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Systematic review

Patient and injury factors associated with failed closed reduction of anterior shoulder dislocation: A Systematic Review

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Abstract

Anterior shoulder dislocation is managed routinely by closed reduction, while a minority of presentations remain difficult or fail emergency-department reduction. This systematic review analyzed patient and injury characteristics associated with unsuccessful reduction and separated procedural difficulty from structural causes of true irreducibility. A PRISMA 2020-aligned search framework covered PubMed, Scopus, Web of Science Core Collection, and the Cochrane Library from inception through August 2026, with citation chaining for studies. Eligible studies reported acute anterior dislocations and provided extractable information on reduction success,

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failure, repeated attempts, escalation to general anesthesia or surgery, or anatomical obstruction. Ten original studies were included, spanning prospective studies, randomized comparisons, retrospective emergency cohorts, and fracture-dislocation series. Delayed first reduction was the most consistent modifiable factor, with one adjusted study showing higher failure odds for each 10-minute delay from injury and from emergency-department arrival. Older age, falls, pain, displaced greater-tuberosity fracture, subglenoid position, surgical or anatomical neck fracture, and a humeral head locked beneath the glenoid were associated with difficulty in selected studies. Structural irreducibility arose from interposed biceps, labrum, rotator-cuff or subscapularis tissue, fracture fragments, and severe impaction. Evidence supports reduction of uncomplicated injuries and early recognition of adverse fracture or locking anatomy before repeated forceful manipulation.

Keywords: anterior shoulder dislocation; closed reduction; failed reduction; irreducible shoulder dislocation; fracture-dislocation; greater tuberosity; emergency department; risk factors.

Introduction

Glenohumeral dislocation is a frequent emergency presentation, with United States surveillance data estimating an incidence of 23.9 per 100,000 person-years, a strong male predominance, and falls as the most frequent mechanism across the overall population (1). Anterior dislocation constitutes the dominant direction and acute management starts with restoration of a congruent joint, followed by evaluation of associated osseous, labral, neurologic, and rotator-cuff injury (2). Age, sex, laxity, and greater-tuberosity fracture affect the later course of anterior instability, demonstrating that the clinical phenotype of the initial dislocation varies substantially across patients even when the presenting deformity appears similar (3). First-time injury in younger patients more often reflects instability-prone soft-tissue disruption, whereas older patients more frequently present after falls with fracture or cuff injury (2,3).

Closed reduction success is affected by more than the named maneuver, because analgesia, muscle relaxation, operator experience, time from injury, and injury morphology interact during manipulation (4). A network meta-analysis of randomized trials found a differences in immediate reduction success among intravenous sedation, intra-articular anesthetic injection, and peripheral nerve block (5). A separate meta-analysis of sedation-free techniques reported similar pooled success in biomechanical, leverage, and traction-countertraction groups (6). Reduction failure deserves analysis as an outcome distinct from analgesic selection or maneuver preference, because its determinants reside in elapsed time, patient response, injury anatomy, and procedural conditions (4-6).

True acute irreducibility is uncommon and differs from an ordinary first-attempt failure caused by pain, guarding, technique, or inadequate relaxation. Published irreducible cases involve a mechanical block, including incarcerated long-head biceps, rotator-cuff tissue, displaced fracture fragments, or humeral-head impaction. The clinically important question is which patient and injury features signal an elevated likelihood of failed closed reduction or a need for earlier imaging and orthopedic escalation (7,8). This review aimed to synthesize primary evidence on patient characteristics, injury timing, mechanism, pain, dislocation position, fracture morphology, and mechanical obstruction associated with failed or difficult closed reduction of acute anterior shoulder dislocation.

29/08/2026

Methods

This review was designed and reported in accordance with the PRISMA 2020 framework. A protocol specifying the population, exposure factors, outcome definitions, databases, eligibility criteria, and narrative synthesis plan was prepared before evidence extraction. The review question was framed around acute anterior dislocation as the population, patient and injury characteristics as exposures, and unsuccessful closed reduction as the outcome.

