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Functional Outcomes after Triceps Splitting versus Triceps Sparing Approach for Extra-Articular Distal Humerus Fractures

Jagdeep Singh, Anoop Kalia*, Anshul Dahuja, Kapil Bansal

Department of Orthopaedics, Guru Gobind Singh Medical College and Hospital, Faridkot, India
Email: jagatwal83@gmail.com, *kaliaanoop@gmail.com, anshuldahuja@gmail.com, kapilortho@gmail.com

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Abstract

Aim: To compare the functional outcome as well as elbow range of motion (ROM) after triceps splitting and triceps sparing approach for AO/OTA TYPE A distal humerus fractures. **Materials and Methods:** This is a prospective study done at our center between 2011 and 2014. A total of 50 patients presented with extra articular distal humerus fracture (AO/OTA 13 A2, 13A3). Exclusion criteria removed 16 patients from the study while 2 patients died due to medical comorbidities before the final follow up. Out of the remaining 32 patients, they were divided into two groups: triceps splitting (15 patients) and triceps sparing (17 patients). Elbow ROM, along with Disabilities of the Arm, Shoulder and Hand questionnaire scores, was compared between the two groups. **Results:** Triceps sparing group had greater elbow flexion (140.0 ± 4.0) compared to triceps splitting group (126.0 ± 10.0) with $p < 0.001$. Extension contracture was also significantly less in triceps sparing (5.0 ± 6.0) group as compared to triceps splitting group (24.0 ± 8.0) with $p < 0.001$. However, there was no statistically significant difference in terms of DASH scores between the two groups with DASH score being (24.28 ± 10.14) in the sparing group as compared to (30.41 ± 14.36) in the splitting group with $p = 0.169$. **Conclusion:** As compared to triceps splitting approach, triceps sparing approach results in better elbow ROM with less extension contracture, however both approaches result in similar functional outcome.

Keywords

Triceps Sparing, Triceps Splitting, Extension Contracture

1. Introduction

Extra articular distal humerus fractures can be tackled via both triceps splitting

as well as triceps sparing approaches. Schildhauer *et al.* [1] description of triceps sparing approach is actually an extension of bilaterotricipital approach described by Alonso-Llames [2]. Triceps sparing approach avoids direct injury to the triceps and uses bloodless planes and this is the primary reason for improved elbow ROM and less post operative elbow contracture seen after this approach as compared to triceps splitting approach which involves splitting of the muscle and thus denervating a portion of the muscle.

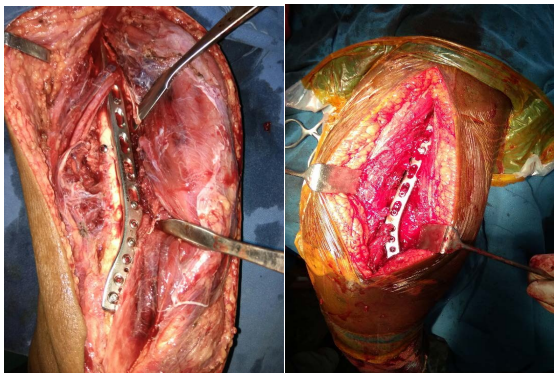
Remia *et al.* [3] compared triceps splitting versus triceps sparing approach and they found no statistically significant difference in elbow ROM and triceps deficit. However, their study was done on intra articular distal humerus fractures (AO/OTA TYPE C). Numerous studies have assessed the functional outcome of patients after the two approaches but these studies included mostly AO/OTA TYPE C fractures [4] and moreover none of these studies directly compared the triceps sparing approach against triceps splitting approach. Few authors [5] [6] [7] have compared triceps split approach to olecranon osteotomy approach. Emmanuel *et al.* [8] compared the outcomes after triceps splitting versus triceps sparing approach in extra articular distal humerus fractures (AO/OTA TYPE A) and they reported better elbow ROM and triceps strength with triceps sparing approach as compared to triceps splitting approach. However, both these approaches had similar functional outcome as per DASH scores.

