

Shoulder Arthroplasty for Acute Proximal Humerus Fracture

Overview

- Patients undergoing arthroplasty for acute proximal humeral fractures may achieve satisfactory long-term pain relief, though overall shoulder motion results are less predictable [1].
- In elderly patients undergoing reverse shoulder arthroplasty for acute proximal humeral fractures, anatomic tuberosity healing improves objective and subjective outcomes [2].
- Clinical results at 1-year follow-up confirm the advantage of applying a new intramedullary support nail and plate system to 3- or 4-part proximal humeral fractures in older patients [3].
- Elderly patients requiring admission after sustaining a proximal humeral fracture are frail and subject to a greater-than-average risk of mortality for their age [4].
- Patients who undergo initial nonoperative management have worse functional outcomes and higher complication rates than those who undergo acute reverse total shoulder arthroplasty (rTSA) for proximal humeral fractures [5].
- Patients with acute proximal humeral fractures who undergo reverse shoulder arthroplasty appear to achieve superior 5-year functional outcomes compared with patients who undergo hemiarthroplasty [6].
- The study cited represents the largest long-term follow-up of acute proximal humeral fractures treated with hemiarthroplasty [9].
- In most studies of proximal humeral fractures, only 1 or 2 patients experiencing an alternative outcome or lost to follow-up would change the conclusions for the dichotomous outcome studied [16].
- The increased in-hospital risk for major adverse events and surgical complications may moderate enthusiasm for reverse total shoulder arthroplasty (RTSA) for proximal humeral fractures in patients 65 years and older [21].
- Available literature suggests that reverse shoulder arthroplasty performed to address complex proximal humeral fractures might result in more favorable clinical outcomes than hemiarthroplasty performed for the same indication [26].
- Reverse total shoulder arthroplasty (RTSA) performed for acute 3- and 4-part proximal humeral fractures yields overall worse clinical outcomes and active range of motion compared with RTSA performed for elective indications [66].

- No clear benefits were observed in treating patients 65 years or older with four-part fractures of the proximal humerus with either hemiarthroplasty or nonoperative treatment [67].

Anatomy & Pathophysiology

- Shoulder rotational ability is improved by systematically repairing the tuberosities around the implant, provided their consolidation is anatomic [8].
- Greater tuberosity healing does not seem to impact reverse shoulder arthroplasty biomechanics during abduction or forward flexion [28].
- Greater tuberosity healing affects reverse shoulder arthroplasty biomechanics during external rotation [28].
- With minimal and moderate amounts of glenohumeral abduction, glenohumeral joint forces are significantly displaced superiorly [30].
- Varus and antecurvatum proximal humerus deformities as small as 15 degrees were associated with statistically significant alterations in glenohumeral joint mechanics [40].
- The control volume is an important anatomic and functional area of the proximal humerus [44].
- Vertical abduction has the greatest effect on axillary nerve position during the split lateral deltoid approach [43].
- Horizontal glenohumeral forward flexion and humeral rotation have little effect on axillary nerve position during the split lateral deltoid approach [43].
- The study demonstrates variability in the glenopolar angle with increased AP rotational offset of the shoulder radiograph [38].
- The study reveals inaccuracies in glenopolar angle measurement even at an institution with an established protocol [38].
- Range of motion and strength thresholds can identify subjects with normal shoulder function [29].
- The authors recommend performing the measurement of objective strength at the insertion of the deltoid muscle in a 90° abduction position in the scapula plane [35].
- Dominance of the affected shoulder has no influence on functional and quality of life outcome compared with the nondominant shoulder [37].
- Dominance of the affected shoulder should not be used to make treatment decisions [37].

Classification

- The Neer classification system covers 98% of all proximal humeral fractures and is appropriate for clinical practice [58].
- Classifications of proximal humeral fractures using the Neer system based on CT scans and plain radiographs are not very reliable or reproducible due to difficulty in determining which segments are fractured [60].

