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Acute versus delayed reverse total shoulder arthroplasty for proximal humeral fractures: a consecutive cohort study

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Background: The treatment of displaced proximal humeral fractures (PHFs) remains controversial. Open reduction–internal fixation (ORIF) can be challenging, especially in elderly patients with poor bone quality, whereas hemiarthroplasty has had unpredictable outcomes. Conservative treatment may result in severe fracture sequelae with poor outcomes, requiring late reverse total shoulder arthroplasty (RTSA) in many cases. The past few years have seen a shift toward the use of RTSA for the treatment of PHFs. The aim of this study was to compare the outcomes of RTSA between patients with acute fractures and patients who underwent delayed RTSA for fracture sequelae. Our hypothesis was that the outcomes of RTSA for acute PHFs would be better than those of delayed RTSA for fracture sequelae.

Methods: We followed up 36 patients with a mean age of 79.1 years who underwent primary RTSA for acute PHFs and 56 patients with a mean age of 72.1 years who underwent RTSA in delayed fashion for fracture sequelae, including failed ORIF. The minimum follow-up period was 24 months. The mean follow-up period was 39.3 months in the acute RTSA group and 56.6 months in the delayed RTSA group. Demographic data, radiographs, and surgery data were prospectively collected and analyzed. At final follow-up, range of motion and radiographic analysis findings, as well as the Subjective Shoulder Value (SSV) and Constant score (CS), were recorded.

Results: The clinical results favored the group undergoing acute RTSA for acute PHFs, with a mean SSV of 8.3 of 10 and adjusted CS of 88.9% compared with a mean SSV of 8.0 of 10 and adjusted CS of 77.6% in the group undergoing late RTSA for fracture sequelae—but without statistically significant differences between the groups. Although the acute RTSA group showed slightly better range-of-motion values, no statistically significant differences were found between the groups. No intraoperative complications occurred. The time from injury to the regaining of good pain-free function was significantly shorter in the acute RTSA group.

Conclusion: Although there were no statistically significant differences in outcomes between early RTSA for acute PHFs and late RTSA for fracture sequelae, the time from injury to the regaining of good pain-free function was significantly shorter in the acute RTSA group. Therefore, we advocate early RTSA for acute PHFs in elderly patients to provide a quicker recovery and an early return to good predictable outcomes with a much shorter period of pain and discomfort. In cases of failed conservative treatment, malunion, or failed ORIF, salvage RTSA has the potential to provide a good outcome.

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Proximal humeral fractures (PHFs) in elderly individuals can be treated conservatively when good alignment is maintained.[18] Yet, 3- and 4-part fractures with marked displacement represent a challenge for the orthopedic surgeon as they can be treated in a variety of ways. The publication of the much-disputed PROFHER (Proximal Fracture of the Humerus: Evaluation by Randomisation) study in recent years[31] has led surgeons to treat even severely displaced PHFs conservatively, which has resulted in poor outcomes and severe fracture sequelae in many cases. The use of reverse total shoulder arthroplasty (RTSA) in the acute fracture setting (acute RTSA [aRTSA]) in elderly patients with complex PHFs is gaining popularity.[13,15,23] However, it remains to be elucidated whether its use in the acute setting yields better results than its use to address the consequences of treatment failure with fracture sequelae, whether this is operative (ie, acute hemiarthroplasty [aHA] or failed open reduction–internal fixation [ORIF]) or nonoperative (ie, fracture sequelae after conservative treatment). Unsatisfactory results can be a consequence of either treatment choice when radiographic evidence of nonunion, malunion, and/or bone necrosis develops; when the Constant score (CS) fails to improve (<30); or when there is persistent pain and dysfunction.

The aim of this study was to compare the results of aRTSA for PHFs vs. delayed RTSA in patients with fracture sequelae. Our hypothesis was that the use of aRTSA would lead to significantly better outcomes in terms of the Subjective Shoulder Value (SSV), CS, and range of motion (ROM) in these patients.

Materials and methods

This was a retrospective study compiled from our institutional research database of prospectively collected data on consecutive patients. A total of 92 patients treated with RTSA by the senior author (O.L.) between 2005 and 2017 were included in this study. Of these patients, 36 (28 women and 8 men) underwent immediate RTSA for acute fracture (aRTSA) whereas 53 (41 women and 12 men) underwent late RTSA for fracture sequelae (36 after conservative treatment and 17 after ORIF). We excluded 3 further patients from the statistical analysis—1 patient who underwent intramedullary nailing and 2 patients who underwent hemiarthroplasty (aged 33 and 38 years)—because their numbers were deemed too small to have any statistical significance and they could be perceived as confounding factors. The minimum follow-up period was 24 months.

