

Functional Outcome in Triceps Muscle Sparing Versus Muscle Splitting Approach in Pediatric Supracondylar Humerus Fracture

Kamran Asghar, Shakir Nazir, Nouman Maqbool

ABSTRACT

Objective: To determine the functional outcome of posterior triceps muscle sparing versus muscle splitting approach in supracondylar humerus fracture in children.

Methods: This prospective randomized controlled study was conducted from September 2014 to March 2016. Thirty-eight patients from pediatric age group (5 to 14 years) and either gender side with the delayed presenting (4.97 ± 1.69 days) supracondylar humerus fracture [SHF], Gartland type III. Patients were randomly divided into group A (triceps muscle sparing approach) and group B (triceps muscle splitting) each having 19 patients, for Open Reduction and Internal Fixation [ORIF]. Functional outcome was determined in outpatient department on follow up using Gruber and Healy scoring system.

Results: Out of 38 patients, 24 (63.1%) were male and 14 (36.8%) were females. The mean age of the patients in our study was 9.13 ± 4.97 years and the mean delay in presentation was 4.97 ± 1.69 days. These patients were randomly divided into group A and group B, each having 19 patients. Group A patients underwent triceps muscle sparing technique while group B had triceps muscle splitting technique. The success of either procedure was assessed by functional outcome using Gruber and Healy score on progressive follow ups in outpatient department. The fractures in group A united radiologically in a mean duration of 7.52 ± 1.46 weeks, while in group B the mean duration of union was 8.12 ± 1.34 weeks. We found that the muscle sparing approach had excellent functional outcome in 18 (94.73%) patients as compared to 09 (47.36%) patients in muscle splitting (group B) which was significant, p value < 0.05 .

Conclusion: Supracondylar humerus fractures requiring open reduction and fixation in children with triceps muscle sparing technique had better functional outcome than triceps muscle splitting approach.

Key Words: Supracondylar humerus- fracture [SHF], triceps splitting approach, triceps sparing approach.

This article may be cited as:

INTRODUCTION

Supracondylar humerus fracture [SHF] is a common entity in children which requires surgical intervention [1]. It consists of about 15% of all pediatric age group fractures [2]. The SHF has two types, extension type (98%) and flexion type (2%). Gartland further divided the extension type SHF into three types depending upon the displacement i.e. type I (without displacement), type II (with displacement but intact

posterior cortex) and type III (with displacement and disruption of both cortices) [3]. Close reductions and percutaneous fixation with Kirschner wires is usually required in most of cases, but patients with gross displacement, delayed presentation, flexion type of SHF and failure of close reduction require open reduction and internal fixation [4-7]. In sub-continent, lack of health insurance system local quacks intervention significantly delays the definitive treatment. In such situations, the orthopaedic surgical intervention becomes inevitable [8]. Controversies exist regarding the best surgical approach for supracondylar humerus fracture. Literature regarding triceps muscle splitting and muscle sparing approaches show variable results [9,10]. The rationale of the study

*Orthopaedic Foundation University Medical College
DHA 1, Islamabad*

Correspondence: Dr. Kamran Asghar

Email: thekmcite@hotmail.com

was to determine the optimal functional outcome in supra condylar humerus shaft fracture in children by comparing two operative technique i.e. triceps muscle sparing and triceps muscle splitting approach after radiological and clinical union.

Hypothesis of the study was that functional outcome in triceps muscle sparing approach was better than triceps muscle splitting approach.

METHODS

This prospective randomized controlled study was conducted from September 2014 to March 2016, which included 38 patients. Out of 38 patients, there were 24 (63.14%) males and 14 (36.84%) females. The mean age of patients included in the study was 9.13 ± 4.97 years. The patients included in the study had Gartland type III extension type supracondylar fracture with intact distal neurovascular status. The time duration between the injury and presentation to hospital was 4.97 ± 1.69 days, because of referrals from the remote areas of Pakistan or negligence by the parents. We did not include the patients with compartment syndrome and open type supracondylar fractures which may alter the outcome of the surgical procedure.

The patients were evaluated by taking complete history and managed initially in the emergency department according to Advanced Trauma Life Support (ATLS) protocol. The injured limb was evaluated for deformity, swelling, skin condition, and neurovascular status and compartment syndrome. Radiographic evaluation was done for the site, type and callus formation at the fracture.

