

Original Research Article

The joy stick technique: an easy, reliable, safe and cost effective, technique in closed reduction and percutaneous fixation of supracondylar fracture of the humerus in children

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ABSTRACT

Background: Supra condylar fractures of humerus account for approximately 16% of all pediatric fractures. This produces an extension type fracture in 97–99%. Flexion type accounting for 1-3%. This often causes significant morbidity due to malunion (gun-stock deformity) reported in 12 to 20%, while neurovascular complications and compartment syndrome is documented in worse scenarios.

Methods: A prospective study was conducted with 24 cases of supracondylar humerus fracture between June 2017 to June 2021. Both males and females aged 3 years to 12 years, within 5 days of injury, with modified Gartland's type III and type IV, without compartment syndrome were included and followed up for 6 months to one year. The fracture was closely reduced using a 2-2.5 mm k-wire (joystick) in proximal fragment placed 5-7 cm proximal to fracture line and fixed with multiple percutaneous pinning under C-arm. All the patients were followed for rate of union and functional outcome using Flynn's criteria.

Results: All the 24 cases were managed by closed maneuver with the help of a joy stick. This reduces the surgical time and stress, preventing opening of fracture. Outcome was assessed in each follow up using Flynn's criteria. 87.5% of patients had good to excellent outcomes.

Conclusions: Our results demonstrate that good functional outcomes are expected in supracondylar fracture regardless of age at injury, sex, weight, side of extremity provided satisfactory reduction by closed technique with help of joy stick. This simple technique reduces surgical stress, duration of surgery and also minimizes the C-arm exposure.

Keywords: Fish tail sign, Joy-stick technique, Closed maneuver, Reduces surgical duration and stress, Flynn's criteria

INTRODUCTION

Supracondylar humerus fractures in children account for around 60% cases in the elbow. The incidence is more in pts less than 10 years and decreases drastically as the age advances. Extension type is more common than flexion type. It is usually caused by fall on the outstretched hand with elbow joint in hyperextension, thus pushing the distal fragment posteriorly. Gartland type III, IV and some displaced type II needs operative management.

Conventionally it is being managed with closed reduction and percutaneous pinning using Kirschner wires under image intensification which has been established as the standard treatment for unstable supracondylar fractures of the humerus in children. Malunion has been reported in 12 to 20% which is common in many developing countries due to lack of awareness, inaccessibility and unaffordability of healthcare services.¹⁻⁴ Marked soft tissues swelling and difficulty in achieving satisfactory reduction and maintaining reduction in the process of

pinning may require open reduction, with the conversion rate to open reduction being between 3 and 15%.^{1,5,6} Open reduction may have worse results than closed reduction as loss of motion, elbow stiffness, myositis ossificans, infection, scar formation and an increased risk of iatrogenic neurovascular injury are possible complications.⁶

The aim of this study was to report the surgical technique, its indications, learning curve, complications associated with it, related additional cost if any and the result of the use of this reduction technique.

METHODS

A prospective study was conducted during the period from June 2017 to June 2021. Both male and female patients were included in the study.

Table 1: Inclusion and exclusion criteria.

S. no.	Inclusion criteria	Exclusion criteria
1.	3–12 years	Open fracture
2.	Within 5 days of injury	Fractures with intercondylar extension
3.	Gartland type III and IV	Patients with compartment syndrome
4.		Patients with neurovascular injury

All the patients were initially assessed and were given first aid in the form of analgesia, splint immobilization and other resuscitation measures. After selection patients were prepared for surgery.

Pre-operative evaluation

It included demographic details of patients (name, age, sex, and address) and other relevant history like date and mode of injury, associated chronic illness. Every patient was evaluated clinically for swelling, bruising and ecchymosis at the fracture site, visible deformity of the elbow and puckering of skin. A careful neurological and vascular examination of the involved limb was done. Closed reduction was attempted under intravenous (IV) sedation to convert a severely displaced fracture to a lesser displaced or a reduced configuration and to prevent neurovascular compromise due to existing deformity. A posterior above the elbow slab was applied. Check X-ray done to assess reduction. All the routine investigations like complete blood count and biochemistry were done. Radiographic evaluation by X-ray of the chest was done in every patient. Informed and written consent was taken from the patient’s parent/guardian.

Operative procedure

Closed reduction of fracture was attempted as usual with an assistance by a 2.0-2.5 mm K-wire inserted bicortically

at mid arm circumference from lateral to medial direction around 5-7 cm above fracture line working as joy stick under C-arm imaging. After satisfactory reduction fracture was fixed with K-wires and above elbow back slab was applied and limb was elevated.