2. Materials and Methods

After obtaining clearance from ethical committee, patients presenting with extra articular distal humerus fractures (AO/OTA TYPE A) were included in the study. During 2011-2014, 50 patients presented with extra articular distal humerus fracture. 16 patients were excluded from the study. Exclusion criteria included patients presenting with pathologic fracture, periprosthetic fractures, isolated lateral or medial epicondyle fractures (AO/OTA 13A1), compound injuries as well as any other illness like mental illness, dementia, Parkinson disease that would affect the post operative rehabilitation protocol. Patients were divided into two groups depending upon the surgical approach chosen by the operating surgeon. The choice of surgical approach was based on discretion of treating surgeon.

3. Surgical Approach

The triceps sparing approach was performed as described by Schildhauer *et al.* [1] where the triceps is elevated off the posterior border of intermuscular septum. The radial nerve was protected by tagging throughout the procedure and insertion of triceps onto the olecranon was not disrupted (**Figure 1**). The triceps split approach was done as described by Ziran *et al.* [9] in which the interval between the long and lateral head of triceps is located and separated to identify the medial head which is then split in such a fashion to maintain full thickness medial and lateral flaps (**Figure 2**).

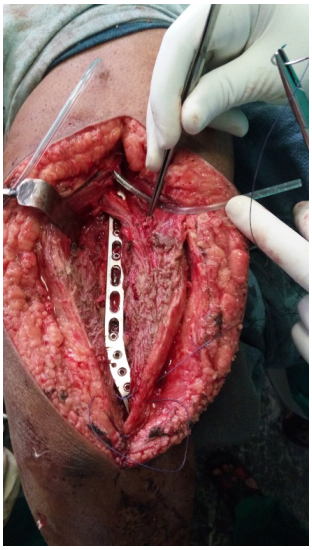


(a) (b)

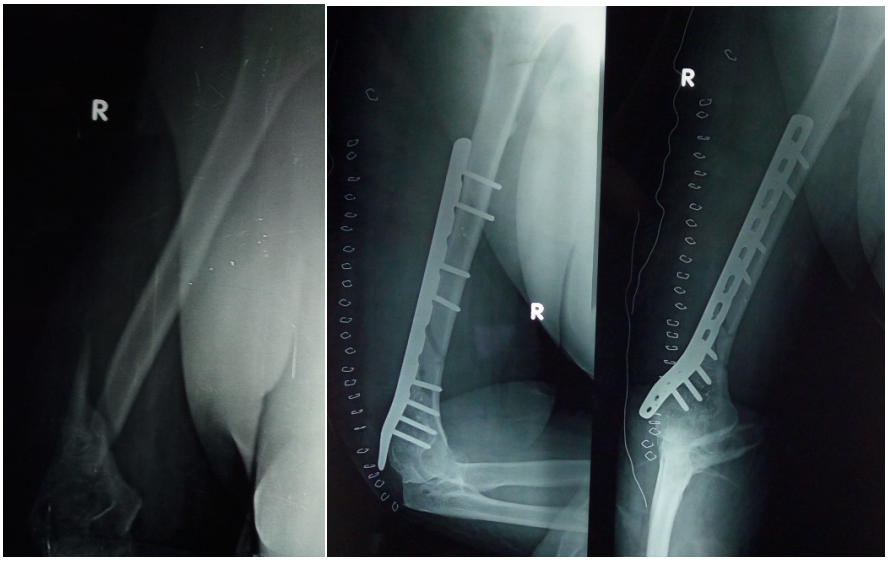
(c)

(d)

Figure 1. (a) Showing the retraction of triceps without disrupting its attachment from the olecranon and radial nerve being preserved. (b) Another case depicting tricep sparing approach. (c) Preoperative x-ray of the same case as in **Figure 1(b)**. Immediate postoperative x-ray of the same case as in **Figure 1(b)**.



(a)



(b) (c)

Figure 2. (a) Showing the triceps splitting approach with full thickness medial and lateral flaps and radial nerve seen proximally. (b) Pre-operative x-ray of the same Case as in **Figure 2(a)**. (c) Immediate postoperative x-ray of the same case as in **Figure 2(a)**.

