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Original Article

Triceps Sparing Approach for Fixation of Distal Humerus Fractures in Adults

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ABSTRACT

Background: Distal humerus fractures had acquired an attention due to poor outcomes regardless of treatment modality which may be conservative or surgical. These fractures can be addressed with either triceps splitting or triceps sparing approach. 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.

Objective: The current work aimed to evaluate the outcome of surgical treatment of fracture distal humerus through triceps sparing approach.

Patients and methods: A prospective, descriptive clinical study had been conducted at the Department of Orthopedic Surgery [Al Mataria Teaching Hospital, Egypt]. The study included 33 patients, and the average follow up was 12 months. The study completed from December 2018 to May 2020. Pain, clinical and radiological outcomes had been assessed and documented. Preoperatively, all patients had been clinically and radiologically evaluated. In addition, laboratory investigations had been performed to assess the fitness of the patient.

Results: The study participants were 25 males and 8 females. Their age ranged between 30 and 55 years [mean age 43.09±7.93 years]. The mean quick Disabilities of the Arm, Shoulder and Hand [DASH] score was 18.3±3.3 points [ranged between 15 and 25]. The mean range of elbow flexion was 143.3 ± 3.9 degrees [135-145], while the mean range of elbow extension and contracture 8.6 ± 1.7 degrees [6-15]

Conclusions: Triceps sparing avoids direct triceps injury with bloodless fields. However, a limited articular surface visualization of the distal humerus is an evitable drawback.

Keywords: Total Elbow Arthroplasty; Distal humerus; fixation; Triceps sparing; Fractures.

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* Main subject and any subcategories have been classified according to the research topic.

INTRODUCTION

Distal humerus fractures are a challenging condition, due to its poor outcome regardless of conservative or surgical treatment modalities [1]. These fractures are most often the result of direct [e.g., direct blow to the affected limb] or indirect trauma [e.g., foreign object or fall on the ground]. In addition, high-energy mechanisms are due to a motor car or motorcycle accident. Distal humerus fractures have also even been reported in cases of projectile injury. Patient age is usually an incorporating factor in whether the mechanism is of low- or high-energy [2].

The conservative treatment achieved by the cast immobilization. However, surgical treatment provides more predictable alignment and a quicker return to function. These fractures can be managed by triceps splitting or sparing approaches [3].

The triceps sparing approach is associated with low intramuscular adhesion and scar formation. It theoretically lower the potential for elbow contracture and enhances the post-operative triceps function [4].

Triceps sparing technique escapes direct triceps trauma and performed with bloodless planes. This is the principal cause for improved elbow range of motion [ROM] and less postoperative contractures of the elbow [3].

Here we presented our clinical experience with triceps sparing approach for distal humerus fractures. We expected better and improvement outcome.

AIM OF THE WORK

The current work aimed to evaluate the results of surgical intervention for distal humerus fractures through triceps sparing approach.

PATIENTS AND METHODS

This was a prospective, descriptive, clinical study, included 33 patients [convenient sample], presented with fracture distal humerus. All were selected from El-Mataria Teaching Hospital, Ministry of Health, Egypt. The study completed between December 2018 to May 2020.

The age ranged between 30 and 55 years. The mechanism of injury was road traffic accidents [RTA] and falling on the ground [FOG]. Every patient was instructed about the study and signed a written informed consent for participation [available on request].

His/her privacy, confidentiality and withdrawal right

were guaranteed. Additionally, the administration and research ethics committee approval was obtained [IRB#00012367-31-9-2018].

The exclusion criteria were open fractures, intra articular fractures of distal humerus, pathological fractures and surgically unfit.

Preoperative evaluation consisted of inquiry about all medical history data, a detailed clinical examination [general and local examinations] and standard laboratory investigations. A plain x-ray [figure 1] was the preoperative radiological assessment method.

Surgical technique: A broad-spectrum antibiotic was administered as a prophylactic drug, one hour pre-operatively. All operations were completed under general anesthesia. The patient was positioned in the lateral decubitus position. The injured arm was supported to permit elbow flexion of at least 90°. Then, an extensile midline posterior skin incision, curving laterally around the olecranon, was performed. The fascia over the triceps brachii was recognized, splitted in the midline, and raised enblock with the dermis and subcutaneous tissues. The triceps was separated from the posterior aspect of the intermuscular septum. Laterally, the radial nerve with concomitant vessels were recognized. The posterolateral aspect of the humeral shaft was reached by the triceps muscle elevation and medial retraction from the posterior periosteum. Medially, the ulnar nerve was identified and exposed proximally in the posterior compartment. Distally, the ulnar nerve was released from the cubital tunnel and dissected to its first branch. Medial paratricipital dissection through the intermuscular septum posterior border exposes the posteromedial aspect of distal humerus. Connection of the medial and lateral dissections by mobilization and triceps elevation from the fracture and posterior periosteum permits visualization of the whole posterior distal humerus [figure 2]. Fracture reduction was performed with internal fixation with anatomical locked plate for distal humerus. The wound was closed in layers over a drain, which was removed after 48 hours.