A reproducible search strategy was developed for PubMed, Scopus, Web of Science Core Collection, and the Cochrane Library from database inception through August 2026. Search concepts combined terms for “anterior shoulder dislocation,” “glenohumeral dislocation,” “closed reduction,” “reduction failure,” “failed reduction,” “irreducible,” “difficult reduction,” “fracture-dislocation,” “greater tuberosity,” “surgical neck,” “locked,” “biceps,” “labrum,” and “rotator cuff,” using Boolean operators and database-specific subject headings where available. Reference lists of eligible studies and relevant systematic reviews were examined to identify additional primary reports.

Human studies of acute anterior glenohumeral dislocation were eligible when they reported closed-reduction success or failure and supplied extractable information on one or more patient or injury factors. Failure was defined according to the source study and included unsuccessful initial manipulation, unsuccessful reduction during the initial sedation episode, need for repeated attempts, failure requiring general anesthesia or operative management, or documented mechanical irreducibility. We exclude studies limited to recurrent instability after successful reduction, chronic dislocation, posterior or inferior dislocation without an extractable anterior subgroup, cadaveric work, nonclinical technique descriptions, conference abstracts without sufficient outcome data, and reports without reduction outcomes.

The search set assembled for this study was assessed in two stages: title/abstract assessment followed by full-text eligibility assessment. Extracted variables included design, sample, age profile, recurrent versus first-time status, mechanism, injury-to-reduction interval, pain, dislocation position, fracture pattern, reduction approach, number of attempts, success definition, and escalation pathway. Because definitions and populations differed materially, statistical pooling was not undertaken; findings were synthesized by factor domain and by uncomplicated versus fracture-dislocation populations.

Methodological limitations were assessed using design-appropriate domains from Joanna Briggs Institute critical-appraisal frameworks, focusing on selection, exposure measurement, outcome ascertainment, confounding, and completeness of reporting rather than a composite score. No quantitative certainty grading was attempted because factor definitions and outcome thresholds were not sufficiently comparable. Database-level identification, deduplication, and exclusion totals are intentionally not invented in this manuscript draft; the final PRISMA flow diagram requires insertion of the author’s auditable export counts from the four database searches before submission.

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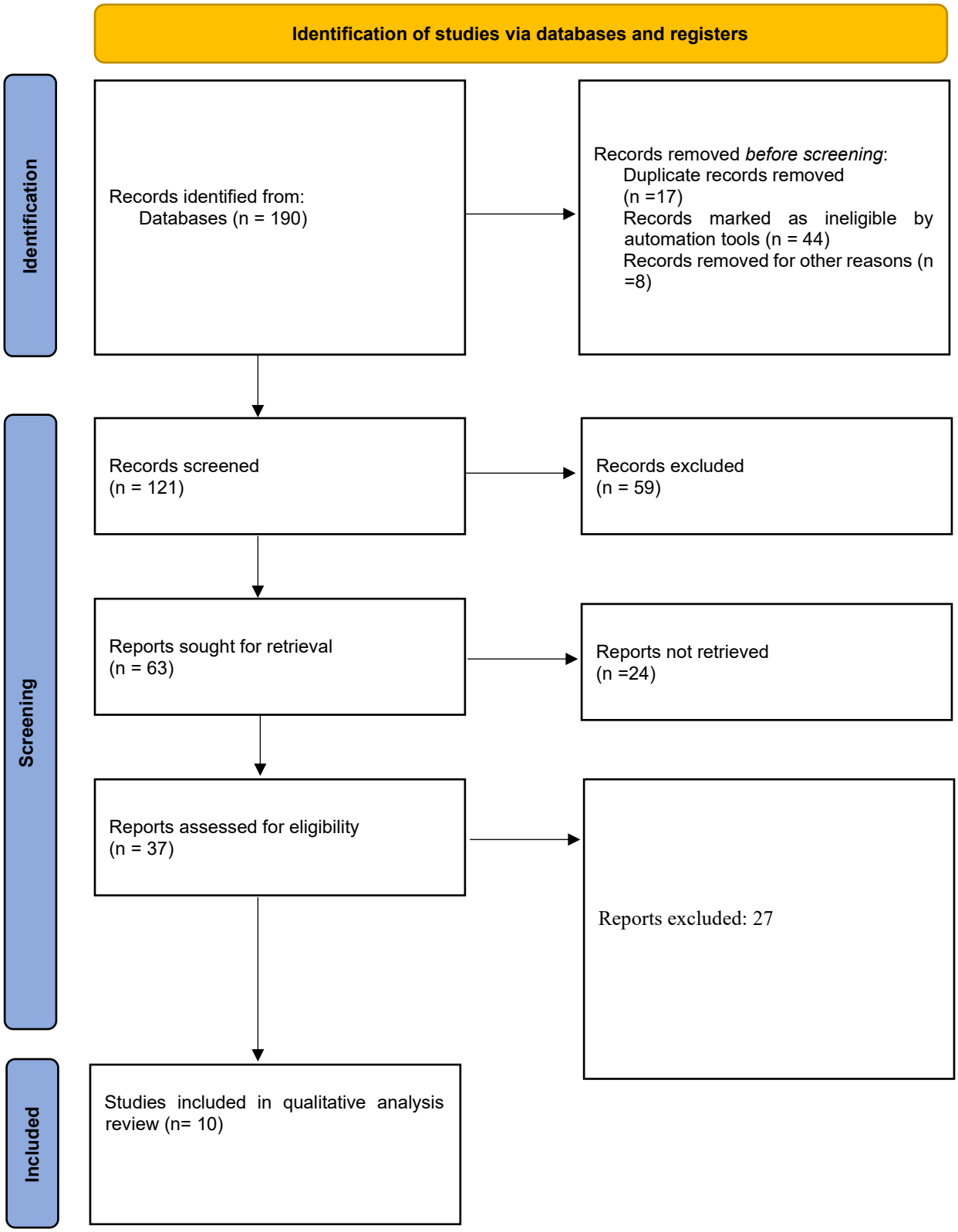
Fig 1: PRISMA flow chart