After the exposure, the fracture site was identified and reduction was done either with or without lag screws depending upon the fracture morphology and an extra articular distal humerus plate was applied. The wound was washed thoroughly with saline and closure was done in layers over the negative suction drain.

4. Post Operative Protocol

The dressing was done on 3rd, 7th and 10th day with drain removal at first dressing and stich removal at 14 days. Elbow ROM was started as soon as the patients were comfortable. The patients were followed up there after every 2 months till

the clinical and radiological union occurred.

5. Final Assessment and Statistical Analysis

Elbow ROM which included the degree of flexion occurring at elbow joint and the degree of extension contracture was measured after the radiological and clinical union occurred using a hand held goniometer and was recorded. Post-operative range of motion measures were done by an independent evaluator and not by the treating surgeon. DASH scores were recorded for assessment of functional outcome [10]. Elbow ROM and DASH scores were compared between the two groups using student t test where $p < 0.05$ was considered significant.

The DASH questionnaire is given below in Table 1.

Table 1. A disabilities of the arm, shoulder and hand.

(a)

		NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1.	Open a tight or new jar.	1	2	3	4	5
2.	Write.	1	2	3	4	5
3.	Turn a key.	1	2	3	4	5
4.	Prepare a meal.	1	2	3	4	5
5.	Push open a heavy door.	1	2	3	4	5
6.	Place an object on a shelf above your head.	1	2	3	4	5
7.	Do heavy household chores (e.g., wash walls, wash floors).	1	2	3	4	5
8.	Garden or do yard work.	1	2	3	4	5
9.	Make a bed.	1	2	3	4	5
10.	Carry a shopping bag or briefcase.	1	2	3	4	5
11.	Carry a heavy object (over 10 lbs).	1	2	3	4	5
12.	Change a lightbulb overhead.	1	2	3	4	5
13.	Wash or blow dry your hair.	1	2	3	4	5
14.	Wash your back.	1	2	3	4	5
15.	Put on a pullover sweater.	1	2	3	4	5
16.	Use a knife to cut food.	1	2	3	4	5
17.	Recreational activities which require little effort (e.g., cardplaying, knitting, etc.).	1	2	3	4	5
18.	Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g., golf, hammering, tennis, etc.).	1	2	3	4	5
19.	Recreational activities in which you move your arm freely (e.g., playing frisbee, badminton, etc.).	1	2	3	4	5
20.	Manage transportation needs (getting from one place to another).	1	2	3	4	5
21.	Sexual activities.	1	2	3	4	5

(b)

		NOT AT ALL	SLIGHTLY	MODERATELY	QUITE A BIT	EXTREMELY
22.	During the past week, *to what extent* has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups? (*circle number*)	1	2	3	4	5
		NOT LIMITED AT ALL	SLIGHTLY LIMITED	MODERATELY LIMITED	VERY LIMITED	UNABLE
23.	During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem? (*circle number*)	1	2	3	4	5
Please rate the severity of the following symptoms in the last week. (circle number)						
		NONE	MILD	MODERATE	SEVERE	EXTREME
24.	Arm, shoulder or hand pain.	1	2	3	4	5
25.	Arm, shoulder or hand pain when you performed any specific activity.	1	2	3	4	5
26.	Tingling (pins and needles) in your arm, shoulder or hand.	1	2	3	4	5
27.	Weakness in your arm, shoulder or hand.	1	2	3	4	5
28.	Stiffness in your arm, shoulder or hand.	1	2	3	4	5
		NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	SO MUCH DIFFICULTY THAT I CAN'T SLEEP
29.	During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand? (*circle number*)	1	2	3	4	5
		STRONGLY DISAGREE	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	STRONGLY AGREE
30.	I feel less capable, less confident or less useful because of my arm, shoulder or hand problem. (*circle number*)	1	2	3	4	5

DASH DISABILITY/SYMPTOM SCORE = ([(sum of n responses/n) − 1] × 25, where n is the number of completed responses). A DASH score may not be calculated if there are greater than 3 missing items.