Data were collected prospectively in a computerized database and were analyzed to compare the clinical and radiologic outcomes of either immediate RTSA implantation in acute PHFs (<4 weeks from the fracture) or late RTSA in cases with fracture sequelae. Demographic data, radiographs, and surgery data were collected and analyzed. Patients were divided into 2 groups: Group A comprised patients who underwent aRTSA, and group B comprised patients who underwent RTSA for fracture sequelae. In group B, patients were further classified into 2 subgroups: those with fracture sequelae after conservative treatment and those with fracture sequelae after ORIF. Patients were further categorized by fracture sequela type according to Boileau et al[5] on the basis of radiographic appearance. Patients were followed up clinically and radiographically at 3 weeks and at 3, 6, and 12 months postoperatively, as well as yearly thereafter. Clinical evaluation included the CS, age- and sex-adjusted CS, SSV, return to function, and ROM. In group B, the same parameters were collected preoperatively as well. As part of the evaluation for the CS, strength was measured using a standard handheld dynamometer (IDO Isometer; Innovative Design Orthopaedics, London, UK) for medical use. Radiographic analysis included implant position, inferior scapular notching, lucencies around the implant or signs of loosening, and greater tuberosity position on standardized anteroposterior and axillary lateral radiographs. Glenoid notching was evaluated and, if present, was graded according to the classification previously described by Sirveaux et al.[37]

Statistical analysis

Statistical analysis was performed using IBM SPSS software (version 26.0; IBM, Armonk, NY, USA). Descriptive statistics (means, ranges, and standard deviations) were calculated. We evaluated whether a normal distribution was present using the Kolmogorov-Smirnov test, and the data were found to be non-normally distributed. Therefore, statistical analyses were performed using nonparametric tests. The Mann-Whitney *U* test and Kruskal-Wallis 1-way analysis of variance were used for group comparisons, and the Wilcoxon signed rank test was used to assess differences between the preoperative and postoperative values. $P < .05$ was considered statistically significant.

Surgical technique

All procedures were performed by the senior author or under his supervision. The operations were performed in a room with laminar flow. Regional anesthesia with an interscalene block combined with either general anesthesia or sedation only was used. Patients were positioned in the beach-chair position for surgery. The anterosuperior (Neviaser-Mackenzie) approach was used in all cases. In cases in which scarring from a previous deltopectoral approach was present, the previous scar was reused, with proximal extension of the skin incision to allow for a subcutaneous anterosuperior approach with acromioclavicular joint exposure.

The prosthesis used was a cementless RTSA (Verso Shoulder; Innovative Design Orthopaedics) in all cases. In the acute fracture group (Fig. 1), the stemmed version of the implant was used in all cases (36 cases). In the group with late fracture sequelae (Fig. 2), a short metaphyseal RTSA without a diaphyseal stem was used in 40 cases. Whenever metaphyseal bone both was preserved and provided enough support,[14,26] a short metaphyseal humeral implant without a diaphyseal stem was used with impaction grafting of autologous morcellized bone graft. A stemmed implant had to be used in cases with surgical neck nonunion or cases of deficient humeral metaphyseal bone. In the failed ORIF group, all cases were addressed in a single stage, with removal of previous implants and RTSA in the same operative setting.

The humeral component was implanted in 30° of retroversion. The biceps tendon, if present, underwent tenodesis. The position of the tuberosities in the sequela group was accepted in all cases, and no attempt was made to improve any malposition, although balancing the tension of the remnants of the rotator cuff was attempted in all cases. In the acute group, the tuberosities were released and repaired with transosseous mattress sutures by use of No. 5 Ethibond sutures (Ethicon, Somerville, NJ, USA) threaded through holes fashioned in the humeral diaphysis with the aid of a 2-mm drill. If significant comminution was encountered, cancellous bone graft, taken from the humeral head, was placed between the tuberosities and the diaphysis to facilitate bony union. The height of the prosthetic stem was determined using the following references: (1) the height of the fractured tuberosities; (2) the distance from the tip of the fractured greater tuberosity to the articular-side insertion of the rotator cuff, which determines the height of the lateral aspect of the humeral head; and (3) the height of the cartilage-free zone of the humeral head at the calcar, which determines the medial-inferior border of the prosthetic head.