Post-operative care and follow up: The arm was held in a pouch arm sling. Postoperative intravenous broad-spectrum antibiotic for 72 hours was given, then oral for 4 days. Stitches were removed after 2 weeks. A well-structured rehabilitation program was followed that was begun from the third post-operative day. The immobilizer was used for 2 to 4 weeks postoperatively. All patients had been evaluated clinically at discharge, at six and twelve postoperative months. The radiological outcome had been carried out at 2, 6 and 12 weeks, then after 6 and 12 months [Figures 3 to 5].

The evaluation done according to the Quick Disabilities of the Arm, Shoulder and Hand [DASH] system [5].

Statistical analysis: The collected data were coded [anonymized], and fed to personal computer through Microsoft excel software. Then, transferred to the statistical package for social science [SPSS] for windows, version 16

[SPSS Inc., Chicago, USA]. The qualitative variables were presented in the form of their relative frequency and percentages, while quantitative data were presented as mean, and standard deviations. In addition, minimum and maximum values were calculated as an indication of the range.



Figure [1]: Preoperative -ray showed distal humeral fracture

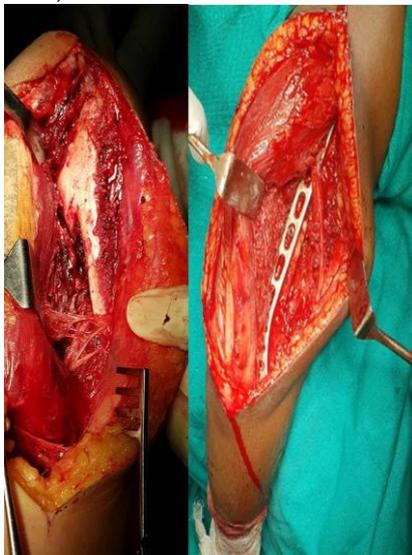


Figure [2]: Operative image showing exploration and previous prosthesis



Figure [3]: Immediate postoperative x-ray showed a good fracture fixation

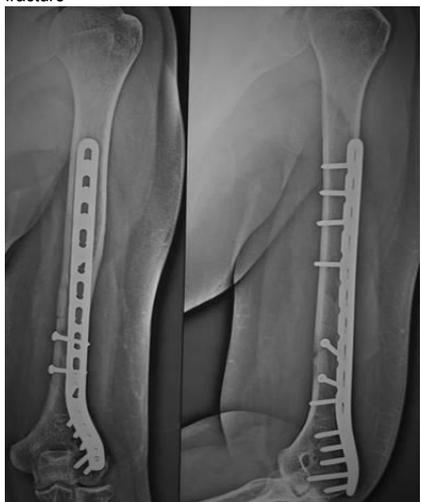


Figure [4]: Last follow up X-ray of the same patient



Figure [5]: Last follow up clinical image reflecting ROM at the elbow

RESULTS

The current work included 33 patients [25 males and 8 females]. The mean age was 43.09 ± 7.93 years [ranging between 30 and 55 years]. There were 8 housewives, 14 workers, 5 farmers, and 6 employees. The mean intraoperative blood loss was 346.36 ± 60.71 [250–450cc]. The mean operative time was 92.72 ± 15.81 minutes [70–120]. The mean quick DASH score was 20.87 ± 3.17 points

[15 to 25]. The mean range of elbow flexion was 140.45 ± 3.82 degrees [135–145]. The mean range of elbow extension and contracture 9.96 ± 2.98 degrees [6–15] [Table 1]. Radiological outcome revealed that, union achieved in all patients. The mean time of bone union was 14.8 ± 0.72 weeks [12–20]. There were no non-union.

Regarding complications, there was one superficial wound infection [3.03%] that resolved with debridement and antibiotics.