6. Results

6.1. Age and Sex

The mean age of the patients in triceps sparing group was 38.0 ± 5.0 while the mean age of the patients in triceps splitting group was 36.0 ± 6.0 with p value = 0.311 which was found to be statistically non significant. Out of the 15 patients in triceps splitting group, 7 were males and 8 were females while in the triceps paring group, out of 17 patients , 10 were males and 7 were females as shown in Table 2. The p value for gender distribution was > 0.05 and was non-significant.

6.2. Time to Union

The fractures in both the groups united uneventfully with no post operative radial nerve palsies in either group as shown in Figure 3.

The mean time of union in triceps sparing group was 12.0 ± 3.6 months while the mean duration of union in triceps splitting group was 11.8 ± 2.8 with p value = 0.863, which was found to be statistically non significant.

Table 2. Frequency distribution of sex in each group.

SEX	TRICEPS SPARING	TRICEPS SPLITTING
MALES	10	7
FEMALES	7	8
TOTAL	17	15

(a) (b)

(c)

Figure 3. (a) Pre-operative x-ray showing extra articular distal humerus fracture. (b) Immediate post-operative x-ray showing satisfactory reduction after application of extra articular distal humerus LCP. (c) Final follow up at 1 year showing solid union.

Radiological union was declared when three out of four cortices united on standard AP and lateral views and clinical union was confirmed when there was absence of pain or tenderness at fracture site.

6.3. Clinical Outcome

Triceps sparing group had greater elbow flexion (140.0 ± 4.0) compared to triceps splitting group (126.0 ± 10.0) with $p = 0.001$. Extension contracture was also significantly less in triceps sparing (5.0 ± 6.0) group as compared to triceps splitting group (24.0 ± 8.0) with $p < 0.001$.

6.4. Functional Outcome

The patients in both the groups were given DASH questionnaires which was assessed at the final follow up. However, there was no statistically significant difference in terms of DASH scores between the two groups with DASH symptom score being (24.28 ± 10.14) in the sparing group as compared to (30.41 ± 14.36) in the splitting group with $p = 0.169$.

7. Discussion

The aim of this study was to compare the clinical and functional outcome of extra-articular distal humerus fractures treated with triceps splitting and triceps sparing approaches. The true triceps sparing technique described by Schildhauer [1] is actually an extension of bilaterotricipetal approach described by Alonso-Llames [2]. Other approaches which were described by different authors [11] [12] were actually triceps reflecting approaches as they involved detachment of a part of extensor mechanism from the olecranon. But in true triceps sparing approach the triceps is not detached from olecranon and so theoretically less injury is caused to triceps muscle and this may help to reduce elbow contracture post operatively.

Various authors have compared the triceps splitting approach with olecranon osteotomy approach and have reported favorable results [5] [6] [7]. The triceps split approach does not utilize a true internervous intermuscular plane and theoretically can lead to greater scar formation but one study reported that triceps split approach does not appear to cause significant muscle dysfunction [11].

Remia *et al.* [3] directly compared a triceps sparing approach to a triceps splitting approach. They used triceps spring approach described by Bryan and Morrey [12] in nine of their patients with AO/OTA TYPE C distal humerus fractures and triceps splitting approach in 6 patients with AO/OTA TYPE C distal humerus fractures. They concluded that there was no difference in elbow ROM or triceps deficit.

Emmanuel *et al.* [8] compared the outcomes after triceps splitting versus triceps sparing approach in extra articular distal humerus fractures (AO/OTA TYPE A) and they reported better elbow ROM and triceps strength with triceps sparing approach as compared to triceps splitting approach. However both these

approaches had similar functional outcome as per DASH scores.

The limitations of this study are that sample size is small and the choice of surgical approach was based on discretion of treating surgeon.

8. Conclusion

Both the triceps splitting as well as triceps sparing approach can be used to treat extra articular distal humerus fractures (AO/OTA TYPE A). Both the approaches result in similar functional outcome but triceps sparing approach results in better elbow ROM and less extension contracture in the final follow up. We therefore recommend triceps sparing approach for treating extra articular distal humerus fractures based on our study.

Consent

The patient has given his informed consent for the case report as well as for his photographs to be published.

Conflict of Interest

Authors declare that they have no conflict of interest.

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