- The HGSL classification is a reliable method of describing fractures of the proximal humerus compared with the Neer and AO systems [56].
- A new classification system with emphasis on the qualitative aspects of proximal humeral fractures showed high reliability when based on a standardized imaging protocol including computed tomography scans [49].
- Consensus when managing proximal humerus fractures is limited to specific scenarios, whereas lack of consensus still exists in others [11].

Clinical Presentation

- Patients undergoing arthroplasty for acute proximal humerus fractures may achieve satisfactory long-term pain relief, though overall shoulder motion results are less predictable [1].
- In elderly patients undergoing reverse shoulder arthroplasty for acute proximal humeral fractures, anatomic tuberosity healing improves objective and subjective outcomes [2].
- Clinical results at 1-year follow-up confirm the advantage of applying a new intramedullary support nail and plate system to 3- or 4-part proximal humeral fractures in older patients [3].
- Elderly patients requiring admission after sustaining a proximal humeral fracture are frail and subject to a greater-than-average risk of mortality for their age [4].
- Patients undergoing initial nonoperative management have worse functional outcomes and higher complication rates than those undergoing acute reverse total shoulder arthroplasty for proximal humeral fractures [5].
- Fractures of the proximal humerus follow characteristic patterns [7].
- A majority of patients with proximal humeral fractures undergo non-operative treatment [10].
- Consensus on managing proximal humerus fractures is limited to specific scenarios, while a lack of consensus exists in others [11].
- There is significant heterogeneity in the terminology and definitions used to describe complications following non-surgical management of proximal humeral fractures [12].
- Nonoperative treatment of proximal humeral fractures produces considerable variation in shoulder-specific and general health outcomes at 1 year, with a substantial proportion of patients having poor perceived functional outcomes [13].
- Mortality at 1 year for fragility proximal humerus fractures is universally high regardless of risk factors [15].
- The majority of unplanned hospital readmissions after surgical treatment of proximal humerus fractures are associated with medical diagnoses [19].
- In patients presenting with a traumatic shoulder injury and normal radiographs, the anterior bruise sign (ABS) is a highly sensitive and specific clinical aid to identify occult greater tuberosity fractures [22].
- Most proximal humeral fractures in elderly patients can be treated nonoperatively with good functional outcomes [23].

- Patients sustaining a proximal humeral fracture have a significantly higher risk of mortality up to one year after the injury compared with the general population [25].
- Most pediatric patients with proximal humerus fractures have favorable results, and complications are infrequent [50].
- Reverse shoulder arthroplasty is a powerful tool for managing proximal humerus fracture sequelae when joint-preserving options are not optimal, provided there is careful management of the tuberosities and understanding of associated pearls and pitfalls [54].
- Prevention of local complications, particularly those leading to severe varus deviation, appears essential to improve shoulder function after a proximal humeral fracture [55].
- Factors associated with poor results after internal fixation of three-part and four-part proximal humerus fracture-dislocations include being a woman, four-part fracture dislocation, and absence of metaphyseal head extension [57].
- A wide range of outcome measures are used in proximal humeral fracture studies, but there is limited evidence regarding their psychometric properties in this specific population [59].

Investigations

- Elderly patients requiring admission after sustaining a proximal humeral fracture are frail and subject to a greater-than-average risk of mortality for their age [4].
- A majority of patients with proximal humeral fractures undergo non-operative treatment [10].
- Fractures of the proximal humerus follow characteristic patterns [7].
- Despite a delayed diagnosis of more than one year, osteotomy and realignment of a displaced lesser tuberosity fracture can be successful and enhance overall shoulder function [17].
- Undisplaced greater tuberosity fractures can be managed non-operatively with good results [72].
- Patients with persistent post-traumatic shoulder pain and limitation of function warrant MRI investigation to identify occult greater tuberosity fractures [72].
- In patients presenting with a traumatic shoulder injury with normal radiographs, the anterior bruise sign (ABS) is a highly sensitive and specific clinical aid to identify patients with an occult greater tuberosity fracture [22].
- There is relevant variability in displacement measurements between shoulder radiographs and CT scans in the coronal plane [73].
- Nearly 30% of cases suggesting surgical treatment on radiographs are reclassified for conservative treatment based on CT findings [73].
- The inherent nature of medial comminution of proximal humeral fracture may lead to inferior radiographic outcomes [71].
- Routine use of 3D-printed models may not be beneficial for classifying proximal humeral fracture patterns beyond the information gained from currently available imaging modalities [74].