Patients in group B commenced immediate mobilization postoperatively with passive and active ROM. They were advised to avoid extension and internal rotation movement, such as forcefully pushing oneself out of a chair, for 6 weeks per the standard postoperative protocol used in our institution for elective RTSA. Patients in group A were placed in a sling with a body belt for 3 weeks postoperatively to allow healing of the tuberosities, with gradual mobilization after this period. Passive ROM exercises were started at 3 weeks postoperatively. Active ROM exercises were started at 6 weeks postoperatively.

Results

Demographic data comparisons between the aRTSA and delayed RTSA cohorts are summarized in Table I. There were no significant differences between the groups regarding age, comorbidities, body mass index, or original fracture patterns. The mean follow-up period was 39.3 months (range, 24-120 months) for group A (aRTSA) and 56.6 months (range, 24-136 months) for group B (late RTSA).

In group B, 28 patients had type 1 sequelae, 16 had type 3, 6 had type 2, and 3 had type 4. In addition, 17 patients in group B underwent previous surgery (ORIF with a locking plate and screws): 14 in the type 1 sequela group and 3 in the type 3 sequela group. The median time from injury to RTSA was 2 weeks (range, 0-5 weeks) in group A and 32 weeks (range, 5-111 weeks) in group B. In group B, preoperatively, the average SSV was 1.73 of 10 and the mean age- and sex-adjusted CS was 20.8%. Preoperatively, average abduction was 42° (range, 0°-90°); forward flexion, 46° (range, 0°-90°); external rotation, 5° (range, 0°-60°); and internal rotation, 24° (range, 0°-90°). In group A, all 36 patients received a stemmed RTSA (Fig. 1). In group B, 13 patients received a stemmed RTSA (because of deficient metaphyseal bone or surgical neck nonunion) whereas 40 received a short metaphyseal RTSA without a diaphyseal stem (Fig. 2).

At final follow-up, good functional outcomes with good CSs, SSVs, and ROM measures were observed in both groups (Table II). In group B (late RTSA), statistically significant improvements compared with the preoperative data were observed for all parameters ($P < .001$) (Table III).

At final follow-up, the average SSV and adjusted CS were 8.3 of 10 and 88.9%, respectively, in group A and 8.0 of 10 and 77.6%, respectively, in group B ($P = .761$ for SSV and $P = .158$ for adjusted CS). The mean ROM values were as follows: 126° of forward flexion (range, 30°-160°), 120° of abduction (range, 30°-170°), 26° of external rotation (range, 0°-60°), and 69° of internal rotation (range, 20°-90°) in group A and 112° of forward flexion (range, 30°-150°), 107° of abduction (range, 30°-160°), 25° of external rotation (range, 0°-60°), and 73° of internal rotation (range, 0°-90°) in group B. Although group A (aRTSA) showed slightly better outcomes, no statistically significant differences were found between the groups, with the exception of forward elevation, for which marginal statistical significance was found. Tables II and Table III summarize these findings.

No postoperative infection or neurologic deficit was observed in either group. In group A, radiographic evidence of grade 1 notching was found in 1 case. In group B, grade 2 notching was observed in 2 cases. Radiographic studies performed at final follow-up showed no lucencies around the glenoid and humeral components or evidence of loosening or subsidence in either group.

Comparisons between the 2 subgroups in group B (late RTSA after conservative treatment and RTSA after ORIF), as well as comparisons of each subgroup vs. group A (aRTSA), are presented in Tables IV, V, VI, and VII. The analysis between the subgroups of patients with and without previous surgery showed similar clinical results, with CSs of 53.3 and 54.5 (age- and sex-adjusted CSs, 77.7% and 77.5%) for RTSA after conservative treatment and RTSA after ORIF, respectively. The SSV was 8.0 of 10 in both subgroups, and the ROM values were similar. Although the results of RTSA after ORIF were marginally better, no statistically significant differences between the subgroups were observed (Table V). The average time from