Table [1]: Data of studied patients

Variable		Statistics
Age [mean±SD]; min. – max.		43.09±7.93; 30-55
Sex [n,%]	Male	25[75.8%]
	Female	8[24.2%]
Mechanism of injury [n,%]	RTA	15[45.5%]
	FOG	18[54.5%]
Intraoperative blood loss [ml] [mean±SD]; min. – max.		346.36±60.71; 250-450
Operative time [minutes] [mean±SD]; min. – max.		92.72±15.81; 70-120
DASH score [mean±SD]; min. – max.		20.87±3.17; 15-25
Elbow flexion [°] [mean±SD]; min. – max.		140.45±3.82; 135-145
Elbow extension [°] [mean±SD]; min. – max.		9.96±2.98; 6-15
Complications	Yes	1[3.03%]
	No	32 [96.97%]

RTA: road traffic accident; FOG: Falling on the ground; DASH: Disabilities of the Arm, Shoulder and Hand

DISCUSSION

Because long-term elbow immobilization leads to stiffness, the conservative management protocols in distal humeral fractures play a role for inoperable geriatrics [6]. The dispute for a triceps-sparing rather than a triceps-splitting [detaching] approach used in young active adults with distal humerus fracture was further reinforced by the expanded elbow range of motion [ROM] as well as preservation of the triceps strength that has been shown in the muscle-sparing technique [7].

The two techniques provided a good-enough access for fracture reduction, fixation and application of 90/90 or parallel fixation plates [8].

In the current study, ORIF was applied for 33 patients with distal humerus fractures through triceps-sparing approach. The mean elbow flexion was 140.45±3.82 degrees [135-145], and the mean elbow extension was 9.96±2.98 degrees [6-15]. Radiological outcome was achieved in all patients. The mean time of bone union was 14.8 ± 0.72 weeks [12-20].

Yorukoglu *et al.* [9] reported that, the general function of affected extremity [DASH-T] was perfect [27.14 ± 25.66], and the performance of elbow joint was good, after using distal medial locking plates for extra-articular distal humeral fractures. Additionally, Ali N. *et al.* [10] reported that mean flexion at elbow was 127±12.07° [95 to 145] and all the patients had flexion extension arc movement of more than 100° at the elbow joint at final follow up.

Furthermore, Illical *et al.* [11] proved that the triceps sparing is associated with better ROM of the elbow than the triceps-detaching approach, with significant improvement of elbow flexion and reduced extension contracture. The triceps strength also favored the triceps-sparing approach when compared to healthy arm.

Jagdeep *et al.* [3] reported that, the mean time of bone union was 11.8 ± 2.8 in triceps splitting, and 12.0 ± 3.6 months in triceps sparing with non-significant difference. The mean elbow flexion was 140.0 ± 4.0 and 126.0±10.0 in triceps sparing and triceps splitting groups respectively, with significant difference. Extension contracture was also significantly lower in triceps sparing than triceps splitting [5.0 ± 6.0 vs 24.0±8.0]. In this study, the mean quick DASH score was 18.3 ± 3.3 points [15 to 25]. Illica *et al.* [11] reported that, the mean DASH score was [14.45 ± 12.17] in triceps sparing. Jagdeep *et al.* [3] reported that, the mean DASH score was [24.28 ± 10.14] in triceps sparing.

More recently, Solarz *et al.* [12] reported that, the functional strength and DASH scores were significantly better in the triceps sparing than triceps detaching techniques. However, the range of motion, and postoperative pain were comparable between both techniques. They concluded that, triceps sparing preserve postoperative triceps function and strength after revision surgery, regardless of the approached used in previous surgeries.

In pediatrics, Kokly *et al.* [13] reported that, triceps sparing is an effective and safe approach who preserved the extensor mechanism with no ulnar nerve injury, acceptable cosmetic appearance of the scar with postoperative satisfactory function.

A meta-analysis by Lu S, *et al.* [14] concluded that, triceps-sparing approach is superior to olecranon osteotomy, regarding the operative duration, blood loss, and complications. Both techniques were comparable regarding excellent/elbow function.

Most recently and reflecting the important of the current work, Meijering *et al.* [15] registered a large trial to establish a consensus on the ideal approach for total elbow arthroplasty [triceps sparing vs. triceps detaching]. They

suggested that, no consensus is present on the best surgical approach. Their results will greatly add to the available evidence.

Finally, Zhang *et al.* [16] found a better functional outcome for C1 and C2 distal humerus fractures using the triceps sparing rather than olecranon osteotomy.

The limiting steps of the current work included the small number of included cases and absent comparative group. These shortages prevent globalization of the results. However, results added to the available evidence, supporting the use of triceps sparing approach, especially for the rate of union [effectiveness] and low or absent complications [safety].

In conclusion, triceps sparing for distal humeral fractures avoids direct injury of triceps muscle and assures bloodless planes. However, a limited field visualization is an evitable drawback. This approach is associated with better ROM at the elbow joint and less extension contractures.

Financial and Conflict of interest disclosure

None

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International Journal

The background of the cover is a light blue gradient. It features a faint, semi-transparent ECG (heart rate) line running across the top and bottom. In the center, there is a globe of the Earth, and a stethoscope is draped over it, with its chest piece on the left and its ear pieces on the right. The overall theme is medical and global.

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