



FUNCTIONAL OUTCOME OF DISPLACED SUPRACONDYLAR HUMERUS FRACTURE IN CHILDREN MANAGED WITH PERCUTANEOUS PINNING - A PROSPECTIVE STUDY

Orthopaedics

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ABSTRACT

Background: The majority of elbow injuries in children are supracondylar fractures of the humerus, accounting for around 60% of all elbow injuries in the first ten years of life. Associated with complications like compartment syndrome, neurovascular damage, Volkmann's ischaemic contracture and malunion. Two lateral pins or a cross pin construction are the most popular options for pinning. As compared to alternative treatment options, closed reduction and percutaneous K-wire fixation are the most effective and least invasive. Complications like malunion, loss of reduction and compartment syndrome may arise from treating it conservatively. This research evaluates the functional and radiological results of closed reduction percutaneous K wire treatment for displaced supracondylar humerus fractures in children. **Materials and Methods:** Based on the inclusion and exclusion criteria from the consecutive sampling, 32 patients were chosen for the research. All patients had percutaneous K wire fixation using the usual procedure. **Results:** 20 children (63%) of them were affected in their first decade of life, with a clear male predilection than females. Mayo elbow scoring was 2.5, 6.0 and 3.75 at 6 weeks, 3 months and 6 months. PTI and Cubitus Rectus was noted in 8 and 2 respectively in our study population. Clinical outcomes measured by Flynn criteria was poor in 2 cases, satisfactorily excellent in 28 and satisfactorily good in 2 case. **Conclusion:** Closed reduction and percutaneous pinning either by crossed configuration or by lateral pinning is the treatment of choice for paediatric supracondylar humerus fractures. Regardless of the configuration, the proper pinning method guarantees a successful result. Closed reduction and percutaneous pinning is a safe, cost-effective, less morbid procedure.

KEYWORDS

Supracondylar Fractures, Closed Reduction, K-Wire Fixation, Paediatric, Mayo Elbow Scoring, Baumann's Angle

INTRODUCTION

In children between the ages of one and ten, 50–70% of all elbow fractures are caused by supracondylar humerus fractures [1]. The Gartland classification [1] is used in the current therapeutic plan for this fracture. Because to the existence of concomitant immediate and late sequelae such as Volkmann's ischaemic contracture, compartment syndrome, neurovascular injury, and malunion, these injuries could pose as the most challenging to treat [2–4]. These injuries are classified into extension type and flexion type, with the extension type being more common [5,6]. Extension injuries are further classified as undisplaced fractures (type 1), partially displaced fractures with intact posterior hinges (type 2), and totally displaced fractures (type 3). Closed reduction and cast application, Dunlop traction or Olecranon traction, have generally been accepted treatment options for Type 1 and a few Type 2 fractures. Closed reduction and pinning are usually required for types 2 and 3 [7].

Many methods, such as close reduction and long arm cast or slab, Dunlop skin traction, and olecranon traction, have been described; nevertheless, all of these therapies had a significant complication rate. Conservative therapeutic complications include loss of reduction, compartment syndrome, and malunion [7]. The most common pinning method is a cross medial or lateral pin or two lateral pins [2,3]. The current suggested treatment for displaced supracondylar fractures is close reduction and percutaneous pin fixation. Several authors have had great success with this method. Closed reduction with percutaneous K-wire fixation is the most effective and has the fewest problems when compared to other methods [5].

The goal of the research is to assess the effectiveness of closed reduction and percutaneous K-wire fixation in treating children with displaced supracondylar humerus fractures.

MATERIALS AND METHOD

This is a prospective observational study done at Aarupadai Veedu Medical College and Hospital, Puducherry from October 2020 to October 2022. Patients presenting with displaced supracondylar humerus fractures presenting to outpatient and inpatient services of

the department of orthopaedics were enrolled in the study by convenient sampling.

