

# Univers Revers™ System for Fracture Scientific Update

A Review of Design Rationale, Techniques, and Outcomes

Reverse total shoulder arthroplasty (rTSA), which was cleared in the United States in the early 2000s, provides surgeons and patients with an option for minimizing pain and improving function. Indications for rTSA have expanded to include the treatment of proximal humeral fractures (PHFs). For challenges presented by complex PHFs, the Univers Revers system offers a 135° neck-shaft angle that allows anatomic positioning of the tuberosities. Additionally, incremental lateralization options (2 mm) with the Modular Glenoid System allow for optimized cuff tension, which can affect tuberosity healing.

O'Sullivan J,  
Lädemann A,  
Parsons BO,  
et al

[A systematic review of tuberosity healing and outcomes following reverse shoulder arthroplasty for fracture according to humeral inclination of the prosthesis.](#) *J Shoulder Elbow Surg.* 2020;29(9):1938-1949. doi:10.1016/j.jse.2020.03.032

- Systematic review of 873 patients in 21 studies
- Tuberosity healing by inclination angle
  - 83% in the 135° group
  - 69% in the 145° group
  - 66% in the 155° group
- “The evidence now appears to be clear that active range of motion is improved when the tuberosities heal.”

#### Takeaway

“RSA for fracture with 135° humeral inclination is associated with higher tuberosity healing rates compared with 145° or 155°. Patients with healed tuberosities have superior postoperative forward flexion and external rotation than those with unhealed tuberosities.”

Schmalz J,  
Jessen M,  
Holschen M,  
et al

[Tuberosity healing improves functional outcome following primary reverse shoulder arthroplasty for proximal humeral fractures with a 135° prosthesis.](#) *Eur J Orthop Surg Traumatol.* 2020;30(5):909-916. doi:10.1007/s00590-020-02649-8

- Multicenter retrospective review of 64 patients with a mean follow-up of 22 ± 8 months
- “Overall healing rate of the greater tuberosity (GT) was 77%”
  - 86% for prosthesis with neutral glenosphere
  - 70% with the use of a +4 mm lateralized glenosphere
  - 33% compared to a 2.5 mm inferior eccentric glenosphere
- Lesser tuberosity healing “was associated with a high SSV, but did not influence the other functional outcomes scores or ROM.”

#### Takeaway

“Reverse shoulder arthroplasty with a 135° humeral inclination leads to good and reproducible clinical results and a high rate of tuberosity healing in the treatment of proximal humeral fractures. Tuberosity healing is associated with improved range of motion and functional outcome.”



Erickson BJ,  
Shishani Y,  
Bishop ME,  
Romeo AA,  
Lederman E,  
Gobezie R

[Tuberosity repair in reverse total shoulder arthroplasty for fracture using a stem-based double-row repair: a cadaveric biomechanical study.](#) *J Am Acad Orthop Surg.* 2020;28(23):e1059-e1065. doi:10.5435/JAAOS-D-19-00667

- Cadaveric biomechanical study
- Ultimate load to failure
  - Stem-based tuberosity repair technique:  $668 \pm 164$  N
  - Nonstem-based technique:  $483 \pm 67$  N
- Cyclic displacement
  - Stem-based tuberosity repair technique:  $0.83 \text{ mm} \pm 0.67$
  - Nonstem-based technique:  $3.36 \text{ mm} \pm 2.36$

#### Takeaway

“This study found that a stem-based repair technique provided markedly higher load to failure and markedly less cyclic displacement of the tuberosity fragments than a previously described, nonstem-based technique.”

Schmalzl J,  
Jessen M,  
Sadler N,  
Lehmann LJ,  
Gerhardt C

[High tuberosity healing rate associated with better functional outcome following primary reverse shoulder arthroplasty for proximal humeral fractures with a 135° prosthesis.](#) *BMC Musculoskelet Disord.* 2020;21(1):35. doi:10.1186/s12891-020-3060-8

- 38 patients with a mean age of  $77 \pm 8$  years were available for follow-up at  $34 \pm 5$  months
- Humeral inclination of  $135^\circ$  and standard glenospheres were used for all cases
- Humeral stems were placed in a press-fit fashion in 50% of cases
- Overall healing rate of the greater tuberosity (GT) was 82%
- GT healing significantly improved patient satisfaction, abduction, forward flexion, and external rotation
- Scapular notching was 8% (all grade 1)

#### Takeaway

This study concluded that RSA with  $135^\circ$  humeral inclination and a neutral glenosphere for proximal humeral fractures (PHF) leads to good functional outcome in combination with a high rate of tuberosity healing (TH) and a low rate of scapular notching.