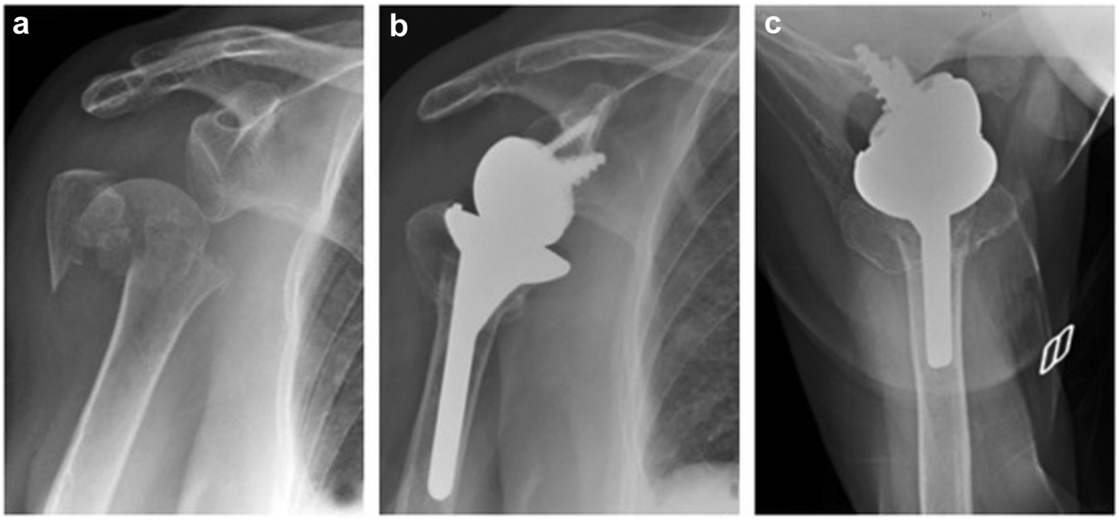

Figure 1 (**a**) Acute proximal humeral fracture. (**b, c**) Stemmed cementless reverse total shoulder arthroplasty with healed tuberosities.

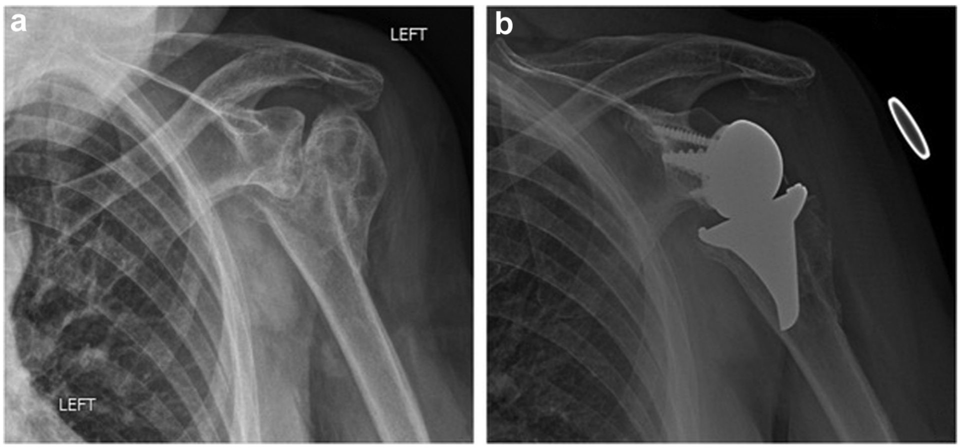

Figure 2 (**a**) Preoperative radiograph of malunited proximal humeral fracture. (**b**) Two-year follow-up radiograph showing short metaphyseal humeral implant without diaphyseal stem.

Table I Patient demographic data

Variable	Acute RTSA (n = 36)	Delayed RTSA (n = 53)
Side		
Right	24 (66)	27 (51)
Left	12 (33)	26 (49)
Sex		
Male	8 (22)	12 (23)
Female	28 (78)	41 (77)
Age, yr	79.1 (40-93)	72.1 (39-90)
Delay from fracture to RTSA, weeks	2 (0-5)	32 (5-111)
Follow-up, mo	39.3 (24-120)	56.6 (24-136)

RTSA, reverse total shoulder arthroplasty.
Categorical data are presented as number (percentage), and continuous data are presented as mean (range).

Table II Comparative postoperative outcomes

Parameter	Acute RTSA (n = 36)	Delayed RTSA (n = 53)	*P* value*
CS	58.3	53.7	.405
Adjusted CS, %	88.9	77.6	.158
SSV	8.3 of 10	8 of 10	.761
Forward flexion, °	126	112	.042
Abduction, °	120	107	.310
External rotation, °	26	25	.753
Internal rotation, °	69	73	.248

RTSA, reverse total shoulder arthroplasty; *CS*, Constant score; *SSV*, Shoulder Subjective Value.
* Calculated using Mann-Whitney *U* test.