All the patients with either gender, affected shoulder side, fulfilling the inclusion criteria were prospectively randomized through consecutive sampling and assigned to group A and B, each having 19 patients. The patients in group A were treated with Open Reduction and Internal Fixation (ORIF) via posterior triceps muscle sparing approach first introduced by Erpelding and Mailander in 2012 [11], while group B patients were treated with ORIF via posterior triceps muscle splitting approach. All the patients were in lateral position with arm and elbow supported on arm rest under general anesthesia and tourniquet control. Midline incision with two third above the elbow and one third below the elbow was made. After skin and soft tissue dissection, ulnar nerve was identified and isolated to avoid any iatrogenic injury along with lateral dissection between antero-lateral border of triceps and intermuscular septum to

avoid injury to radial nerve and profunda brachii artery [11]. In group A patients, sharp scalpel was used to separate the anteriomedial and anteriolateral borders of the triceps muscle to create an interval and elevate the bulk of muscle with index finger of both hands. The fracture was manipulated with the fingers and reduced satisfactorily and fixed with two cross Kirschner wires. While in group B the triceps was incised in inverted v shaped incision and dissected downwards from medial and lateral intermuscular septum. The fracture was reduced under direct vision and fixation of the fracture was done with two cross Kirschner wires. The triceps muscle was re-stitched with interrupted absorbable sutures. Soft tissue and skin closure was done after deflating the tourniquet and achieving the hemostasis. Post-operative x-ray was done on next day to confirm the reduction and proper placement of wires. In both the groups the wires were left outside the skin for easy removal in OPD at follow up under local anesthesia. Splint was used in 90 degrees elbow flexion for two weeks. Skin stitches and splint were removed after two weeks. Post-operative Physiotherapy protocol was advised after splint removal and patient was started on passive range of motion at wrist and elbow for one week, followed by active range of motion exercises in the presence of Kirschner wires and then extensive ROM exercise after Kirschner wires were removed at 6 weeks under local anesthesia in outpatient department. Monthly follow up was done with examination and radiographs for the evidence of healing and callus formation and functional outcome was assessed by Gruber and Healy score, which determined by the degree of loss of elbow extension after surgery at three months post operatively [12]. These patients were categorized as excellent (0-4 degree), good (4-8 degree), fair (8-12 degree) and poor (> 12 degree). Table 3.

RESULTS

Out of 38 patients, there were 24 (63.14%) males and 14 (36.84%) females. The mean age was 9.13 ± 4.97 years. 29 (76.31%) patients had right supracondylar humerus fracture while 9 (23.68%) had left sided humerus fracture. The mean delay in the presentation since the time of injury was 4.97 ± 1.69 days. Post-operative follow up was done for 12 weeks. These patients were randomly allocated to group A (triceps muscle sparing approach) and group B (triceps muscle splitting approach). The success of either procedure was assessed by functional outcome using Gruber and

healy score used by Omid et al [12]. We followed the patients till the radiological union of the fracture and physiotherapy protocol i.e. 12 weeks. The fractures in group A united radiologically in a mean duration of 7.52 ± 1.46 weeks, while in group B the mean duration of union was 8.12 ± 1.34 weeks. In our observation, patients with triceps muscle sparing approach had excellent functional outcome in 18 (94.73%) patients as compared to 09 (47.36%) patients in muscle splitting approach (group B) which was significant, p value < 0.05.

Table 1:

| Gender | Side | |
|--------------|-----------|-----------|
| | Right | Left |
| MALE | 18 | 06 |
| FEMALES | 11 | 03 |
| Total | 29 | 09 |

N= 38

Table 2:

| Gender | Group A | Group B |
|--------------|-----------|-----------|
| Males | 11 | 13 |
| Females | 08 | 06 |
| Total | 19 | 19 |

N= 38

Table 3: Gruber and Healy score [12]

| Grade | Loss of Elbow Range of Motin |
|-----------|------------------------------|
| EXCELLENT | 0-4 |
| GOOD | 4-8 |
| FAIR | 8-12 |
| POOR | >12 |

Table 4:

| Functional score | Group A | Group B |
|------------------|-------------|-------------|
| EXCELLENT | 18 (94.73%) | 09 (47.36%) |
| GOOD | 01 (5.26%) | 04 (21.05%) |
| FAIR | 0 | 04(21.05%) |
| POOR | 0 | 02 (10.52%) |
| Total | 19 | 19 |

P value; <0.05.

