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Management of Extra-Articular Distal Humerus Fractures Using Triceps Splitting Versus Triceps Sparing

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ABSTRACT

Background: Treatment of extra articulardistal humeus fractures seen in traumatic population is to prevent the probable complications as joint stiffness, limitation of movement and joint deformity, by providing good fixation and early mobilization. The aim of the present study was to find the Better management and improving outcome of patients with extra-articular distal humerus fractures. **Patients and methods:** In this study included 24 patients were divided into two groups, 12 patients for Triceps sparing technique and 12 patients for triceps splitting technique. The mean duration of follow up was 7.4 ±3.4 months. A treatment protocol was designd for all patient by preoperative evaluation, intraoperative evaluation and post operative evaluationusing radiological assessment and clinical finding by MEPI and DASH score. **Results:** The mean age was 42.9 ± 9 in triceps splitting group and was 43.6 ± 9.7 in triceps sparing group. There was no statistically significant difference between two groups as regard intra-operative blood loss. The mean MEPI was 94.2 ± 4.7 with four excellent, five good, and three fair grades. The mean DASH score was 18.3 ± 3.3 points. The mean range of elbow flexion was143.3 ± 3.9. The mean range of elbow extention and contracture 8.6 ± 1.7 in group II. **Conclusion:** Triceps-splitting approach was found to afford adequate exposure of even the most complex fractures, and to allow for proximal extension when the fracture had proximal extension.But this approachinvolves splitting of the muscle and thus denervating a portion of the muscle and disruption of the extensor mechanism requiring postoperative protection and the risk of triceps dehiscence.

Keywords: Triceps Splitting ; Articular distal Humeus Fractures ; Triceps Sparing

INTRODUCTION

Fractures of the adult extra-articular distal humeral diaphysis are relatively rare, However, the combination of the complex anatomy of the distal part of the humerus and complicated fracture morphology creates a challenge for the treating surgeon **[1]**. Distal humerus fractures had gained a reputation for universally poor outcomes regardless of treatment modality which may be conservative or surgical **[2]**.

Surgical treatment provides more predictable alignment and potentially quicker return of function . These fractures can be addresed with either triceps spliting or triceps sparing approach. Extra articular distal humerus fractures can be tackled via both triceps splitting as well as triceps sparing approaches **[3]**.

The triceps sparing approach was performed by lateral window was developed on the lateral side of the triceps as it is elevated off the posterior border of the intermuscular septa and posterior humerus .The radial nerve was identified, mobilized in a tension-free technique and protected during the procedure. This split was extended distally over the olecranon in a subperiosteal fashion, maintaining full-thickness medial and lateral fascial sleeves, thereby maintaining continuity with the flexor carpi ulnaris and anconeus **[4]**.

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 Triceps splitting approach provides adequate exposure of articular fracture **[5]**.

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Triceps splitting approach which involves splitting of the muscle and thus denervating a portion of the muscle for surgical treatment of extra-articular distal humerus fractures can result in better elbow ROM and triceps strength than a triceps splitting approach Both approaches had similar result in reliable union and similar functional outcome **[6].** Therefore, this study aimed to find the Better management and improving outcome of patients with Extraarticular Distal humerus fractures.

PATIENTS AND METHODS

A prospective study was conducted involving 24 cases with extra articular distal humers fractures. All patients were operated at Zagazig University and El mataria Teaching Hospitals. All cases were surgically managed by open reduction of the fractures and internal fixation by triceps splitting approach (12cases) or triceps sparing (12cases) approach.The follow up period of the cases ranged from 6 to 12 months.

Inclusion criteria:

Adult Patients with displaced extra articular distal humerus fractures who surgically fit patients.

Exclusion criteria:

1) Open fractures of extra articular distal humerus fractures.
2) Intra articular fractures of distal humerus fractures.
3) Pathological fractures.
4) Surgically unfit patients.

Clinical Examination:

A comprehensive general examination of each patient was performed. After stabilizing the patient's general condition, local clinical examination was performed with particular emphasis. Complete neurovascular examination of the involved upper extremity: assessment of peripheral arterial pulsation at the affected extremity was performed to detect any possible insult

Radiological Evaluation:

The aim of preoperative radiological evaluation was to determine the fracture type, understand the fracture pattern, detect associated fractures or dislocations and bone stock of the fragments.