In our study, the mean age was 7.13 years ranging from 2-12 years. 62% of the patients were male and remaining 38% were female. 22 patients (69%) were affected on the left arm and (31%) affected on the right arm. 94% were found to be having extension type of fracture and 6 % were flexion type of fracture of Gartland classification

Surgical Procedure

Following a pre-operative review, all procedures were performed under regional anaesthesia or general anaesthesia at the anaesthetist's discretion. By giving traction and counter traction along the longitudinal axis with elbow in supination and extension, closed reduction is achieved and is checked under fluoroscopy guidance. The reduction is maintained by keeping the forearm in pronation. Percutaneous k-wire fixation was used to keep the reduction in place once good alignment was confirmed. K-wires ranging in size from 1.2mm to 2.0mm were employed. Either 2 cross K-wires fixation or 2 lateral K-wires fixation was used to fix the fracture. If the fracture is found to be unstable, and additional K-wire is introduced to make the fixation stable. Under fluoroscopy guidance, the reduction and fixation was verified and a poster slab was applied with elbow at 90° flexion and forearm in supination.

Follow Up

Patients were seen for pin tract dressing on a weekly or biweekly basis. After X-ray confirmation of adequate callus development, K-wires were removed after 4-6 weeks of surgery. At the same time, the pop splint was removed, and the patient was encouraged to perform active aided elbow flexion, extension, and supination - pronation exercises. Follow-up was performed at 6 weeks, 3 months, and 6 months after surgery and was evaluated using Mayo elbow score. Baumann's angle was also checked at every follow-up.

RESULTS

32 patients were treated with supracondylar pinning for supracondylar

fracture of humerus at paediatric age group age ranging from 2-12 years with mean of 7.13 years. In this study 20 of the patients were male and the other 12 were female. It was observed that 22 out of 32 were affected on the left side whereas the others were injured on right side. In our study, it was observed that 94% were having extension type fracture and 6% were having flexion type fracture. All the cases were followed up for a minimum of six months.

8 individuals had pin-tract infections, which were superficial and recovered when the pins were removed and oral antibiotics were administered. There was no evidence of a profound infection or septic arthritis. This poor pin tract care was most likely to blame for the infection. Cubitus rectus (zero degrees of carrying angle) was seen in 2 patients (6%), which rebounded with a positive functional result with following follow up. Complications like ulnar nerve damage, vascular injury, compartment syndrome, pin migration and cubitus varus was observed not in our study.

The mean and standard deviation of Mayo elbow scoring at the end of 6 months follow up was 98.18 ± 2.83 . At the end of 6 months based on Mayo elbow scoring 30 patients had excellent outcome and 2 patients had good outcome. Fair and poor outcome was not seen in our study. The mean and standard deviation of Baumann's angle was 75.93 ± 10.04 .



Fig 1: (A) AP and lateral view showing extension type fracture (B) Immediate Post of X-Ray showing fixation with cross K-wires. (C) X-Ray after 6 weeks after pin removal



Fig 2: (A) Pre Op X-ray showing flexion type of injury (B) Immediate post op x ray showing additional lateral K-wire for stability (C) 6 weeks post op X-ray after pin removal

DISCUSSION

Supracondylar humerus fractures are one of the most common fractures in children, accounting for 50-70 percent of all elbow fractures. It prefers the first ten years of a person's existence. It involves the lower end of the humerus just above the olecranon and coronoid fossa, or it can be accessed via the humeral metaphysis. They are classified into two types: extension type and flexion type [8].

For these fractures, many treatment options are discussed. Non-operative treatment is often reserved for undisplaced or mildly displaced fractures that may be reduced and treated with POP. In displaced/open fractures, surgical intervention is required to avoid problems such as malunion and cubitus varus, mobility loss at the elbow, and persistent discomfort. In some cases, such as when an open fracture necessitates vascular exploration or when the fracture is irreducible, open reduction with fixation is recommended. There is disagreement among researchers about percutaneous K wire fixation following closed or open reduction. Though some firmly urge closed reduction, others believe it is suboptimal [9].

Age:

The average age of the children in the current research was 7.13 years, ranging from 2 to 12 years. This was in comparison to the 8.9-year research conducted by Avnesh Gattu et al [8]. A Saudi Arabian survey found that the average age was 8.1 years [10]. The majority (63%) of our research participants were aged 5 to 10, which matched the findings of Fowles et al [11]. Other surveys found a higher share of the population under the age of ten. According to Reising et al, supracondylar humeral fractures are extremely common between the ages of 4 and 9 years [12].

