quality of evidence was assessed using Joanna Brigg's quality assessment tool. A narrative analysis was conducted and evidence gaps were identified.
Results Nine studies evaluating 11 rehabilitation protocols with a total of 384 participants were included. Considerable variability was seen in rehabilitation protocols and evaluation parameters. Return to sports/activity was frequently measured, but not well-defined. Strengthening was an important component of rehabilitation protocols, but rarely reported as an outcome. Follow-up was variable, with 4 studies ending follow-up before 24-months postoperatively. Overall, patient outcomes improved postoperatively.
Conclusions There is a paucity of evidence investigating the impact of rehabilitation approaches following ABR. Although patient outcomes improve after ABR, selected outcomes/measures are highly variable with limited evidence on those important to measure rehabilitation success, particularly strength and return to activity. Identified evidence gaps should be addressed in future research.

Contribution of the paper

- Identified important evidence gaps related to rehabilitation parameters and outcome assessment following rehabilitation after ABR.

Keywords: Arthroscopic Bankart repair; Postoperative rehabilitation; Return to sport

Introduction

Persistent anterior shoulder instability is common following traumatic anterior dislocation of the shoulder [1], and is often associated with anteroinferior labral detachment (Bankart lesion) and compromise of the glenohumeral lig-

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aments [2]. To stabilize the shoulder and prevent recurrent dislocations, Arthroscopic Bankart Repair (ABR) is used to repair Bankart lesions without substantial bony injury [3]. Postoperatively, rehabilitation focuses on regaining shoulder mobility and strength for dynamic joint stability while protecting the surgical repair, to allow patients to return to previous activities.

Recent reviews report sparse evidence to guide postoperative rehabilitation following ABR [4,5]. In the absence of evidence, clinical experts developed rehabilitation guidelines, but substantial heterogeneity exists regarding duration and type of postoperative immobilization, exercise parameters, and timing for progression and return to sport/activities [6–8]. Although some treatment variability is expected, to individualize patient care, substantial heterogeneity in outcome measures and assessment parameters/timing prevents establishing care standards. This, in turn, limits assessment of the impact of rehabilitation and surgical techniques, potentially negatively affecting patient outcomes.

We undertook a systematic scoping review to determine:

(1) current evidence for rehabilitation parameters and associated patient outcomes after ABR;
(2) outcomes/outcome measures utilized to assess ABR outcomes and timing of assessments.

We aimed to identify important evidence gaps related to (a) rehabilitation protocol parameters and (b) evaluation of such protocols.

Methodology

We followed the five-stage methodological framework proposed for scoping reviews [9–11] and the Preferred Reporting in Systematic Reviews and Meta-analyses Extension for Scoping Reviews (PRISMA-ScR) guidelines [12].

Stage one: identifying the scope and research questions

Research Questions: We used the 'population, concept and context (PCC)' approach to develop the research questions [11].

For adults who have undergone ABR (population):

(1) What are current postoperative rehabilitation practices and their associated outcomes (concept/context)?
(2) What outcomes are reported and when are they assessed during recovery (concept)?

We then identified evidence gaps to advance future research to improve postoperative rehabilitation and evaluation following ABR.

Selection criteria: Articles published in English after 1999 that included patients between 18 and 40 years of age undergoing ABR were included; the date limitation ensured that current ABR surgical and rehabilitative approaches were represented. Prospective studies with pre-operative functional assessments comparing ABR rehabilitation approaches, or describing postoperative outcomes including detailed descriptions of rehabilitation protocols were included. Eligible studies had to report at least 1 clinical outcome (e.g., pain, function, range of motion [ROM], strength, health related quality of life [HRQL], return to activity, re-dislocation) that was assessed within 1 year of surgery to facilitate evaluation of the impact of the rehabilitation protocol on patient outcomes. Long-term outcome studies were included if at least one assessment occurred in the first postoperative year.

Studies focusing on surgical techniques without describing rehabilitation, or on surgical techniques other than ABR, or only reporting outcomes after the first postoperative year were excluded. Cross-sectional studies and clinical practice guidelines were also excluded as they did not evaluate the impact of rehabilitation.