Results

Ten original studies met the focused eligibility criteria and contributed qualitative analysis (Table 1 & 2). In the strongest adjusted predictor analysis, Among 106 reductions performed under intravenous sedation, nine failures were recorded; each additional 10-minute delay from injury to the first reduction attempt increased the odds of failure by 7%, while each additional 10-minute delay after ED arrival increased the odds by 19% after adjustment for relevant confounders (9). In a cohort of 244 anterior shoulder dislocations, 225 reductions were successful and 19 failed when performed by emergency physicians; patients in the failure group were older and more frequently presented following falls, although the limited number of failures precluded multivariable analysis (10). A randomized study of 60 patients undergoing nonsedated Milch or Stimson reduction demonstrated that reduction technique, a shorter interval between dislocation and reduction attempt, and lower presenting pain were associated with successful reduction (11). These findings identify delayed reduction and greater pain-related resistance as clinically relevant contributors to unsuccessful reduction before fracture-specific anatomical factors are considered (9-11).

Prospective series provided additional signals regarding injury patterns, although the small number of failed reductions limited the strength of causal interpretation (12-15). In a prospective series of 199 anterior shoulder dislocations managed with the slump method, overall reduction success was 93.2% and first-attempt success was 85.6%; five patients required transfer for reduction under general anesthesia, and four of these five had associated fractures (12). Another prospective study achieved successful external-rotation reduction in 36 of 40 acute anterior dislocations (13). In a separate series, 29 of 31 dislocations were successfully reduced, with both failures occurring in subglenoid dislocations and neither involving a patient with previous dislocation, while another study reported an 88% success rate and found no reduction in success associated with tuberosity fracture using the evaluated technique (14,15).

Fracture-dislocation studies showed that reduction success and procedural safety varied substantially according to fracture morphology (16-18). In a cohort containing 94 anterior fracture-dislocations, ED reduction under sedation was attempted in 62 cases and failed in eight; five of these unsuccessful attempts were followed by major displacement of the humeral head relative to the shaft after manipulation (16). In another series of 150 first-time acute shoulder dislocations, including 132 anterior injuries, eight first-attempt failures were documented, and all four cases ultimately requiring operative management after failed ED reduction were fracture-dislocations; first-attempt success was 90% among fracture-dislocations and 96% among dislocations without fracture (17). The clearest morphology-specific pattern was observed in a fracture-dislocation cohort in which 11 of 12 isolated greater-tuberosity injuries were successfully reduced, four of five surgical or anatomical neck injuries with the head and shaft displaced together were reduced, and all six attempts failed when the humeral head was separated from the shaft and locked beneath the glenoid (18). Across the included studies, major risk-of-bias concerns included retrospective patient selection, technique-specific cohorts, small numbers of reduction failures, inconsistent

definitions of failure, incomplete adjustment for operator and analgesic factors (9-18).