Table III Data of patients in group undergoing late RTSA for fracture sequelae

Parameter	Preoperative	Postoperative	*P* value*
CS	14.8	53.7	<.001
Adjusted CS, %	20.8	77.6	<.001
SSV	1.73 of 10	8.0 of 10	<.001
Forward flexion, °	46	112	<.001
Abduction, °	42	107	<.001
External rotation, °	5	25	<.001
Internal rotation, °	24	73	<.001

RTSA, reverse total shoulder arthroplasty; *CS*, Constant score; *SSV*, Shoulder Subjective Value.
* Calculated using Wilcoxon signed rank test.

Table IV Clinical outcomes of acute RTSA for proximal humeral fractures compared with RTSA after prior ORIF

Parameter	Acute RTSA (n = 36)	RTSA after ORIF (n = 17)	*P* value*
CS	58.3	54.5	.689
Adjusted CS, %	88.9	77.5	.281
SSV	8.3 of 10	8.0 of 10	.642
Forward flexion, °	126	116	.047
Abduction, °	120	113	.773
External rotation, °	26	27	.697
Internal rotation, °	69	72	.646

RTSA, reverse total shoulder arthroplasty; *ORIF*, open reduction–internal fixation; *CS*, Constant score; *SSV*, Shoulder Subjective Value.
* Calculated using Mann-Whitney *U* test.

injury (fracture) to resuming good pain-free function was 3.5 months (average, 104.9 days; range, 90-122 days) for the aRTSA group and 23 months (average, 686.8 days; range, 4-97 months) for the late RTSA group ($P < .001$).

Discussion

In our study, at final follow-up, the average SSV and adjusted CS were 8.3 of 10 and 88.9%, respectively, in group A (aRTSA) and 8.0 of 10 and 77.6%, respectively, in group B (late RTSA) ($P = .761$ for SSV and $P = .158$ for adjusted CS). The results in the aRTSA group were clinically slightly better than those in the group undergoing late RTSA for fracture sequelae; however, there were no statistically significant differences, with the exception of forward elevation, which was slightly better in the aRTSA group. These findings correspond well with those of previous studies.[9,22,27-30,40,42] The analysis between subgroups of patients with and without previous surgery showed similar clinical results with CSs of 53.3 and 54.5 (age- and sex-adjusted CSs of 77.7% and 77.5%) for late RTSA after conservative treatment and RTSA after ORIF, respectively. The SSV was 8.0 of 10 in both subgroups, and the ROM

Table V Clinical outcomes of RTSA for fracture sequelae after conservative treatment compared with RTSA after ORIF

Parameter	RTSA for malunion or nonunion (n = 36)	RTSA after ORIF (n = 17)	*P* value*
CS	53.2	54.5	.834
Adjusted CS, %	77.7	77.5	.962
SSV	8.0 of 10	8.0 of 10	.804
Forward flexion, °	109	116	.653
Abduction, °	104	113	.572
External rotation, °	23	27	.433
Internal rotation, °	74	72	.364

RTSA, reverse total shoulder arthroplasty; *ORIF*, open reduction–internal fixation; *CS*, Constant score; *SSV*, Shoulder Subjective Value.
* Calculated using Mann-Whitney *U* test.

Table VI Clinical outcomes of late RTSA for fracture sequelae (malunion or nonunion) after conservative treatment compared with acute RTSA for proximal humeral fractures

Parameter	RTSA for malunion or nonunion (n = 36)	Acute RTSA (n = 36)	*P* value*
CS	53.2	58.3	.377
Adjusted CS, %	77.7	88.9	.205
SSV	8.0 of 10	8.3 of 10	.893
Forward flexion, °	109	126	.037
Abduction, °	104	120	.232
External rotation, °	24	26	.514
Internal rotation, °	74	69	.196

RTSA, reverse total shoulder arthroplasty; *CS*, Constant score; *SSV*, Shoulder Subjective Value.
* Calculated using Mann-Whitney *U* test.