DISCUSSION

The main aim of severely displaced supracondylar humerus fracture is to attain a normal elbow, which is fully functional and cosmetically acceptable [13-15]. According to the literature, children treated after 14 days of injury were considered as neglected

supracondylar fracture of humerus in which there was already some callous formation. There are different reasons for the delay in treatment of children with SHF. Failure to achieve the satisfactory reduction by closed method is the most common cause for open reduction and internal fixation (ORIF), which accounts for 3 to 46% according to various studies [16,17]. Open reduction was associated with high risk of elbow stiffness, myositis ossificans and scaring and iatrogenic neurovascular injury. However, there are many studies [18], which demonstrate low complication rates of surgery and no correlation between stiffness and the type of surgical approaches used especially the posterior approach [19].

All the patients in our study had displaced Gartland type III supracondylar fracture with gross swelling with intact distal neurovascular status. These patients were presented with an average delay of 6 days, ranging from 3-9 days. A study by Eren et al [8] included 20 children, who had an average delay of 6 days ranging from 2-9 days. We used back slab for post-operative immobilization. The average time of radiological union was 6.5 weeks, ranging from 4-10 weeks. We removed the back slab at 2 weeks and k-wires in outpatient department at 6 weeks. The patients in group A, regained their normal ROM in a mean time of 9 weeks (ranging 8 to 15 weeks), as compared to group B with ROM in a mean time of 12 weeks (ranging 10 to 16 weeks). Eren et al achieved full ROM within 3 months in their 29 patients (93.5%) and found no correlation between the duration of immobilization and delay in ROM recovery [8]. In a study conducted by Ahmed Shawkat Rizk the union was achieved in a mean duration of 7.2 weeks (range from 5 to 10 weeks), with excellent functional outcome in 15 patients (86.66%) while good results were found in 2 patients (13.33%) in patients undergoing muscle sparing technique [9]. Similarly, Eren et al restored excellent outcome during three months in 29 patients (93.5%) with triceps muscle sparing technique [8]. Omid-Kasha et al found that 10 patients (71.4%) had excellent functional outcome with triceps muscle splitting approach [12]. We found that the patients with muscle sparing approach had excellent functional outcome in 18 (94.73%) patients as compared to 09 (47.36%) patients in muscle splitting (group B), which was found to be significant with p value < 0.05, table 04. In group A, 01 (5.26%) had good outcome while in group B 04 (21.05%) had good outcome, 04 (21.05%) had fair and 02 (10.52%) had poor outcome according

to Gurber and Healy score. The limitations of our study included, our strict inclusion criteria to have a more valuable analysis of the surgical approaches used for comparison. Our complications included pin tract infection in 3 patients (one in group A and two patients in group B), all of which responded to local wound care and oral antibiotic regimen. Cubitus varus deformity occurred in 01 patient of group B and failure to regain full ROM occurred in 2 patients (one each in group A and B).

CONCLUSION


Based upon the above observation our hypothesis was proven correct significantly, that supracondylar fractures requiring open reduction and fixation in children with triceps muscle sparing technique had better functional outcome than triceps muscle splitting approach. However further studies on large scale are suggested for further evaluation and recommending it as a standard procedure for supracondylar humerus shaft fracture.