- The routine use of 3D-printed models should be avoided as the sole determinant for recommending surgical intervention at this time [74].
- Convolutional neural networks (CNNs) proficiently rule out proximal humerus fractures on plain radiographs [76].
- Missed posterior dislocation of the shoulder after intramedullary fixation of proximal humeral fractures is an extremely rare injury that can be missed due to inadequate initial and postoperative x-ray images and incorrect interpretation [79].
- Consensus when managing proximal humerus fractures is limited to specific scenarios, whereas lack of consensus still exists in others [11].

Treatment

- Patients undergoing shoulder hemiarthroplasty for acute proximal humerus fractures may achieve satisfactory long-term pain relief, though overall shoulder motion results are less predictable [1].
- In elderly patients undergoing reverse shoulder arthroplasty for acute proximal humeral fractures, anatomic tuberosity healing improves objective and subjective outcomes [2].
- Clinical results at 1-year follow-up confirm the advantage of applying a new intramedullary support nail and plate system to 3- or 4-part proximal humeral fractures in older patients [3].
- Elderly patients requiring admission after sustaining a proximal humeral fracture are frail and subject to a greater-than-average risk of mortality for their age [4].
- Patients undergoing initial nonoperative management have worse functional outcomes and higher complication rates than those undergoing acute reverse total shoulder arthroplasty (rTSA) for proximal humeral fractures [5].
- Patients with acute proximal humeral fractures who undergo reverse shoulder arthroplasty appear to achieve superior 5-year functional outcomes compared with patients who undergo hemiarthroplasty [6].
- Shoulder rotational ability is improved by systematically repairing the tuberosities around the implant in complex shoulder fractures treated by reverse shoulder arthroplasty, provided their consolidation is anatomic [8].
- A majority of patients with proximal humeral fractures underwent non-operative treatment [10].
- Significant heterogeneity exists in the terminology and definitions used to describe complications following non-surgical management of proximal humeral fractures [12].
- Nonoperative treatment of proximal humeral fractures produces considerable variation in shoulder-specific and general health outcomes at 1 year, with a substantial proportion of patients having poor perceived functional outcomes [13].
- Primary shoulder hemiarthroplasty for proximal humeral fracture is associated with satisfactory prosthetic survival at an average of 6.3 years [14].
- Short and long periods of immobilization yield similar results for nonoperatively treated proximal humeral fractures, independent of the fracture pattern [20].

- Most proximal humeral fractures in elderly patients can be treated nonoperatively with good functional outcomes [23].
- Available literature suggests that reverse shoulder arthroplasty performed to address complex proximal humeral fractures might result in more favorable clinical outcomes than hemiarthroplasty performed for the same indication [26].
- Nonsurgical management of proximal humerus fractures decreased during the study period [46].
- Treatment with reverse shoulder arthroplasty provides superior functional outcomes compared with conservative treatment for patients presenting with an acute proximal humeral fracture [47].
- There is no significant difference in clinical outcomes at 2 years between surgery and non-operative treatment in patients 60 years of age or older with displaced 2-part fractures of the proximal humerus [48].
- Nonsurgical management of proximal humerus fractures demonstrates successful outcomes and union rates greater than 90% [51].
- Nonsurgical treatment should have a more prominent role in the treatment of proximal humeral fractures compared to locking plate fixation [52].
- Osteoporosis may not be regarded as a contraindication for open reduction and internal fixation of unilateral displaced 3- or 4-part fractures, as shoulder function was restored to preinjury levels for most patients at 12-month follow-up [53].
- Percutaneous treatment of selected proximal humeral fractures results in predictable union and good clinical results with a low rate of complications [62].
- With narrow indications, use of a specific fracture stem and adequate tuberosity management, successful radiographic and functional results are presented after a mean follow-up of 4.8 years after hemiarthroplasty for primary nonreconstructable humeral head fractures [65].