Table VII Clinical outcomes of RTSA for acute fractures compared with RTSA for fracture sequelae after conservative treatment and after ORIF

Parameter	Acute RTSA (n = 36)	RTSA for fracture sequelae after conservative treatment (n = 36)	RTSA for fracture sequelae after ORIF (n = 17)	*P* value*
CS	58.3	53.3	54.5	.686
Adjusted CS, %	88.9	77.7	77.5	.368
SSV	8.3 of 10	8.0 of 10	8.0 of 10	.915
Forward flexion, °	126	109	116	.044
Abduction, °	120	104	113	.496
External rotation, °	26	24	27	.670
Internal rotation, °	69	74	72	.387

RTSA, reverse total shoulder arthroplasty; *ORIF*, open reduction–internal fixation; *CS*, Constant score; *SSV*, Shoulder Subjective Value.
* Calculated using Kruskal-Wallis test.

values were similar. There were no statistically significant differences between the subgroups.

Several studies in the literature have investigated the outcomes of different treatment options for PHFs. The use of aRTSA, both as a primary procedure and as a salvage procedure for failure of other treatment options, has been compared with several alternatives (conservative treatment,[32] acute ORIF,[6] aHA,[3,6,8,10-12,33,41] and closed reduction–internal fixation,[25] as well as treatment of fracture sequelae,[22,27-30,40,42] after failed ORIF,[7,9,34,35] and after failed hemiarthroplasty[9,35]), with the vast majority of studies favoring aRTSA in terms of both clinical results and ROM. Regarding fracture sequelae, Raiss et al[27-30] published a series of 4 observational studies on the outcomes of delayed RTSA after fracture sequelae and concluded that, although improvement could be achieved regardless of the type of sequelae, RTSA for type 2 (chronic fracture-dislocations) and type 3 (surgical neck nonunion) sequelae led to less reliable results, with increased complications (ie, dislocation) and revision rates, than RTSA for type 1 and type 4 fracture sequelae. Other authors have also previously compared the results of aRTSA vs. late RTSA for fracture sequelae, reporting better results with aRTSA, especially in active external rotation.[22,40,42] This may be a result of better repair of the tuberosities in aRTSA, whereas in late RTSA, the tuberosities may have united in malposition. Dezfuli et al[9] found that, although the aRTSA group outperformed the group in which late RTSA was used as a revision procedure, the outcomes between aRTSA and late RTSA for malunion or nonunion were comparable. A previous surgical procedure seems, therefore, to constitute an independent risk factor for worse outcomes. This is also confirmed by studies that compared aRTSA and late revision RTSA for failure of a previous surgical procedure (ie, aHA and ORIF).[7,34-36]

With the rise in popularity of RTSA for the treatment of PHFs, the impact of timing (acute vs. delayed) has been subject to greater scrutiny. The publication of the debated PROFHER (Proximal Fracture of the Humerus: Evaluation by Randomisation) study in recent years[31] has led surgeons to treat, erroneously in our opinion, even severely displaced PHFs conservatively, which has resulted in poor outcomes and severe fracture sequelae in many cases. It is clear that the greater the deformity and malunion of the tuberosities are, the less predictable the results of late RTSA for fracture sequelae are. In their systematic review and meta-analysis, Torchia et al[39] found 4 studies directly comparing acute vs. delayed RTSA. They concluded that a trial of conservative treatment can be undertaken without jeopardizing clinical results. Our study indeed indicates that, in general, the results of late RTSA for fracture sequelae are good and do not show strong statistically significant differences from the results of aRTSA. However, the aRTSA group showed slightly better results clinically that were more predictable, with an earlier return to good pain-free function. The period of pain and dysfunction from the occurrence of the fracture until the resumption of good pain-free function was significantly shorter in the aRTSA group. This important variable of a shorter symptomatic period has been unfortunately omitted and overlooked in previous studies.[7,9,32,35]

The strengths of our study include the prospective collection of data, with a considerably larger sample size comparing acute vs. delayed RTSA for PHFs. For the group undergoing late RTSA for fracture sequelae, preoperative data were collected as well and confirmed the substantial improvement achievable in these patients. To our knowledge, this is the first study to analyze the outcomes of acute vs. delayed RTSA in PHFs with the use of a cementless, short metaphyseal prosthesis without a diaphyseal stem for most of the fracture sequela cases.