REFERENCES

1. Lamdan R, Liebergall M, Gefen A, Symanovsky N, Peleg E. Pediatric supracondylar humerus fractures: effect of bone-implant interface conditions on fracture stability. *J Child Orthop.* 2013 Dec;7:565-569.
2. Akbar B, Samin B, Meherdad H. Pediatric Elbow Fractures in a Major Trauma Center in Iran. *Arch Trauma Res.* 2013 winter; 1(4): 172-175.
3. Mihrano Tachdjian. *Pediatric orthopedics (3rd edn)*, Philadelphia, W Saunders Co. 2008.
4. Kazimoglu C, Cetin M, Sener M, Aqus H, Kalanderer O. Operative management of type III extension supracondylar fractures in children. *Int Orthop* 2009 Aug;33: 1089-1094.
5. Skaggs DL, Hale JM, Bassett J, Kaminsky C, Kay RM, Tolo VT. Operative treatment of supracondylar fractures of the humerus in children. The consequences of pin placement. *J Bone Joint Surg Am.* 2001 May;83: 735-40.
6. Larson L, Firozbakhsh K, Passarelli R, Bosch P. Biomechanical analysis of pinning techniques for pediatric supracondylar humerus fractures. *J Pediatr Orthop.* 2006 Sep-Oct;26: 573-578.
7. Kaewpornsawan K. Comparison between closed reduction with percutaneous pinning and open reduction with pinning in children with closed totally displaced supracondylar humeral fractures: a randomized controlled trial. *J Pediatr Orthop B* 2001 Apr;10: 131-137.
8. Abdullah Eren, Guven Melih, Erol Builent, C, akar Murat. Delayed surgical treatment of supracondylar humerus fractures in children using a medial approach. *J Child Orthop.* 2008 Feb;2(1):21-27.
9. Ahmed Shawkat Rizk. Triceps-sparing approach for open reduction and internal fixation for neglected displaced supracondylar and distal humerus fractures in children. *J orthopaedic traumatol* 2015 Jun;16:105-116.
10. Ali AM, Hassanin EY, El-Ganainy AE, Abd-Elmola T. Management of intercondylar fractures of humerus using the extensor mechanism-sparing paratricipital posterior approach. *Acta Orthop Belg.* 2008 Dec;74:747-52.
11. Erpelding Jason M, Mailander A, High R, Fehringer EV. Outcomes following distal humeral fracture fixation with an extensor mechanism-on approach. *J Bone Joint Surg Am.* 2012 Mar; 94:548-553.
12. Omid-Kashani F, Hasankhani EG, Hasankhani GG. Surgical Outcomes of Pediatric Humeral Supracondylar Fractures Treated By Posterior Approach and Triceps Splitting. *J Trauma Treat* 2013 Nov;S4: 007. doi:10.4172/2167-1222.S4-007.
13. Ersan O, Gonen E, Arik A, Dasar U, Ates Y. Treatment of supracondylar fractures of the humerus in children through an anterior approach is a safe and effective method. *Int Orthop* 2009 Oct;33:1371-1375.
14. Sharma H, Taylor GR, Clarke NM. A review of K-wire related complications in the emergency management of paediatric upper extremity trauma. *Ann R Coll Surg Engl* 2007 Apr;89: 252-258.
15. Pretell-Mazzini J, Rodriguez-Martin J, Andres-Esteban EM. Does open reduction and pinning affect outcome in severely displaced supracondylar humeral fractures in children? A systematic review. *Strategies Trauma Limb Reconstr* 2010 Jul;5: 57-64.
16. Ozkoc G, Gone U, Kayaalp A, Teker K, Peker TT. Displaced supracondylar humeral fractures in children: open reduction vs. closed reduction and pinning. *Arch Orthop Trauma Surg* 2004 Oct;124:547-551.
17. Gupta N, Kay RM, Leitch K, Femino JD, Tolo VT, Skaggs DL. Effect of surgical delay in perioperative

- complications and need for open reduction in supracondylar humerus fractures in children. J Pediatr Orthop 2004 May-Jun;24:245-248.
18. Brauer CA, Lee BM, Bae DS. A systematic review of medial and lateral entry pinning versus lateral entry pinning for supracondylar fractures of the humerus. J Pediatr Orthop. 2007 Mar;27:181–186.
19. Kumar R, Kiran EK, Malhotra R, Bhan S. Surgical management of the severely displaced supracondylar fracture of the humerus in children. Injury. 2002 Jul;33:517–522.

AUTHORSHIP AND CONTRIBUTION DECLARATION

| No | Author Name | Contribution to paper | Signature |
|----|---------------------------------------|---|---|
| 1 | Principal author Dr. Kamran Asghar | Contribution in the literature review, study design and analyzed & interpreted the data |  |
| 2 | Second Author Dr. Shakir Nazir | Contribution in the record keeping & maintenance & also collected and analyzed the data | |
| 3 | Third Author Dr. Nouman Maqbool | Contribution in questionnaire design & finally approved | |