Complications

- Patients undergoing arthroplasty for acute proximal humeral fractures may achieve satisfactory long-term pain relief, but overall shoulder motion results are less predictable [1].
- In elderly patients undergoing reverse shoulder arthroplasty for acute proximal humeral fractures, anatomic tuberosity healing improves objective and subjective outcomes [2].
- Clinical results at 1-year follow-up confirm the advantage of applying a new intramedullary support nail and plate system to 3- or 4-part proximal humeral fractures in older patients [3].
- Elderly patients requiring admission after sustaining a proximal humeral fracture are frail and subject to a greater-than-average risk of mortality for their age [4].
- Patients undergoing initial nonoperative management have worse functional outcomes and higher complication rates than those undergoing acute reverse total shoulder arthroplasty (rTSA) for proximal humeral fractures [5].
- Patients with acute proximal humeral fractures who undergo reverse shoulder arthroplasty (RSA) appear to achieve superior 5-year functional outcomes compared with patients who undergo hemiarthroplasty [6].

- Fractures of the proximal humerus follow characteristic patterns [7].
- Primary shoulder hemiarthroplasty for proximal humeral fracture is associated with satisfactory prosthetic survival at an average of 6.3 years [14].
- Mortality at 1 year for fragility proximal humerus fractures is universally high regardless of risk factors [15].
- The majority of unplanned hospital readmissions after surgical treatment of proximal humerus fractures are associated with medical diagnoses [19].
- In-hospital complications are more likely to occur after reverse shoulder arthroplasty than after locked plating for proximal humeral fractures [21].
- Surgery for complex proximal humeral fractures leads to overall good long-term outcomes but is associated with high overall complication and reoperation rates [24].
- Patients sustaining a proximal humeral fracture have a significantly higher risk of mortality up to one year after the injury compared with the general population [25].
- Short-term complication rates for fixation and arthroplasty alike have decreased compared with recent historic norms [27].

Recovery

- Patients undergoing arthroplasty for acute proximal humerus fractures may achieve satisfactory long-term pain relief, though overall shoulder motion results are less predictable [1].
- In elderly patients undergoing reverse shoulder arthroplasty for acute proximal humeral fractures, anatomic tuberosity healing improves objective and subjective outcomes [2].
- Clinical results at 1-year follow-up confirm the advantage of applying a new intramedullary support nail and plate system to 3- or 4-part proximal humeral fractures in older patients [3].
- Elderly patients requiring admission after sustaining a proximal humeral fracture are frail and subject to a greater-than-average risk of mortality for their age [4].
- Patients who undergo initial nonoperative management have worse functional outcomes and higher complication rates than those who undergo acute reverse total shoulder arthroplasty (rTSA) for proximal humeral fractures [5].
- Patients with acute proximal humeral fractures who undergo reverse shoulder arthroplasty appear to achieve superior 5-year functional outcomes compared with patients who undergo hemiarthroplasty [6].
- Fractures of the proximal humerus follow characteristic patterns [7].
- This study represents the largest long-term follow-up of acute proximal humeral fractures treated with hemiarthroplasty [9].
- Nonoperative treatment of proximal humeral fractures produces considerable variation in shoulder-specific and general health outcomes at 1 year, with a substantial proportion of patients having poor perceived functional outcomes [13].

- Primary shoulder hemiarthroplasty for proximal humeral fracture is associated with satisfactory prosthetic survival at an average of 6.3 years [14].
- Mortality at 1 year for fragility proximal humerus fractures is universally high regardless of risk factors [15].
- In most studies of proximal humeral fractures, only 1 or 2 patients experiencing an alternative outcome or lost to follow-up would change the conclusions for the dichotomous outcome studied [16].
- Despite a delayed diagnosis of more than one year, osteotomy and realignment of a displaced lesser tuberosity fracture was successful and enhanced overall shoulder function in two adolescent patients [17].
- Short and long periods of immobilization yield similar results for nonoperatively treated proximal humeral fractures, independent of the fracture pattern [20].
- Surgery for complex proximal humeral fractures leads to overall good long-term outcomes despite high overall complication and reoperation rates [24].
- The increasing utilization of reverse total shoulder arthroplasty (RTSA) and decreasing short-term complication rates for fixation and arthroplasty represent a substantial change compared with recent historic norms in the management of proximal humerus fractures [27].
- Long-term treatment with reverse shoulder arthroplasty (RSA) for displaced 3- or 4-part proximal humerus fractures provides better functional outcomes compared to nonoperative treatment, a difference attributed to the deterioration of functional outcomes of the nonoperative treatment over time [63].
- Timing of surgery did not affect Oxford Shoulder Score at any stage of follow-up, irrespective of age or fracture type [80].