Plain radiography in all patients antroposterior and lateral views were done included the ipsilateral shoulder and elbow jointsin order to exclude either fracture extension or an associated injury to the joint. Computed tomography (CT) was used in 3 cases (12.5%)where reveal a suspicion of a possible distal intrarticular fracture **[7]**.

Plan of treatment:

The plan of treatment in this work has been based on the preoperative clinical and imaging findings,together with the intraoperative findings.

Operative Techniques: Patients were operated under complete aseptic condition to the affected elbow.

Open reduction: The operations were performed under general anesthesia in all patients. The patient was placed on the operating table in theprone (3 cases) orlateral decubitus position(21cases).The injured arm wasplaced on a support allowing at least 90° of elbow flexion. The entire limb wasprepared circumferentially and draped free in the operative field. A tourniquet was avoided because of the potential for limitation of distal triceps elevation. A broad spectrum antibiotic prophylaxis was administered preoperatively at the time of induction of anesthesia **[8]**.

A. <u>Triceps splitting Approach:</u>

A midline surgical approach is made to the fascial level. At this point, the triceps is divided in its midline unless there are tears in the extensor mechanism, in which case, they are incorporated into the surgical incision in the best manner possible .If the tears are sufficiently distant from the midline, they are simply repaired, and the midline approach is used. On the proximal aspect (triceps),

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electrocautery may be used. On the distal aspect, the fascia is split along the ulnar crest, and care must be taken not to buttonhole through the fascial sleeves.There is minimal undermining, and the medial and lateral muscle masses are elevated en masse .Extreme care is required around the medial aspect of the exposure, and identification of the ulnar nerve, either directly or by palpation, is recommended. Frequent flexion and extension of the elbow facilitates the exposure. Triceps-splitting approach was found to afford adequate exposure of even the most complex fractures, and to allow for proximal extension when the fracture had proximal extension **[9].**

Triceps sparing Approach:

The approach starts with an extensilemidline posterior skin incisionposterior incision between the lateral and medial brachial cutaneous nerves isperformed, curving laterally around the olecranon. It is continued about 5 to 8 cm distal to the olecranon tip. The fascia overlying the triceps brachii is identified,split in the midline, and elevated with the dermis andsubcutaneous tissue, creating two fasciocutaneous flaps.Dissection is continued to the lateral and medial tricepsborders at their respective interfaces with the posterior aspects of the intermuscular septae **[8]**. Fracture reduction can then be performed after cleaning of the fragments off debris, and with indirect manipulation under fluoroscopic control in two planes.

Post-operative Care:

Patient Transfer procedurewas supervised. The arm was held in a pouch arm sling.The patient was observed generally, the vital signs; was checked Pulse oximeter was applied to record the pulse and the oxygen saturation.

Follow up

Mayo Elbow Performance Index (MEPI) scoring system for assessment of the recovery of the elbow joint following trauma. This system assesses motion in terms of flexion and extension. Neither strength nor deformity is included in the content of the scale. Function and motion are weighted less heavily than pain **[10].** In the last follow up visit,all the patients were evaluated clinically by MEPI score and DASH

Statistical analysis:

Data were checked, entered and analyzed using SPSS version 23. Data were expressed as number and percentage for qualitative variables and mean ± standard deviation (SD) for quantitative one. Mann Whitney test and Chi- square test (X2)were used. For all above-mentioned statistical tests done, the threshold of significance was fixed at 5% level (P-value), P value of > 0.05 indicates non-significant results and P value of < 0.05 indicates significant results.

RESULTS

The mean age was 42.9 ± 9 (R:28-59) in group I (triceps splitting),and was43.6 ± 9.7 (R:27-54) in group II (triceps sparing), 12 patients were operated by splitting approach (group I),there were 6 male(50%) and 6 female(50%).12 patients were operated by sparing approach (group II),there were 7 male (58.3%) and 5 female(41.7%). There were 8 patients (66.7%) with right side injury and 4 patients(33.3%) with left side injury in group I (triceps splitting). There were 5 patients (41.7%) with right side injury and 7 patients (58.3%) with left side injury in group II(triceps sparing). Mechanism of injury involved a fall to ground5 cases (41.7%) and road traffic accident 7cases (58.3%) in group I (triceps splitting). The mechanism of injury involved a fall to ground7 cases (58.3%) and road traffic accident5cases(41.7%)in group II (triceps sparing). There were2 cases with hypertension and one caseh as Diabetes Mellitus and hypertensionin group I (triceps splitting). There were3 cases with hypertension and one casehasDiabetes Mellitus and hypertension in group II (triceps sparing). Five (41.7%) patients had a type-A2 fracture,one (8.3%) had a type- A3 and six (60%) hadhigh level injury