Stage two: data sources and search

A health librarian conducted a systematic literature search from 1999 to April-2019 using the following databases: MEDLINE (Medical Literature Analysis and Retrieval System Online), CINAHL (Cumulative Index of Nursing and Allied Health Literature), and Embase. The search included combinations of keywords and terms representative of "anterior shoulder instability", "Bankart repair", and "postoperative rehabilitation". The search was developed in Medline in an iterative format in conjunction with clinical experts (JC, CLC) (Table 1) and revised as needed for the other databases (Appendix 1).

Stage three: record screening and study selection

Identified articles were imported into RefWorks™, an online reference management tool, for de-duplication and then imported into Covidence™, a web-based systematic review tool. At each stage (title/abstract; full text), two blinded reviewers (WM, AL) independently assessed each study using defined selection criteria. Disagreements were resolved through consensus or using third reviewers (LB, AS) as needed. Fifty studies were initially reviewed in the title/abstract stage to examine reviewer agreement using the selection criteria followed by refinement of criteria definitions. A similar process was performed with 10 studies at the full text review stage.

Stage four: data charting

Data extraction: Following study selection, each reviewer independently extracted data from 50% of studies and then checked and confirmed the other reviewer's work. Data extracted included author information (name, institution), publication date, country in which the study took place, study design, population characteristics, postoperative rehabilitation protocol, and reported clinical outcomes/outcome measures (pain, ROM, HRQL, strength, return to activity/sport, re-dislocation).

Quality assessment: While not traditionally included in scoping reviews, internal validity was assessed because we included studies with clinical outcomes. Thus, we thought it necessary to also determine the quality of available clinical evidence. We used Joanna Briggs Institute critical appraisal tools [13], selecting the relevant appraisal tool for each study design. Each reviewer independently assessed study quality after which a narrative synthesis was performed.

Stage five: collate, summarize, analyze and report results

We examined study methodology, participant characteristics and outcomes associated with each rehabilitation protocol as well as the timing and types of outcomes reported. Evidence gaps were identified in discussion with clinical (JC, CLC) and research (LAB, AS) experts.

Results

Data Screening and Selection: The literature search retrieved 3749 articles (Embase = 1728; CINAHL = 736; Medline = 1285). After deduplication, 2197 articles underwent title/abstract screening; 407 advanced to full text screening. Using our standardized selection criteria, 398 articles were excluded leaving nine studies with a total of 384 participants included (Fig. 1).

Study Characteristics: Of nine studies [14–22], two were randomized controlled trials (RCT) comparing rehabilitation approaches [16,17] while the remaining studies were either cohort [20], or case series [14,15,18,19,21,22]. Data from a surgical RCT that compared arthroscopic and open surgical approaches, but detailed postoperative rehabilitation [18] was included as a case series using only the ABR group.

Sample Characteristics. Studies were typically small, varying from 27 [16] to 62 [17] participants. Of the seven studies that reported sex [14,16–20,22], 254 (86%) participants were male. Average ages across all studies varied from 18 [21] to 29 [17,20] years (Table 1).

Rehabilitation protocols: Eleven rehabilitation protocols were reported (Table 2) with only two directly comparing rehabilitation approaches [16,17]. Kim *et al*. [17] compared accelerated (participants immobilized in a sling for the first two weeks with mobility and isometric exercises initiated in the first postoperative week) to standard (participants immobilized in a sling for three weeks and then commenced mobility exercises) rehabilitation. Ismail *et al*. [16] compared supervised physical therapy with a home-based protocol. The home-based group was immobilized in a sling for three weeks before commencing ROM whereas the supervised group was immobilized for one week and then used the sling only while sleeping; passive and active assisted ROM (AAROM) started on the third postoperative day in this group.

The other seven studies described recovery after ABR, with at least one assessment performed within the first postoperative year [14,15,18–22]. Immobilization periods and type of shoulder ROM exercises initiated varied substantially across studies. Six protocols [14–17,20,22] directed mobility exercises, (e.g., pendulum and AAROM), to begin within the first two postoperative weeks, with gradual progression. Three studies [15,19,21] restricted combined abduction and external rotation for an extended period (i.e., ten weeks to four months postoperatively). Submaximal isometrics or gentle strengthening was initiated in the first three weeks in six protocols [14–17,20,21] while one [19] did not initiate strengthening until three months postoperatively. Return to activity/sport guidance, included in seven protocols [14–16,18,19,21], varied from six weeks [15] to six months [14,18,19,21] postoperatively with return to contact and overhead sports requiring longer recovery periods. Only four protocols [14–16] provided guidance for return to activities of daily living (ADLs).