Schmalzl J,  
Piepenbrink M,  
Buchner J,  
Picht S,  
Gerhardt C,  
Lehmann LJ

[Higher primary stability of tuberosity fixation in reverse fracture arthroplasty with 135° than with 155° humeral inclination. \*J Shoulder Elbow Surg.\* 2021;30\(6\):1257-1265. doi:10.1016/j.jse.2020.09.009](#)

- Biomechanical study comparing humeral inclination (HI) of 135° and 155°
- In all specimens, the 135° group obtained an anatomic reposition of the tuberosities around the metaphysis of the prosthesis without any gap formation
- “Assuming identical implant positioning and inlay height, implantation of the prosthesis with a 155° HI leads to 8.9 mm greater lengthening of the arm compared with the 135°”
- Decreased tuberosity movement in all 3 axes in the 135° HI group after cyclic loading.

#### Takeaway

This study shows that primary stability of the reattached tuberosities is significantly increased with an anatomic 135° HI. Moreover, the rotational movements are decreased in prostheses with a 135° HI.

Formaini NT,  
Everding NG,  
Levy JC,  
Rosas S

[Tuberosity healing after reverse shoulder arthroplasty for acute proximal humerus fractures: the “black and tan” technique. \*J Shoulder Elbow Surg.\* 2015;24\(11\):e299-e306. doi:10.1016/j.jse.2015.04.014](#)

- Radiographic and clinical outcomes of a consecutive series of 25 patients
- Tuberosity healing was 88%
- “Mean external rotation was 29° ± 18°”
- “The temperature observed at the surgical neck adjacent to the location of the tuberosity decreased 23% in the impaction grafting technique”

#### Takeaway

When choosing to cement, “a hybrid cementation-impaction grafting technique” combined with “standard suture repair and an implant with features that support tuberosity repair results in a high tuberosity healing rate with restoration of external rotation after RSA for fracture.”

Boileau P,  
Alta TD,  
Decroocq L,  
et al

[Reverse shoulder arthroplasty for acute fractures in the elderly: is it worth reattaching the tuberosities?. \*J Shoulder Elbow Surg.\* 2019;28\(3\):437-444. doi:10.1016/j.jse.2018.08.025](#)

- Retrospective study of 38 acute displaced or dislocated 3- and 4- part fractures in elderly patients treated with RSA and tuberosity reattachment with a minimum 2 years follow-up
- “Tuberosity union rate was 84%”
- “The optimal prosthetic height was achieved when the summit of the prosthesis (i.e. the metallic cup) was positioned level with, or just above, the reduced GT.”
- “The arm was rested in a neutral rotation sling to minimize tension on the tuberosity and deltoid repairs for 4 weeks.”
- “Patients with tuberosity nonunion or osteolysis achieved lower active forward elevation and external rotation.”
- 18 cases (47.3%) of grade 1 or 2 inferior scapular notching were identified

#### Takeaway

Tuberosity reconstruction and healing in reverse total shoulder arthroplasty for fractures improves active mobility in forward elevation and external rotation as well as patient satisfaction.



Ohl X,  
Bonnevialle N,  
Gallinet D,  
et al

[How the greater tuberosity affects clinical outcomes after reverse shoulder arthroplasty for proximal humeral fractures.](#) *J Shoulder Elbow Surg.* 2018;27(12):2139-2144. doi:10.1016/j.jse.2018.05.030

- Retrospective multicenter study of 420 patients with proximal humeral fractures
- “Anterior active elevation and external rotation were significantly better” with anatomic healing of the GT
- 83% of patients were women
- “After excision of the tuberosities, the stabilizing effect of soft tissues (rotator cuff) around the ball-and-socket joint is lost.”
- Excision of the tuberosities removes the anatomic landmark provided by the GT, which makes it difficult to determine the appropriate height of the prosthesis

#### **Takeaway**

“In elderly patients who have undergone an RSA for acute PHFs, tuberosity healing improves the clinical outcomes and decreases the risk of postoperative instability.”

Uzer G,  
Yildiz F,  
Batar S,  
et al

[Does grafting of the tuberosities improve the functional outcomes of proximal humeral fractures treated with reverse shoulder arthroplasty?.](#) *J Shoulder Elbow Surg.* 2017;26(1):36-41. doi:10.1016/j.jse.2016.05.005

- Retrospective comparative study of 33 patients
- Tuberosity fixation in Group I was augmented with autografting; group II did not use autograft to augment the tuberosity repair
- “Cement near the fracture line was removed to prevent interposition and thermal damage.”
- Rate of tuberosity union was significantly higher in group I than in group II (77.8% compared to 40%)
- External rotation muscle strength was significantly greater in group 1

#### **Takeaway**

Cancellous block autograft augmentation can increase the rate of tuberosity union and improve functional outcomes.