Key Evidence

- [L3] Patients undergoing arthroplasty as treatment of an acute fracture of the proximal humerus may achieve satisfactory long-term pain relief; however, the result for overall shoulder motion is less predictable. [1] ([10.1016/j.jse.2007.06.025](https://doi.org/10.1016/j.jse.2007.06.025))
- [L3] In elderly patients who have undergone a reverse shoulder arthroplasty for acute proximal humeral fractures, anatomic tuberosity healing improves objective and subjective outcomes. [2] ([10.1016/j.jse.2018.05.030](https://doi.org/10.1016/j.jse.2018.05.030))
- [L3] Clinical results at 1-year follow-up confirmed the advantage of applying it to 3- or 4-part proximal humeral fractures in older patients. [3] ([10.1186/s12891-022-05998-z](https://doi.org/10.1186/s12891-022-05998-z))
- [L3] Elderly patients who require admission after sustaining a proximal humeral fracture are frail and subject to a greater-than-average risk of mortality for their age. [4] ([10.1016/j.jse.2019.05.030](https://doi.org/10.1016/j.jse.2019.05.030))
- [L3] Patients who undergo initial periods of nonoperative management have worse functional outcomes and higher complication rates than those who undergo acute rTSA for proximal humeral fractures. [5] ([10.1016/j.jse.2021.06.020](https://doi.org/10.1016/j.jse.2021.06.020))