This study is the first to compare the time from injury and fracture to the regaining of good pain-free function between the aforementioned groups. An advantage of aRTSA for PHFs is the reduction of the period of pain and dysfunction. By undergoing aRTSA early, these elderly patients can return to pain-free use of the arm and resume activities of daily living and leisure activities much earlier than when late RTSA is performed for fracture sequelae, where patients have to withstand pain and dysfunction for many months or even years before undergoing RTSA. This precious time is of utmost importance in elderly patients, both physically and mentally. This important advantage, in our opinion, is overlooked by other authors suggesting that "a trial of conservative treatment can be undertaken without jeopardizing clinical results."[39]

Tuberosity healing has also been advocated to lead to better results in the setting of aRTSA for PHFs, especially in forward flexion and external rotation. A systematic review by Jain et al[17] confirmed these findings. Although we did not specifically evaluate the rate of tuberosity healing in the aRTSA group, we believe that our reconstruction strategy for tuberosity repair, as described earlier, contributed to the good results. This is corroborated by the fact that the difference in active forward flexion between the 2 groups was statistically significant ($P = .042$). Whereas the inherent design of RTSA is known to be less reliant on the integrity of the rotator cuff and the tuberosities, their reconstruction is recommended whenever possible, although this can be more arduous in the setting of fracture sequelae with malunited tuberosities or previous surgery in chronic cases.[16]

There appears to be a paucity of studies on the use of short metaphyseal (stemless) RTSA in the current literature. Although several authors found that the use of a short metaphyseal (stemless) RTSA design is reliable for cuff-related conditions (cuff arthropathy or massive tears)[2,24,38] and other non–trauma-related indications,[21] we found no studies specifically investigating the use of short metaphyseal (stemless) RTSA for fracture sequelae. Beck et al[4] investigated the long-term results of stemless RTSA, and although they studied the survival rate of stemless RTSA, in the 7 cases (of a total of 29 cases) in which the indication for treatment was fracture sequelae, they opted to use a stem instead. Levy et al[20] included in their study 12 cases undergoing a short metaphyseal RTSA without a diaphyseal stem for fracture sequelae among 102 consecutive patients with mostly non–fracture-related indications with good outcomes. The CS improved from 12 to 49 (age- and sex-adjusted CS, 17% to 71%). Atoun et al[1] found good results in 5 cases of RTSA for late fracture sequelae (of 31 cases in their study), with improvement in the CS from 10.2 to 47.4. Leonidou et al[19] found similar good results in their study, in which, among

37 consecutive RTSAs using the same implant, 1 patient underwent aRTSA for PHFs and 3 patients underwent stemless metaphyseal RTSA for late fracture sequelae. We therefore believe that the use of a short metaphyseal RTSA design without a diaphyseal stem can provide durable and reliable results in the short to mid term in the presence of fracture sequelae, which are not inferior to other prosthetic designs with bone preservation.

There are several limitations pertinent to this study. This study was retrospective and nonrandomized. The sample size was relatively small, and the study lacked a power analysis, as data were analyzed retrospectively. Another limitation could be drawn from the fact that the group B population was heterogeneous, including both a malunion subgroup and a failed ORIF subgroup. However, analysis comparing the acute group with the individual subgroups drew the same conclusions. The rehabilitation protocol was also slightly different between the 2 groups because we favored 3 weeks of rest in a sling to allow for tuberosity healing in the acute group. Further studies with larger groups and longer follow-up will be needed to draw safer conclusions.

Our results showed good outcomes in both groups—aRTSA for fractures and late RTSA for fracture sequelae—with slightly better outcomes in the first group but with no statistically significant difference in most parameters, with the exception of forward elevation. However, we see an advantage in performing aRTSA for fractures in elderly patients, as it can give them a quicker recovery and much earlier return to function and activities of daily living, with less pain and dysfunction and more predictable results. One must remember that in the elderly age group, time is precious, and every month that pass by relates to a significant part of their remaining life expectancy and, therefore, the significance in quicker recovery of pain-free function. On the other hand, although a stemmed RTSA should be used as a scaffold in the acute fracture setting, in cases of fracture sequelae and malunion, a stemless bone-preserving implant can be used, which can be advantageous when treating comminuted PHFs in slightly younger patients, with bone preservation and good outcomes.

Conclusion

Although there were no statistically significant differences in outcomes between early RTSA for acute PHFs and late RTSA for fracture sequelae in most of the examined parameters, the time from injury to the regaining of good pain-free function was significantly shorter in the aRTSA group. Therefore, we advocate early RTSA for acute PHFs in elderly patients to provide a quicker recovery and early return to good predictable outcomes with a much shorter period of pain and discomfort. In case of failed conservative treatment, malunion, or failed ORIF, salvage RTSA has the potential to provide a good outcome.

Disclaimer

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