Clinical Outcomes/measures and Study Follow-up: Reported outcomes were variable with two studies reporting shoulder pain [17,22], six studies reporting shoulder ROM [15,16,17,18,20,22], two reporting shoulder strength (torque) [14,20], and three reporting return to activity/sport [15,17,19]. Although only three studies reported pain using a pain rating scale [17,19,22], most studies used global shoulder or upper extremity outcome measures (e.g., Rowe, Constant, Walch-Duplay, DASH) that included pain assessment [14,18,19,21]. The most commonly used HRQL measures were the Rowe [14,17–19] and Constant [18,19,21] scores. Total follow up varied from 24-weeks [16] to 4.8 years [15] after ABR with five studies performing multiple assessments within the first year [14,16,18,21,22].

Comparative Trial Outcomes: Kim *et al*. [17] reported that accelerated rehabilitation participants had improved activity-related shoulder pain at six-weeks ($P = 0.013$), faster recovery of external rotation ($P < 0.001$) and return to sport ($P < 0.001$), and greater patient satisfaction ($P < 0.001$) than standard rehabilitation participants. Ismail *et al*. [16] found no significant difference in all reported outcomes at three, six, 12, and 24 weeks postoperatively between those performing a home-based versus a supervised program.

Range of motion: Most studies reported minimal ROM deficits following rehabilitation [15,17,18,22]. Conversely Szuba *et al*. [20] reported significantly reduced total rotation (external plus internal rotation) at 90 degrees of abduction between operative and non-operative sides at 16 months post-operation ($P < 0.001$). Although they started mobilization 2-weeks postoperatively, participants received only 6-weeks of supervised therapy followed by home exercises. Ismail *et al*. [16] reported that relative to the non-operative side, both groups exhibited external rotation deficits at the final 24-week follow up (supervised group = 81% external rotation at 90 degrees abduction, 77% external rotation at 0 degrees abduction; home-based group = 76% external rotation at 90 degrees abduction, 73% external rotation at 0 degrees abduction).