- [L3] Patients with acute proximal humeral fractures who undergo RSA appear to achieve superior 5-year functional outcomes compared with patients who undergo hemiarthroplasty. [6] ([10.1016/j.jse.2012.03.006](https://doi.org/10.1016/j.jse.2012.03.006))
- [L4] Fractures of the proximal humerus follow characteristic patterns. [7] ([10.1016/j.jse.2017.05.014](https://doi.org/10.1016/j.jse.2017.05.014))
- [L3] Shoulder rotational ability is improved by systematically repairing the tuberosities around the implant, provided their consolidation is anatomic. [8] ([10.1016/j.jse.2012.03.011](https://doi.org/10.1016/j.jse.2012.03.011))
- [L3] This is the largest long-term follow-up study of acute proximal humeral fractures treated with hemiarthroplasty. [9] ([10.1302/0301-620x.103b6.bjj-2020-1753.r1](https://doi.org/10.1302/0301-620x.103b6.bjj-2020-1753.r1))
- [L3] A majority of patients with proximal humeral fractures underwent non-operative treatment. [10] ([10.1186/s12891-019-2812-9](https://doi.org/10.1186/s12891-019-2812-9))
- [L5] Consensus when managing proximal humerus fractures is limited to specific scenarios, whereas lack of consensus still exists in others. [11] ([10.1016/j.jse.2024.12.005](https://doi.org/10.1016/j.jse.2024.12.005))
- [L1] This systematic review highlights significant heterogeneity in the terminology and definitions used to describe complications following non-surgical management of proximal humeral fractures, calling for standardized definitions to improve evidence synthesis. [12] ([10.1186/s12891-019-2459-6](https://doi.org/10.1186/s12891-019-2459-6))
- [L1] Nonoperative treatment of proximal humeral fractures produces considerable variation in shoulder-specific and general health outcomes at 1 year, and a substantial proportion of patients have poor perceived functional outcomes. [13] ([10.2106/jbjs.20.02018](https://doi.org/10.2106/jbjs.20.02018))
- [L2] Primary shoulder hemiarthroplasty for proximal humeral fracture is associated with satisfactory prosthetic survival at an average of 6.3 years. [14] ([10.2106/jbjs.l.01115](https://doi.org/10.2106/jbjs.l.01115))
- [L3] Mortality at 1 year for fragility proximal humerus fractures is universally high regardless of risk factors. [15] ([10.1016/j.jse.2022.03.006](https://doi.org/10.1016/j.jse.2022.03.006))
- [L2] In most studies of proximal humeral fractures, only 1 or 2 patients experiencing an alternative outcome or lost to follow-up would change the conclusions for the dichotomous outcome studied. [16] ([10.1016/j.jse.2022.01.141](https://doi.org/10.1016/j.jse.2022.01.141))
- [L4] Despite a delayed diagnosis of more than one year, osteotomy and realignment of the displaced fracture of the lesser tuberosity was successful and enhanced the overall function of the shoulder in these two patients. [17] ([10.2106/00004623-199509000-00020](https://doi.org/10.2106/00004623-199509000-00020))
- [L3] As the majority of unplanned hospital readmissions were associated with medical diagnoses, it is important to consider patient medical comorbidities before surgical treatment of proximal humerus fractures and during the postoperative care phase. [19] ([10.1007/s11999-014-3613-y](https://doi.org/10.1007/s11999-014-3613-y))
- [L2] Short and long periods of immobilization yield similar results for nonoperatively treated proximal humeral fractures, independent of the fracture pattern. [20] ([10.2106/jbjs.20.02137](https://doi.org/10.2106/jbjs.20.02137))
- [L3] The increased in-hospital risk for major adverse events and surgical complications may moderate the enthusiasm associated with RTSA for proximal humeral fractures in patients 65 years and older. [21] ([10.1097/corr.0000000000001776](https://doi.org/10.1097/corr.0000000000001776))
- [L2] In patients presenting with a traumatic shoulder injury with normal radiographs, the anterior bruise sign (ABS) is a highly sensitive and specific clinical aid to identify patients with an occult greater tuberosity fracture. [22] ([10.1016/j.jse.2023.07.044](https://doi.org/10.1016/j.jse.2023.07.044))

- [L5] Most proximal humeral fractures in elderly patients can be treated nonoperatively with good functional outcomes. [23] ([10.2106/jbjs.l.01293](#))
- [L5] Surgery for complex proximal humeral fractures leads to overall good long-term outcomes with high overall complication and reoperation rates. [24] ([10.2106/jbjs.19.01109](#))
- [L3] Compared with the general population, patients sustaining a proximal humeral fracture have a significantly higher risk of mortality up to one year after the injury. [25] ([10.1302/0301-620x.102b11.bjj-2020-0627.r1](#))
- [L1] The available literature suggests that reverse shoulder arthroplasty performed to address complex proximal humeral fractures might result in more favorable clinical outcomes than hemiarthroplasty performed for the same indication. [26] ([10.1016/j.jse.2015.08.030](#))
- [L3] The increasing utilization of RTSA and decreasing short-term complication rates for fixation and arthroplasty alike represent a substantial change compared even with recent historic norms in the management of proximal humerus fractures. [27] ([10.1097/corr.0000000000002391](#))
- [L5] Greater tuberosity healing does not seem to impact reverse shoulder arthroplasty biomechanics during abduction or forward flexion; however, it does affect biomechanics during external rotation. [28] ([10.1016/j.jse.2019.07.022](#))
- [L3] Range of motion and strength thresholds can identify subjects with normal shoulder function. [29] ([10.1016/j.jse.2010.06.005](#))
- [L5] With minimal and moderate amounts of glenohumeral abduction, glenohumeral joint forces are significantly displaced superiorly. [30] ([10.1016/j.jse.2007.06.017](#))
- [L3] The authors recommend performing the measurement at the insertion of the deltoid muscle in a 90° abduction position in the scapula plane. [35] ([10.1186/s12891-019-2795-6](#))
- [L3] Dominance of the affected shoulder has no influence and should not be used to make treatment decisions. [37] ([10.1016/j.jse.2014.10.006](#))
- [L4] The study demonstrates variability in the glenopolar angle with increased AP rotational offset of the shoulder radiograph, revealing inaccuracies even at an institution with an established protocol. [38] ([10.1302/0301-620x.95b8.30631](#))
- [L5] Varus and antecurvatum proximal humerus deformities as small as 15 degrees were associated with statistically significant alterations in glenohumeral joint mechanics. [40] ([10.5435/jaaos-d-20-00555](#))
- [L5] Vertical abduction has the greatest effect on axillary nerve position, while horizontal glenohumeral forward flexion and humeral rotation have little effect. [43] ([10.1016/j.jse.2008.12.001](#))
- [L5] The control volume is an important anatomic and functional area of the proximal humerus. [44] ([10.1016/j.jse.2017.12.004](#))
- [L4] Nonsurgical management of proximal humerus fractures decreased during the study period. [46] ([10.1016/j.jhsa.2020.03.022](#))
- [L1] Treatment with reverse shoulder arthroplasty provides superior functional outcomes compared with conservative treatment for patients presenting with an acute proximal humeral fracture. [47] ([10.1016/j.jse.2024.02.023](#))