Gender:

In our study, boys were shown to have more supracondylar fractures than females (62% versus 38%). Devkota Phale et al. found that boys were impacted more than girls, with a ratio of 58 to 44. This disparity is most likely due to boys' strenuous physical activity, which makes them prone to falls and consequent damage [13].

Side Involved:

22 (69%) of the 32 instances were detected in the left arm, whereas 10 (31%) were found in the right arm). These findings were consistent with those of Devkota P et al., who discovered a ratio of 54:48 for the afflicted left to right arm [13]. Furthermore, the study by Rokaya P et al found that fractures occurred disproportionately on the left side, accounting for 64% of all cases in their study. The explanation for this is due to the defensive stance adopted by the non-dominant extremity following a fall [14].

Mayo Elbow Score:-

The current study's clinical outcome was assessed using the Mayo elbow score. The scores were 79.37 ± 2.5 at 6 weeks, 87.81 ± 6 at 3 months, and 99.06 ± 3.75 at 6 months, which was comparable to Yi-An Li et al [15] study, in which the functional outcome was assessed by the Mayo elbow performance index score on 42 patients undergoing treatment for Modified Gartland's Type 3 fractures. At the most recent follow-up, the Mayo elbow performance index scores were good (>90). Furthermore, our findings were consistent with those of Sinikumpu et al [16], who produced good outcomes with a 96.4 mean value in 25 patients with Modified Gartland's type 3 fractures. Ulmar B et al. reported outstanding outcomes in 46 patients (>90 points on the Mayo elbow grading), which was similar to our investigation [17].

Baumann's Angle

On an anteroposterior radiograph, Baumann's angle is defined as the angle created by the junction of the physal line between the lateral condyle and the distal humeral metaphysis and the long axis of the humerus. At 6 months, one instance of Cubitus Varus exhibited an elevated Baumann's Angle of 108. At 6 months, one instance of Cubitus rectus exhibited an elevated Baumann's angle of 88. (The standard Baumann's Angle is 64 - 81 degrees.) The mean and standard deviation of Baumann's Angle at 6 months were 75.93 ± 10.04 which were judged to be within the permissible range.

Similar findings were seen in the study of Bong-Jin Lee et al., who discovered no significant changes in their sample population at 1 week or 5 weeks after the procedure [18]. Muhhsan Kiita et al. also used Baumann's angle to analyse fracture reduction because it can preserve the carrying angle estimation.

The mean Baumann's angle in the Closed reduction - percutaneous pinning and open reduction - internal fixation groups was 72.3, albeit this was not statistically significant [19]. Basaran et al. had a similar research experience, with no significant difference in closed reduction with and without medial incision, as well as no change in Baumann angle, lateral humerocapitellar angles, carrying angles, and elbow range of motion between fractured and opposite sides.

CONCLUSION

Our study concludes that closed reduction and percutaneous pinning, either by crossing configuration or lateral pinning, is the treatment of choice for paediatric supracondylar humerus fractures. Regardless of the setup, the right pinning approach yields a satisfying result. Closed reduction with percutaneous pinning is a less intrusive and less dangerous therapeutic option.

Author Contributions

The authors contributed equally for its content ,writing and reviewing and/or editing of the manuscript before submission.

Conflicts Of Interest

The authors declare no conflict of interest

Acknowledgement

The authors are grateful to be authorities of Aarupadai Veedu Medical College and Hospital, Vinayaka Mission Research Foundation (Deemed to be University) and to all patients who participated in the study.