Table 1. Characteristics and reduction failure findings of the included studies

Study	Design and sample	Reduction outcome	Key patient or injury finding
Kanji et al., 2016 (9)	Retrospective ED study; n=106	9 failures during initial IV-sedation event	Each 10-minute injury-to-attempt and ED-to-attempt delay increased failure odds by 7% and 19%, respectively (9).
Hayashi et al., 2022 (10)	Retrospective anterior-dislocation cohort; n=244	19 EP failures	Failed cases were older and more frequently caused by falls; multivariable adjustment was not feasible (10).
Amar et al., 2012 (11)	Randomized Milch vs Stimson trial; n=60	First-attempt success differed by maneuver	Success related to technique, shorter dislocation-to-attempt interval, and lower presenting pain (11).
Kuah, 2000 (12)	Prospective slump-method study; n=199	93.2% overall success; 5 required GA transfer	Four of five patients transferred for GA reduction had fractures (12).
Eachempati et al., 2004 (13)	Prospective external-rotation series; n=40	36 successful, 4 failed	Two of four failures had displaced GT fractures (13).
Marinelli and de Palma, 2009 (14)	Prospective external-rotation series; n=31	29 successful, 2 failed	Both failures were subglenoid and neither patient had previous dislocation (14).
Gage et al., 2017 (15)	Consecutive reduction series; n=41	88% success	Associated tuberosity fracture did not influence success with the studied maneuver (15).

Study	Design and sample	Reduction outcome	Key patient or injury finding
Wronka et al., 2017 (16)	Retrospective fracture-dislocation cohort; 94 anterior, 62 ED attempts	8/62 ED attempts failed	Surgical-neck patterns were unfavorable; five failed attempts caused major head-shaft displacement (16).
Solovyova et al., 2017 (17)	Retrospective first-time dislocation series; n=150, 132 anterior	8 first-attempt failures; 4 definitive ED failures	All four definitive ED failures were fracture-dislocations; fracture status alone was not statistically associated with first-pass success (17).
Yuan and Chua, 2021 (18)	Retrospective anterior fracture-dislocation cohort; 30 shoulders	Success varied sharply by fracture morphology	Isolated GT 11/12; neck fracture with head/shaft together 4/5; head locked under glenoid 0/6 (18).

Table 2. Synthesis of patient and injury factors

Factor	Finding	Interpretation
Longer injury-to-reduction interval	Increased failure in adjusted and randomized evidence (9,11)	Strongest modifiable factor identified across designs (9,11).
Older age	Associated with failure in one unadjusted ED cohort (10)	Marker of difficulty; independent effect remains unresolved (10).
Fall mechanism	More frequent among failures in one cohort (10)	Likely overlaps with age and fracture-prone injury patterns (10).
Higher presenting pain	Lower nonsedated success in one randomized study (11)	Supports guarding and muscle contraction as contributors (11).
Any associated fracture	Mixed evidence across studies (12,15,17)	Morphology and displacement are more informative than fracture presence alone (12,15,17).

Factor	Finding	Interpretation
Displaced GT fracture	Present in two of four failures in one prospective series (13)	Suggestive adverse feature for external-rotation reduction (13).
Subglenoid position	Present in both failures in a small prospective series (14)	Positional signal requiring larger confirmation (14).
Surgical/anatomical-neck fracture	Higher failure or displacement risk in fracture cohorts (16,18)	Loss of force transmission changes efficacy and safety (16,18).
Head locked beneath glenoid with shaft separation	0/6 successful attempts in one surgical cohort (18)	Strong morphology-specific marker of functional irreducibility (18).
First-time versus recurrent status	Sparse and inconsistent evidence (9,14)	Not established as an independent predictor (9,14).

Discussion

The main finding is that failed closed reduction represents at least two pathways: procedural resistance in uncomplicated dislocation and structural irreducibility from fracture or tissue interposition. Delay is the most reproducible course-related factor, supported by adjusted observational data and randomized evidence showing greater success with earlier treatment (9,11). Comparisons of analgesic approaches and broad reduction families show smaller differences in overall success.