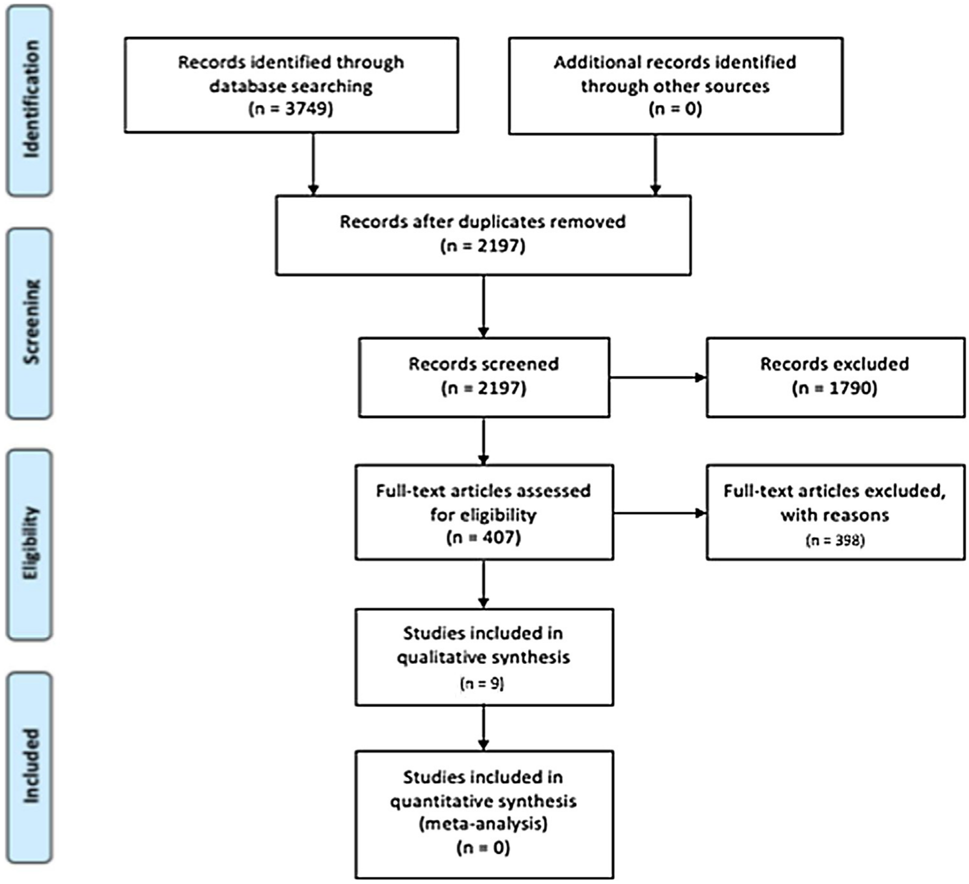

Fig. 1. PRISMA diagram for study selection.

Strength: Only two studies measured strength postoperatively [14,20]. Szuba *et al*. [20] reported deficits compared to matched controls up to 16 months postoperatively in relative torque and total work for external and internal rotation at 90 degrees of abduction as well as time to peak torque for external rotation at 90 degrees per second ($P < 0.001$ and $P = 0.015$, respectively). In contrast, Amako *et al*. [14] found that rotational strength measured by peak torque with the shoulder in 45 degrees of abduction recovered to pre-operative levels within six months of surgery.

HRQL Measures: Studies reporting the Rowe [14,17–19] or the Constant [18,19,21] scores reported significant improvements postoperatively. Kim *et al*. [17] reported that the University of California Los Angeles [UCLA], American Shoulder and Elbow Surgeons [ASES], and Rowe scores all improved postoperatively, but no significant nor clinically important group differences occurred ($P > 0.05$). Ismail *et al*. [16] also found that shoulder function scores (Closed kinetic chain upper extremity stability test [CKCUEST] and Functional impairment test-hand and neck/shoulder/arm [FIT-HaNSA]) significantly improved from week 12 to 24 ($P < 0.05$), with no significant group differences ($P > 0.05$).

Return to Sports/Activity: Kim *et al*. [17] reported similar return to activity at final follow up (mean of 31 months) between groups ($P = 0.80$), but the average time to resume 90% of activity was shorter in the accelerated group ($P < 0.001$). Stein *et al*. [19] reported that the mean return to sport time was six and a half months with no difference noted in different types of athletes, while Gibson *et al*. [15] reported that the mean return to sport time was eleven weeks with some participants returning to sport as early as nine weeks postoperatively.

Redislocation: While most studies reported satisfactory results following ABR and rehabilitation with overall redislocation rates between 0 [16,17,21,22] and 11% [19], Sperber *et al*. [18] reported much higher recurrence within 24 months in 23% (7/30) of participants, which authors potentially attributed to new surgical techniques. Stein *et al*. [19] looked at redislocation rates in different types of athletes and found athletes in collision sports had a much higher redislocation rate (23%) compared to their pooled data for all athletes (11%).

Quality assessment

Of the identified studies, two were level I evidence [16,17] that compared rehabilitation approaches. Although the majority of the included studies met greater than 70% of

Table 1
Study characteristics.