Chun YM,  
Kim DS,  
Lee DH,  
Shin SJ

[Reverse shoulder arthroplasty for four-part proximal humerus fracture in elderly patients: can a healed tuberosity improve the functional outcomes?. \*J Shoulder Elbow Surg.\* 2017;26\(7\):1216-1221. doi:10.1016/j.jse.2016.11.034](#)

- Retrospective case-control multicenter study comparing 38 patients with healed or unhealed tuberosities
- “Tuberosity healing in an anatomic position was achieved in only 37% of patients.”
- External rotation with the arm at the side was better in the healed tuberosity group
- Reasons for the low tuberosity healing rate:
  - “The prosthesis used in this study did not have a porous coating surface on either the humeral cup or the proximal portion of the stem.”
  - “The position of tuberosity fixation around the humeral cup in reverse shoulder arthroplasty was lower than its original anatomic position, and this might entail tuberosity fixation under high tension.”
  - “The mean age of the patients in the current study was relatively high.”
  - “We filled the cement up to the end of the proximal metadiaphysis.”

#### **Takeaway**

“There were no significant differences in functional outcomes and ROM between the two groups, with the exception of external rotation, which was better in the healed tuberosity group.”

Singh A,  
Padilla M,  
Nyberg EM,  
et al

[Cement technique correlates with tuberosity healing in hemiarthroplasty for proximal humeral fracture. \*J Shoulder Elbow Surg.\* 2017;26\(3\):437-442. doi:10.1016/j.jse.2016.08.003](#)

- Retrospective comparative study of 84 patients who underwent hemiarthroplasty for 4-part proximal humeral fracture
- “Cement technique had a statistically significant impact on tuberosity healing”
- “Individuals with a type B (>5 mm distal to the tuberosities) or Type C cement technique healed over 80% of the time.”
- Fenestrated and autografted humeral stems had no effect on healing

#### **Takeaway**

This study reinforces the findings that anatomic horizontal tuberosity reduction and male gender are important predictors of tuberosity healing. In addition, a new classification of cement mantle height is added and the study demonstrates that cementation within 5 mm of the greater tuberosity significantly diminishes healing.



Sebastiá-Forcada E,  
Cebrián-Gómez R,  
Lizaur-Utrilla A,  
Gil-Guillén V

[Reverse shoulder arthroplasty versus hemiarthroplasty for acute proximal humeral fractures. A blinded, randomized, controlled, prospective study. \*J Shoulder Elbow Surg.\* 2014;23\(10\):1419-1426. doi:10.1016/j.jse.2014.06.035](#)

- Randomized controlled trial of 62 patients
- Tuberosity healing of 56.6% in the HA group
- Tuberosity healing of 64.5% in the RSA group
- “The mean functional scores and active range of motion were significantly better in the RSA group, but there was no significant difference of the internal rotation.”
- Six of the 30 patients in the HA group required revision to RSA

#### Takeaway

“The findings of this study indicated that RSA was superior to HA with respect to pain, functional outcome, and revision rate.”

Anakwenze OA,  
Zoller S,  
Ahmad CS,  
Levine WN

[Reverse shoulder arthroplasty for acute proximal humerus fractures: a systematic review. \*J Shoulder Elbow Surg.\* 2014;23\(4\):e73-e80. doi:10.1016/j.jse.2013.09.012](#)

- Systematic review that included nine studies between the years 2008 and 2013
- “Females comprised 90.4% of the patient population”
- Greater tuberosity repair resulted in greater active forward elevation, active external rotation at neutral, and external rotation at 90° abduction compared to no repair
- Scapula notching occurred in 32% of the patients
- “Ultimately, intraoperative assessment is our most important tool in assessing stability; we aim to provide sufficient soft tissue tensioning without excessively constraining the prosthesis; full passive ROM without impingement should be attainable.”

#### Takeaway

RSA for the management of complex proximal humerus fractures provides predictable results. However, these elderly patients still present with some postoperative dysfunction, even though pain is usually well controlled.

Jain NP,  
Mannan SS,  
Dharmarajan R,  
Rangan A

[Tuberosity healing after reverse shoulder arthroplasty for complex proximal humeral fractures in elderly patients-does it improve outcomes? A systematic review and meta-analysis. \*J Shoulder Elbow Surg.\* 2019;28\(3\):e78-e91. doi:10.1016/j.jse.2018.09.006](#)

- Systematic review that included seven studies and 381 patients
- 81.7% of patients were female
- The healed greater tuberosity group showed significantly improved forward flexion and external rotation compared with the nonhealed group
- Rate of scapular notching was 26.1%

#### Takeaway

- “Implant design may have an influence over outcomes, particularly ROM, but this is beyond the scope of this review.” Make this quote a separate bullet:
- “In the context of increasing use of RSA for complex proximal humeral fractures in older patients, RSA with HT seems to result in better functional outcomes compared with RSA with NHT.”