REFERENCES

- MacEwen GD. Tachdjian's Pediatric Orthopaedics, 3rd ed. Volumes 1, 2, and 3. The Journal of Bone and Joint Surgery-American Volume. 2002 Jun;84(6):1104.
- Kocher MS, Kasser JR, Waters PM, Bae D, Snyder BD, Hresko MT, et al. Lateral entry compared with medial and lateral entry pin fixation for completely displaced supracondylar humeral fractures in children: A randomized clinical trial. Journal of Bone and Joint Surgery - Series A. 2007;89(4):706–12.
- Ramachandran M, Skaggs DL, Crawford HA, Eastwood DM, Lalonde FD, Vitale MG, et al. Delaying treatment of supracondylar fractures in children: has the pendulum swung too far? The Journal of bone and joint surgery British volume. 2008 Sep;90(9):1228–33.
- Krusche-Mandl I, Aldrian S, Köttstorfer J, Seis A, Thalhammer G, Egkher A. Crossed pinning in paediatric supracondylar humerus fractures: A retrospective cohort analysis. International Orthopaedics. 2012 Sep;36(9):1893–8.
- Cheng JC, Lam TP, Maffulli N. Epidemiological features of supracondylar fractures of the humerus in Chinese children. Journal of pediatric orthopedics Part B. 2001 Jan;10(1):63–7.
- Mahan ST, May CD, Kocher MS. Operative Management of Displaced Flexion Supracondylar Humerus Fractures in Children. Journal of Pediatric Orthopaedics 2007 Jul;27(5):551–6.
- Brauer CA, Lee BM, Bae DS, Waters PM, Kocher MS. A Systematic Review of Medial and Lateral Entry Pinning Versus Lateral Entry Pinning for Supracondylar Fractures of the Humerus. Journal of Pediatric Orthopaedics. 2007 Mar;27(2):181–6.
- KJ M, T A, W C, M O. Displaced supracondylar fractures of the humerus in children. International orthopaedics. 2000;24(4):221–3.
- Khan AQ, Goel S, Abbas M, Sherwani MKA. Percutaneous K-wiring for Gartland type III supracondylar humerus fractures in children. Saudi Medical Journal. 2007.
- Owles J v, Kassab MT. Displaced supracondylar fractures of the elbow in children. A report on the fixation of extension and flexion fractures by twolateral percutaneous pins. The Journal of bone and joint surgery British volume . 1974 Aug;56B(3):490–500.
- Reising K, Schmal H, Kohr M, Kuminack K, Sudkamp NP, Strohm PC. Surgical treatment of supracondylar humerus fractures in children. Acta Chir Orthop Traumatol Cech. 2011 Jan 1;78:519–23.
- Nms P, Devkota P, JNMA I VOL 47 I NO. 2 I ISSUE 170 I APR-JUN. J Nepal Med Assoc . 2008;47(170):66–70.
- Rokaya P, Karki DB, Rawal M, Limbu D, Menyangbo S, Devkota H. Pattern of Pediatric Supracondylar Fracture Operated at A Rural Teaching Hospital of Nepal: A Descriptive Cross-sectional Study. Journal of Nepal Medical Association . 2020 Mar 30;58(223):153–7.
- Afaq SF, Singh A, Maharjan R, Ranjan R, Panda AK, Mishra A. Comparison of clinic-radiological outcome of cross pinning versus lateral pinning for displaced supracondylar fracture of humerus in children: A randomized controlled trial. Journal of Clinical Orthopaedics and Trauma. 2020 Mar 1;11(2):259–63.
- Sinikumpu J-J, Victorzon S, Pokka T, Lindholm E-L, Peljo T, Serlo W. The long-term outcome of childhood supracondylar humeral fractures. The Bone & Joint Journal . 2016 Oct;98-B(10):1410–7.
- Ulmar B, Brunner A, Kocak T, Schwarz J, Stöckle U, Mittlmeier T, Stuby F, Freude T. Behandlungsergebnisse operativ versorgter kindlicher suprakondylärer Humerusfrakturen. Zeitschrift für Orthopädie und Unfallchirurgie. 2012 Oct;150(05):488–94.
- Lee B-J, Lee S-R, Kim S-T, Park W-S, Kim T-H, Park K-H. Radiographic Outcomes After Treatment of Pediatric Supracondylar Humerus Fractures Using a Treatment-Based Classification System [Internet]. Vol. 25, J Orthop Trauma. 2011.
- Kitta MI, Ismiarto YD, Saleh MR, Sakti M, Abidin MA, Putra LT. Analysis of radiological alignment and functional outcomes of pediatric patients after surgery with displaced supracondylar humerus fracture: A cross-sectional study. International Journal of Surgery Open. 2020 Jan 1;24:136–42.
- Basaran SH, Ercin E, Bayrak A, Bilgili MG, Kizilkaya C, Dasar U, et al. The outcome and parents-based cosmetic satisfaction following fixation of paediatric supracondylar humerus fractures treated by closed method with or without small medial incision. SpringerPlus. 2016 Dec 1;5(1):1–5.