Authors (Year)	Country	Study design	Number of participants	Demographics (age, sex (m/f))	Outcomes used	Follow up period	JBI appraisal checklist*
Amako *et al*. (2017) [14]	Japan	Prospective case series	50	25*, 47/3	Rowe, DASH, JOA, peak torque, total work	24 months	8/10
Gibson *et al*. (2016) [15]	United Kingdom	Prospective case series	34	23*, not reported	Return to play, ROM, recurrence of dislocation	4.8 years*	6/10
Ismail *et al*. (2014) [16]	Egypt	RCT (supervised versus home exercise program)	27 (14 supervised,) 13 home-based)	26.4*, 12/2 (supervised). 27.4*, 12/1 (home)	ROM, FIT-HaNSA, CKCCUEST	24 weeks	11/13
Kim *et al*. (2003) [17]	Korea	RCT (accelerated, standard)	62 (28 standard, 34 accelerated)	28*, 23/5 (standard). 29*, 27/7 (accelerated)	Recurrence of dislocation, UCLA, ASES, Rowe, pain, ROM, return to activity, patient satisfaction	31 months*	10/13
Sperber *et al*. (2001) [18]	Sweden	Prospective case series (only extracted arthroscopic repair data)	30	25*, 21/9	Constant, Rowe, ROM, recurrence of dislocation	24 months	5/13
Stein *et al*. (2011) [19]	Germany	Prospective case series	47	26.9*, 39/8	Rowe, Constant, Walch-Duplay, ASOSS, SSAS, redislocation rate	32 months	9/10
Szuba *et al*. (2016) [20]	Poland	Prospective cohort	45	29*, 20/0 (surgical). 26.9*, 25/0 (matched controls)	ROM, torque, total work, mean power	16 months*	8/11
Wade *et al*. (2018) [21]	India	Prospective case series	49	18–40 (range), not reported	Constant, DASH, recurrence of dislocation	12 months	6/10
Yin *et al*. (2014) [22]	United States	Prospective case series	33	23*, 28/5	ROM, ASES, WOSI, pain, SF-12, recurrence of dislocation	16 months*	9/10

*Reported as mean. LEGEND: ROM (range of motion), UCLA (University of California Los Angeles shoulder score), ASES (American Shoulder and Elbow Surgeons shoulder score), WOSI (Western Ontario Shoulder Instability Index), DASH (Disability of the arm, shoulder, and hand), SF-12 (12-item short form survey), FIT- HaNSA (Functional impairment test-hand and neck/shoulder/arm), CKCCUEST (Closed kinetic chain upper extremity stability test), JOA (Japanese Orthopedic Association shoulder score), ASOSS (Athletic shoulder outcome scoring system), SSAS (Shoulder specific activity score). * Score represents the number of items that were considered low risk of bias; items that scored as high risk of bias or unclear received a score of 0.

the quality checklist criteria from the Joanna Briggs Institute critical appraisal tools, most were prospective case series, hindering any conclusions about superiority in rehabilitation approaches. Three studies [15,18,21], did not meet 70% of the quality criteria; in particular, Sperber *et al*. [18] had 8/13 items scored as unclear or at risk of bias (Table 1).

Identified evidence gaps

Several evidence gaps were identified that require further investigation. We categorized them under. Rehabilitation Parameters and Evaluation Parameters following ABR to determine success (Table 3).

Discussion

This systematic scoping review synthesized the limited evidence on rehabilitation and the associated patient outcomes after ABR. Despite most studies reporting positive postoperative outcomes, we found substantial heterogeneity in both the rehabilitation parameters and evaluation approaches (e.g., outcomes, timing). Only two trials published since 1999 compared rehabilitation approaches [16,17]. Expertise-based guidelines [5,8] have emerged to provide clinical guidance, but current protocols continue to deviate from the guidelines [7]. Further it is unclear if guideline concordant care results in better outcomes as only 1 small non-randomized study has compared 'usual care' to 'guideline-concordant care', finding no differences [6]. Current expertise-based guidelines should be applied and rigorously tested in clinical settings to determine their effectiveness; further research is clearly needed. This dearth of evidence provides a confusing picture for patients and providers where similar patients follow different rehabilitation pathways without clear rationale. Our review attempted to relate current rehabilitation practices to patient outcomes, but we found limited published evidence. Thus, we identified important evidence gaps to guide future research to advance rehabilitation practice and evaluation for this patient population (Table 3).

Table 2
Rehabilitation protocol parameters.