- [L1] This trial found no significant difference in clinical outcomes at 2 years between surgery and non-operative treatment in patients 60 years of age or older with displaced 2-part fractures of the proximal humerus. [48] ([10.1371/journal.pmed.1002855](https://doi.org/10.1371/journal.pmed.1002855))
- [L3] The new classification system with emphasis on the qualitative aspects of proximal humeral fractures showed high reliability when based on a standardized imaging protocol including computed tomography scans. [49] ([10.1016/j.jse.2015.08.006](https://doi.org/10.1016/j.jse.2015.08.006))
- [L5] Most pediatric patients with proximal humerus fractures have favorable results, and complications are infrequent. [50] ([10.5435/jaaos-d-14-00033](https://doi.org/10.5435/jaaos-d-14-00033))
- [L5] Treatment for proximal humerus fractures remains controversial, with nonsurgical management demonstrating successful outcomes and union rates greater than 90%. [51] ([10.5435/jaaos-d-24-01073](https://doi.org/10.5435/jaaos-d-24-01073))
- [L3] Nonsurgical treatment should have a more prominent role in the treatment of proximal humeral fractures. [52] ([10.1016/j.jse.2011.01.025](https://doi.org/10.1016/j.jse.2011.01.025))
- [L1] Shoulder function was restored to preinjury levels for most patients, and osteoporosis may not be regarded as a contraindication for this treatment. [53] ([10.1016/j.jse.2022.07.008](https://doi.org/10.1016/j.jse.2022.07.008))
- [L5] Reverse shoulder arthroplasty is a powerful tool for managing proximal humerus fracture sequelae when joint-preserving options are not optimal, provided there is careful management of the tuberosities and understanding of associated pearls and pitfalls. [54] ([10.5435/jaaos-d-23-00740](https://doi.org/10.5435/jaaos-d-23-00740))
- [L2] Prevention of local complications, in particular those leading to severe varus deviation, appears essential to improve shoulder function after a proximal humeral fracture. [55] ([10.1016/j.jse.2011.06.009](https://doi.org/10.1016/j.jse.2011.06.009))
- [L3] The HGLS classification is a reliable method of describing fractures of the proximal humerus compared with the Neer and AO systems. [56] ([10.1016/j.jse.2012.09.018](https://doi.org/10.1016/j.jse.2012.09.018))
- [L5] Surgical treatment of proximal humerus fractures remains far from straightforward, with unpredictable outcomes where factors associated with poor results include being a woman, four-part fracture dislocation, and absence of metaphyseal head extension. [57] ([10.1097/corr.0000000000002242](https://doi.org/10.1097/corr.0000000000002242))
- [L4] The revised Neer classification covers 98% of all proximal humeral fractures and is appropriate for clinical practice. [58] ([10.1016/j.jse.2009.01.018](https://doi.org/10.1016/j.jse.2009.01.018))
- [L1] The review identified a wide range of outcome measures used in proximal humeral fracture studies, but found limited evidence regarding their psychometric properties in this specific population. [59] ([10.1016/j.jse.2010.10.028](https://doi.org/10.1016/j.jse.2010.10.028))
- [L4] Classifications of proximal humeral fractures using the Neer system based on CT scans and plain radiographs are not very reliable or reproducible due to difficulty in determining which segments are fractured. [60] ([10.2106/00004623-199609000-00012](https://doi.org/10.2106/00004623-199609000-00012))
- [L4] Percutaneous treatment of selected proximal humeral fractures results in predictable union and good clinical results with a low rate of complications. [62] ([10.1016/j.jse.2006.09.006](https://doi.org/10.1016/j.jse.2006.09.006))
- [L1] Long-term treatment with RSA for displaced 3- or 4-part proximal humerus fractures provides better functional outcomes compared to nonoperative treatment, a difference attributed to the deterioration of functional outcomes of the nonoperative treatment over time. [63] ([10.1016/j.jse.2024.09.032](https://doi.org/10.1016/j.jse.2024.09.032))