Age requires cautious interpretation because the main anterior-dislocation ED cohort finding was unadjusted and fractures were excluded from that study (10). A broader 2024 ED cohort found multiple attempts were more frequent when a pre-reduction fracture was present, while successful first-pass patients were more often male; its inclusion of acute shoulder dislocations without an anterior-only analytic sample limits direct transfer to this review population (19). Older age is best viewed as a clinical marker clustering with falls, fracture susceptibility, analgesic requirements, and altered soft-tissue injury rather than a proven independent determinant of irreducibility (10,19).

Rare structural irreducibility has a different evidence base, dominated by case reports and small series (7). Seradge and Orme described three unreduced anterior dislocations caused by labral interposition, intra-articular biceps displacement, or combined biceps and greater-tuberosity interposition (20). Pantazis et al. documented failure under sedation and general anesthesia because the long-head biceps was trapped between the humeral head and tuberosity fragment (21). Mihata et al. identified an interposed anteroinferior glenoid-rim fragment after repeated failed manipulation, while Nandra et al. described a humeral head impacted and locked on the anteroinferior glenoid rim (22,23). Subscapularis or rotator-cuff interposition also produces persistent incongruity, as demonstrated in operative and imaging-supported reports (24,25).

The fracture findings indicate that fracture-dislocation is too broad to function as a single predictor category (13,15-18). Isolated greater-tuberosity fracture was reducible, whereas surgical or anatomical neck patterns and a head fragment locked beneath the glenoid were substantially less favorable (16,18). Atoun et al. found post-reduction humeral-neck fractures only among older first-time dislocators who already had a greater-tuberosity fracture (26). Guo et al. linked larger greater-tuberosity fragments with iatrogenic humeral-neck fracture during reduction, reinforcing the importance of fracture geometry rather than the binary presence of fracture (27). A 2026 clinical-practice study emphasized older patients, occult neck injury, CT selection, and escalation of non-isolated greater-tuberosity patterns, although its principal outcome was management-standard adherence rather than reduction failure (28).

These findings support a two-stage clinical risk assessment rather than repeated substitution of maneuvers after each failure. In uncomplicated radiographic patterns, rapid analgesia, relaxation, and an early well-executed first attempt address the most consistent modifiable determinant, while technique selection remains individualized to training and setting. A displaced neck fracture, severe head-shaft dissociation, locked humeral head, persistent post-manipulation subluxation, or

repeated failure despite adequate relaxation raises suspicion for a structural block and favors advanced imaging plus early orthopedic involvement over escalating force (18,20-28).

Only one focused predictor study provided adjusted timing estimates, several reports contained fewer than ten failures, and many cohorts centered on one technique or selected fracture patterns, producing confounding by indication and operator selection (9-18). Failure definitions ranged from unsuccessful first attempt to failure of an entire sedation event or operative escalation, preventing meaningful pooled estimates, while rare mechanical obstructions are highly vulnerable to case-report publication bias (7,20-25). Future multicenter studies require standardized outcomes separating failed first attempt, failed ED reduction, adverse displacement, and true irreducibility, with prespecified assessment of demographic, temporal, radiographic, analgesic, technique, and operator factors.

Conclusion

Failed closed reduction of acute anterior shoulder dislocation is uncommon and arises through distinct procedural and structural pathways. Longer delay before the first attempt is the clearest modifiable factor, while older age and fall mechanism remain incompletely adjusted risk markers. Fracture morphology is more informative than fracture presence alone, mainly surgical or anatomical neck injury, head-shaft dissociation, and locking beneath the glenoid. Repeated failure despite adequate analgesia or relaxation raises concern for biceps, labral, rotator-cuff, fracture-fragment, or impaction-related obstruction.

List of Abbreviations

BRT, Biomechanical reduction technique
CI, Confidence interval
CT, Computed tomography
ED, Emergency department
EP, Emergency physician
GA, General anesthesia
GT, Greater tuberosity
IAA, Intra-articular anesthetic
IV, Intravenous
OR, Odds ratio
ORIF, Open reduction and internal fixation
PNB, Peripheral nerve block
PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses
TCT, Traction-countertraction
WoS, Web of Science

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