Author (year)	Immobilization period	ROM	Strengthening/Proprioception	Return to activity
Amako *et al*. (2017) [14]	3 weeks	ROM initiated in first 2 weeks. Active flexion and passive external rotation initiated at 3 weeks.	Isometric exercises in sling Isotonic strengthening of rotator cuff started at 4 weeks (<2 kg dumbbell at 2 months, push ups at 3 months)	Unlimited ADLs at 6 weeks. Non-contact sports at 2–3 months. Contact sports and overhead throwing at 6 months.
Gibson *et al*. (2016) [15]	2 to 3 weeks	AAROM/AROM initiated in first week (with restrictions). Unrestricted elevation at 3 weeks. Restricted abduction with external rotation until 10 weeks.	Isometrics and closed kinetic chain/proprioceptive exercise in first 4 weeks. Isotonic exercises initiated at 3 weeks. Plyometric and functional strengthening at 6 weeks.	Return to light activity in first four weeks. Return to work and sport at 6–16 weeks
Ismail *et al*. (2014) [16]	Supervised: 2 weeks (sling during sleep only) Home: 3 weeks in sling	Supervised: Pendulum on day 1. Staged PROM/AAROM starting on first week. Progress to full ROM after 6 weeks. Home: Staged PROM/AAROM starting at 3 weeks. Progress to full ROM after 6 weeks.	Supervised: Submaximal isometrics, scapular strengthening, rhythmic stabilization at 2 weeks. Progressive strengthening within protected ROM, loaded open and closed kinetic chain exercises at 3 weeks. Home: same as supervised at 3 weeks.	Sedentary activities starting at 3 weeks. Light, non-repetitive overhead and light lifting at 6 weeks. Gradual return to all activities at sport after 12 weeks.
Kim *et al*. (2003) [17]	*Standard*: 3 weeks *Accelerated*: 2 weeks (at rest and sleep only)	*Standard*: Pendulum, AAROM at 3 weeks *Accelerated*: Pendulum on day 1, PROM/AAROM at day 3 (unrestricted at 4 weeks)	*Standard*: isotonic at 4 weeks *Accelerated*: Submaximal isometrics on day 3, isotonic at 2 weeks	Restrictions not specified
Sperber *et al*. (2001) [18]	3 weeks	Gradual increase in ROM starting at 4 weeks. Unrestricted ROM after 6 weeks.	Not specified	Return to overhead and contact sports at 6 months
Stein *et al*. (2011) [19]	2 months	Abduction in first four weeks (restricted). Staged ROM started at 2 to 3 months. Unrestricted ROM at 4 months (limiting stress into abduction and external rotation)	Strengthening and endurance started at 3 months. Functional strengthening started at 4 months (avoid stressing anteroinferior capsule-labrum). Unrestricted strengthening at 6 months.	Initiate return to sport at 6 months.
Szuba *et al*. (2016) [20]	2 weeks	Pendulum at day 5, AAROM/AROM of shoulder at 3 weeks. Unrestricted ROM at 6 weeks.	Closed kinetic chain exercises at 3 weeks. Isometric exercises initiated in the first 3 weeks.	Restrictions not specified
Wade *et al*. (2018) [21]	2 weeks	AAROM/AROM at 3 weeks. Restricted combined abduction and external rotation for 12 weeks.	Gentle rotator cuff and scapular muscle strengthening started in first three weeks.	Return to sport at 4–6 months
Yin *et al*. (2014) [22]	4–6 weeks	PROM/AAROM in first two weeks.	Strengthening (isotonic) at 4 weeks. Dynamic weight-bearing at 8 weeks.	Restrictions not specified

LEGEND: ROM (range of motion), AAROM (active assisted range of motion), AROM (active range of motion), PROM (passive range of motion).

Rehabilitation parameters

Postoperative immobilization type and duration varied significantly across studies. However, the one comparative trial [17] and the descriptive studies that used shorter periods of immobilization and started early AAROM and active ROM [15,16] suggest that while earlier active movement has unclear clinical benefit, it does not appear harmful; this supports the ASSET guideline recommendations [8]. Recent work in rotator cuff repair patient populations also supports that early active ROM is well-tolerated and does not appear associated with adverse effects [23]. A well-powered randomized trial is recommended to evaluate the need for immobilization following ABR.

Strength was much less consistently reported, despite being an important component of rehabilitation. The ASSET guidelines focus on strengthening exercises in Phase 3, but use pain with activity, rather than strength measurements

Table 3
Evidence gaps for rehabilitation parameters and evaluation after ABR.

Rehabilitation Parameters after ABR
Immobilization & ROM Initiation/Progression goals remain unclear
1. Immobilization after ABR – type and duration (if needed)
2. Timing and Type of ROM in early postoperative period
3. Timing of starting ROM exercises in 'higher risk' positions (e.g., abduction and external rotation)
Strengthening Initiation/Exercise Type/Progression criteria are lacking
1. Timing to commence
2. Type of strengthening exercises for best impact without harm (i.e., isometric, isotonic)
3. Criteria for progression
Return to Activity/Sport Criteria are poorly defined
Evaluation Parameters after ABR
No clearly defined outcomes exist for success after ABR including the timing of determining a successful outcome
Strength is an important parameter of rehabilitation protocols, but rarely evaluated as part of the outcome assessment.