- [L4] With narrow indications, use of a specific fracture stem and adequate tuberosity management, successful radiographic and functional results are presented after a mean follow-up of 4.8 years after hemiarthroplasty for primary nonreconstructable humeral head fractures. [65] ([10.1016/j.jse.2023.02.118](https://doi.org/10.1016/j.jse.2023.02.118))
- [L1] RTSA performed for acute 3- and 4-part proximal humeral fractures yields overall worse clinical outcomes and active ROM compared with RTSA performed for elective indications. [66] ([10.1016/j.jse.2021.07.014](https://doi.org/10.1016/j.jse.2021.07.014))
- [L1] We observed no clear benefits in treating patients 65 years or older with four-part fractures of the proximal humerus with either hemiarthroplasty or nonoperative treatment. [67] ([10.1007/s11999-012-2531-0](https://doi.org/10.1007/s11999-012-2531-0))
- [L3] This implies that the inherent nature of medial comminution of proximal humeral fracture may lead to inferior radiographic outcomes. [71] ([10.1186/s13018-022-03337-5](https://doi.org/10.1186/s13018-022-03337-5))
- [L4] Undisplaced greater tuberosity fractures can be managed non-operatively with good results, but patients with persistent post-traumatic shoulder pain and limitation of function warrant MRI investigation to identify occult fractures. [72] ([10.1186/s12891-018-2225-1](https://doi.org/10.1186/s12891-018-2225-1))
- [L3] There is relevant variability in displacement measurements between shoulder radiographs and CT scans in the coronal plane, with nearly 30% of cases suggesting surgical treatment on radiographs being reclassified for conservative treatment based on CT findings. [73] ([10.1016/j.jse.2016.05.016](https://doi.org/10.1016/j.jse.2016.05.016))
- [L5] The routine use of 3D-printed models may not be beneficial for classifying proximal humeral fracture patterns beyond the information gained from currently available imaging modalities, and their use as the sole determinant for recommending surgical intervention should be avoided at this time. [74] ([10.1097/corr.0000000000002017](https://doi.org/10.1097/corr.0000000000002017))
- [L3] CNNs proficiently rule out proximal humerus fractures on plain radiographs. [76] ([10.1302/0301-620x.106b11.bjj-2024-0264.r1](https://doi.org/10.1302/0301-620x.106b11.bjj-2024-0264.r1))
- [L4] Missed posterior dislocation of the shoulder after intramedullary fixation of proximal humeral fractures is an extremely rare injury that can be missed due to inadequate initial and postoperative x-ray images and incorrect interpretation. [79] ([10.1016/j.jse.2008.10.020](https://doi.org/10.1016/j.jse.2008.10.020))
- [L1] Timing of surgery did not affect Oxford Shoulder Score at any stage of follow-up, irrespective of age or fracture type. [80] ([10.1302/0301-620x.102b1.bjj-2020-0546.r1](https://doi.org/10.1302/0301-620x.102b1.bjj-2020-0546.r1))

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