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in group I (triceps splitting).Six (50%)patients had a type-A2and six (50%) hadhigh level injury in group I (triceps splitting). The mean time from injury to surgerywas3.3± 1.4 (R:2-5) in group I(triceps splitting),and was 4.1± .99 (R:2-5) in group II (triceps sparing) **(Table 1).** The mean intraoperative blood loss was 370.8 ± 58.2 (R:250–450cc) in group I (triceps splitting),and was 325 ± 65.7 (R:250–450cc) in group II(triceps sparing). However there was no statistically significant difference between two groups as regard intra-operative blood loss. The mean operation time was 122.9±8.5 min (R: 105–140) in group I (triceps splitting), and was 84.60 ±17.4 min (R:70-120) in group II (triceps sparing). However there was no statistically significant difference between two groups as regard operative time **(Table 2).**

In Group I (triceps splitting) showed the mean MEPI was 82.9 ± 3.3 (R: 70 to 90), with seven excellent, three good, and two fair grades. The mean DASH score was 28.8 ± 4.8points (R: 20 to 35). The mean range of elbow flexion was 131.3 ± 4.3 (R: 125-135). The mean range of elbow extention and contracture was 24.2 ± 1.9 (R: 15-30) in group I **(Table 3).** In GroupII (triceps sparing) showed the mean MEPI was 94.2 ± 4.7 (R:85 to 100), with four excellent, five good, and three fair grades. The mean DASH score was 18.3 ± 3.3 points (R:15 to 25). The mean range of elbow flexion was143.3 ± 3.9 (R:135 to 145). The mean range of elbow extention and contracture 8.6 ± 1.7(R: 6to 15) in group II **(Table 4).** Regarding complications in Group I (triceps splitting) There was one case of infection.(8.3%)There was one case of radial nerve palsy (8.3%) and one case of non union (8.3%). In Group II (triceps sparing), there was one case of infection.(8.3%)
-There was one case of implant failure (8.3%) **(Table 5).**

Table 1 :Demographic data among the studied groups

Variable	Group I (Triceps splitting) N=12		Group II (triceps sparing) N=12		t-test	P-value
Age (years): Mean ± SD Range	42.9 ± 9 28-59		43.6 ± 9.7 27-54		-0.174 (MW)	0.863
Variable	N	%	N	%	χ 2	P-value
Sex:						
Male	6	50	7	58.3	0.168	1
Female	6	50	5	41.7		
Affected side:						
Right	8	66.7	5	41.7	1.5	0.414
Left	4	33.3	7	58.3		
Mechanism of injury						
FTG	5	41.7	7	58.3	3.7	0.297
RTA	7	58.3	5	41.7		
Comorbidities:						
No	9	75	7	58.3	1.5	0.694
Diabetes mellitus	0	0	1	8.3		
Hypertension	2	16.7	3	25		
Diabetes and hypertension	1	8.3	1	8.3		
Fracture type:						
A2	5	41.7	6	50	1.1	0.580
A3	1	8.3	0	0		
High	6	50	6	50		
Time from injury to surgery (days): Mean ± SD Range	3.3 ± 1.4 2-5		4.1 ± 0.99 2-5		-1.6 (t-test)	0.127

Table 2: Intra-operative blood loss and operative time among the studied groups

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Variable	Group I (Triceps splitting) N=12	Group II (triceps sparing) N=12	t-test	P-value
Intra-operative blood loss (cc):				
Mean ± SD	370.8 ± 58.2	325 ± 65.7	1.8	0.08
Range	250-450	250-450		
Operative time :				
Mean ± SD	122.9±8.5	84.60 ±17.4	-1.6	
Range	(105–140)	(70-120)	(t-test)	0.127

Table 3:MEPS, DASH and range of elbow flextio - extention and contracture in group I:

Variable	Results
MEPI:	
Mean ± SD	82.9 ± 3.3
Range	70-90
DASH score:	
Mean ± SD	28.8 ± 4.8
Range	20-35
Range of elbow flexion:	
Mean ± SD	131.3 ± 4.3
Range	125-135
Range of elbow extension and contracture:	24.2 ± 1.9
Mean ± SD	15-30
Range	

Table 4:MEPI, DASH and Range of elbow flextion-extention and contracture in group II:

Variable	Results
MEPI:	
Mean ± SD	94.2 ± 4.7
Range	85-100
DASH score:	
Mean ± SD	18.3 ± 3.3
Range	15-25
Range of elbow flexion:	
Mean ± SD	143.3 ± 3.9
Range	135-145
Range of elbow extension and contracture:	
Mean ± SD	8.6 ± 1.7
Range	6-15

Table 5: Complications among the studied groups:

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Variable	Group I (Triceps splitting) N=12		Group II (triceps sparing) N=12		$\chi 2$	P-value
	N	%	N	%		
Complications:						
• *Infection*	1	8.3	1	8.3		
• *Implant failure*	0	0	1	8.3	2.9	0.404
• *Radial n palsy*	1	8.3	0	0		
• *Non-union*	1	8.3	0	0		

DISCUSSION:

Distal humeral fractures involve the supracondylar region of the humerus and/or the articular surface of the distal part of the humerus **[11]**. The history should determine the mechanism of injury, the energy level, and the time since injury. In patients with high energy injuries, physical examination be done to identify systemic injures and associated fractures.Extensive medical comorbidities often can preclude safe surgical intervention and non operative management may be required **[12]**.

In the present study, extra-articular distal humeral diaphysis fractures can be addresed with either triceps splitting approach or triceps sparing approach. In the current study, 24 patients were divided into two groups,12 patients for Triceps sparing technique and 12 patients for triceps splitting technique.

In this study, the mean operation time was 122.9±8.5min(R: 105–140)in group I (triceps splitting),and was 84.60 ±17.4 min (R:70-120) in group II(triceps sparing).Howevere there was no statistically significant difference between two groups asregard operative time. **Yin et al. [13]** reported the mean operation time in group I (triceps splitting) was 132.15±11.845 min (R:108–153), and was 129.40 ±11.337min(R: 106–157) in group II(triceps sparing).

Also, **Yang et al. [14]** reported the mean operation time was 122.98 ±8.5 min (range 105–140) in groupI (triceps splitting),and was 104.60 ±17.4 min (R:100-130) in group II (triceps sparing).

In this study ,the mean intraoperative blood loss was 370.8 ± 58.2 (R:250–450cc) in group I(triceps splitting),and was325 ± 65.7 (R:250–450cc) in group II(triceps sparing).Howevere there was no statistically significant difference between two groups asregard operative time.[table 4]. **Yin et al. [13]** reported the mean intraoperative blood loss was 290.80±7.797 cc (R:275–310) in group I (triceps splitting),and was 293.19 ± 8.386 cc (R:280–310) in group II (triceps sparing).

In this study,there was one case of infection.(8.3%), one case of radial nerve palsy (8.3%) andone case of non union (8.3%),in group I (triceps splitting).There was one case of infection.(8.3%),there was one case of implant failure (8.3%) in group II (triceps sparing). **Yatinder et al. [15]** revealed one patient had a flexion deformityin group II (triceps sparing).

Triceps-splitting approach was found to afford adequate exposure of even the most complex fractures, and to allow for proximal extension when the fracture had proximal extension.But this approachinvolves splitting of the muscle and thus denervating a portion of the muscleand disruption of the extensor mechanism requiring postoperative protection and the risk of triceps dehiscence **[16]**.

Triceps sparing approach avoids direct injury to the triceps and uses bloodless planes. But this approach is limited visualization of the articular surface of the distal humerus.

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The limitations of this study was the numbers of patients was limitedand the follow up period was short.

CONCLUSION:

Triceps-splitting approach was found to afford adequate exposure of even the most complex fractures, and to allow for proximal extension when the fracture had proximal extension.But this approachinvolves splitting of the muscle and thus denervating a portion of the muscle and disruption of the extensor mechanism requiring postoperative protection and the risk of triceps dehiscence.

No Conflict of interest.

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