(e.g., comparison to non-injured side) as a milestone to achieve in rehabilitation [8]. Muscular strength and control are recognized as important contributors to shoulder stability [24]. In particular, strength is recognized clinically as an important consideration for determining return to activity [25]. A recent abstract noted that strength and functional deficits were prolonged after ABR [26]. This is a major evidence gap that may play a role in return to sport rates; recent work suggests that up to one-third of patients do not return to pre-injury levels of sport [27].

Another important evidence gap was understanding what defines success after ABR. Return to activity/sport lacks a standardized definition. This is a highly relevant outcome given the primary rationale for surgery and rehabilitation is to prevent recurrent dislocations while enabling return to activity. While identifying that a substantial proportion do not appear to return to sport postABR, Memon *et al*. also noted that standardized definitions were lacking [27]. Future studies should clearly define whether they are measuring return to sport or physical activity including type of sport (e.g., overhead, contact, etc.) and patients' desired level of play, where appropriate. Success could also be defined by whether postoperative levels meet or exceed preoperative levels. Research is required to understand how success should be defined with input from both patients and clinicians.

Additionally, another systematic review investigating postABR return to play criteria found that 76% of studies included time from surgery as the only criterion [28]. This criterion may be insufficient as functional performance measures of the shoulder, such as strength and endurance, are important considerations in clinical decision making around return to play [25]. This further supports the need for objective strength assessment in ABR outcome evaluations.

While composite HRQL measures that include return to activity, ROM, pain and strength as part of a global score are frequently used, they appear less able to discriminate between different rehabilitation and surgical approaches [16,17]. Thus, these measures may have limited utility in comparative rehabilitation studies.

Finally, the timing and duration of follow-up assessments vary substantially. Most protocols, including the ASSET guideline [8] recommend multiple follow up points within the first year to evaluate rehabilitation outcomes, as rehabilitation typically continues for approximately 6 months postoperatively. With return to sport/physical activity generally occurring after 6 months, studies should plan at least 2-year follow up to evaluate recurrence of instability once participants return to usual activity levels where there may be risk for recurrence [29].

Strengths

Previous reviews comparing rehabilitation approaches after ABR have been limited by sparse evidence [4,5]. We performed a systematic scoping review, following standardized methodology [10–12] with selection criteria that included both comparative and non-comparative prospective studies that described both rehabilitation protocols and the associated participant outcomes. Including more studies with associated outcomes highlighted the variability of current rehabilitation approaches and the limited quantity and quality of evidence. Most studies lacked comparative designs, consisting of level IV evidence. Our augmented selection approach further highlights the paucity of evidence to guide clinical decision-making about best rehabilitation practices.

Limitations

The primary limitation of this review, similar to others attempted in this area, is the lack of evidence to guide best practices. Despite utilizing rigorous scoping review methodology and expanded selection criteria, we found few comparative rehabilitation studies. Much of the literature focuses on surgical techniques and postoperative outcomes with limited details regarding rehabilitation parameters. Thus, we did not find substantial numbers of studies that evaluated the impact of rehabilitation on reported outcomes. Further, heterogeneity of study designs limited our ability to assess and synthesize the quality of current evidence. Finally, we did not search gray literature for rehabilitation protocols because we were interested in patient outcomes, so it is possible that we missed clinical databases/registries that reported patient outcomes after ABR.

Conclusion

Evidence investigating rehabilitation following ABR is sparse. Current studies investigating patient outcomes following surgery and rehabilitation demonstrate substantial heterogeneity in both rehabilitation parameters and assessment of outcomes that do not appear to be related to patient characteristics. Further research comparing rehabilitation parameters and investigating outcomes that enable evaluation of these parameters is urgently needed; thus the identified evidence gaps should guide researcher and clinicians to undertake further studies to advance the care and outcomes of this patient population.

Ethical approval

Ethics was not required for this systematic scoping review as there was no original data collection performed.

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Conflicts of interest

None to declare.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.physio.2021.03.014.

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