Post operative period and follow-ups

K-wires were removed after 3 weeks and active elbow mobilization was started after 4 weeks. Radiological evaluation was done at 3 weeks, 6 weeks, 3 months, 6 months and 1 year. Functional evaluation of patients was done at every follow-up using Flynn criteria.

RESULTS

All twenty-four fractures in 14 boys and 10 girls were studied. The average age of patients was 6.46±2.08 years (range: 2-12 years) with the majority between 4-6 years. 14 patients had injury to the left elbow while 10 patients had injury at right elbow. 6 patients (25%) had Gartland grade III injury whereas 18 (75%) had Gartland type IV injury.

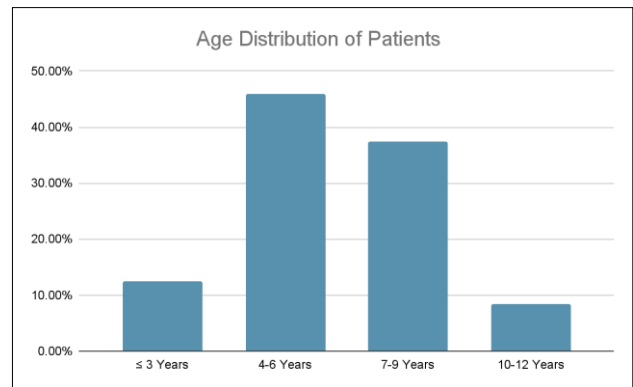


Figure 1: Age distribution of patients.

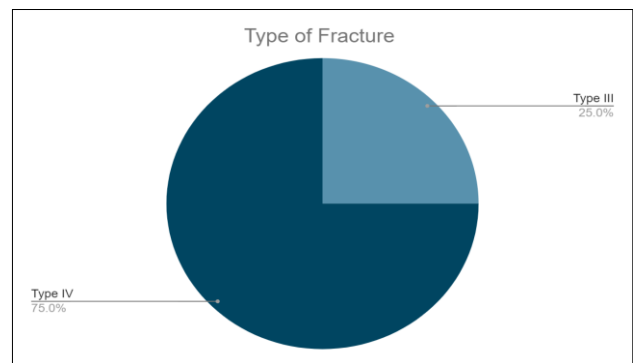


Figure 2: Type of fracture.

The mean duration of surgery was 38.8±9.80 min (range 25-55 min). The mean Union time was 6.92±1.18 weeks. All patients achieved a satisfactory cosmetic and functional result. There was no significant loss of initial reduction during follow ups. The complication rate was

16.67%. One patient developed pin tract infection requiring regular dressing and oral antibiotics. There were two patients with radial nerve palsy preoperative which resolved completely in due course of follow-up. One patient got an iatrogenic shaft of humerus fracture managed with intramedullary K-wire fixation. According to Flynn's criteria 13 children had excellent (54.2%) outcomes, 8 (33.3%) had a good outcome and 3 (12.5%) did not complete follow up.

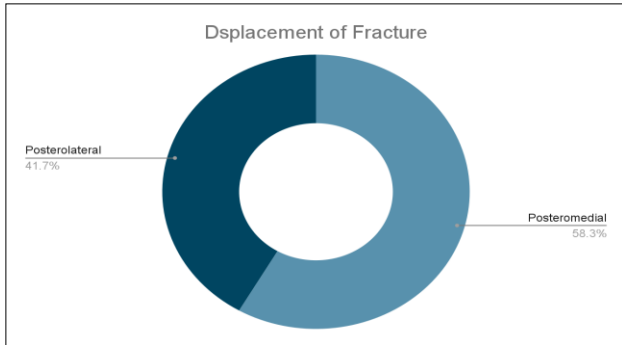


Figure 3: Displacement of fracture.



Figure 4: (A) Pre-op X-ray; (B) Post-op X-ray; radiological evaluation of patient sustained supracondylar # humerus.



Figure 5: Post-op clinical evaluation of patient sustained supracondylar # humerus.

DISCUSSION

Closed reduction and percutaneous fixation of displaced supracondylar fracture of humerus is the standard of care ever since Swenson first described it in 1948.⁷ As the remodeling capacity is poor in the distal humerus, restoration of normal distal humerus relationships is important to prevent late complications. The periosteum in the pediatric population is thicker and stronger than that of an adult.^{8,9} When a pediatric fracture occurred, the periosteum usually remained intact on the compression side of the injury and tears on the extension side.⁸ The intact periosteum acted as a periosteal hinge.^{8,10,11}

This theory was proposed by Rang and Smith.¹²⁻¹⁴ This hinge can contribute to the intrinsic stability of the fracture and aid in closed fracture reduction in children, but it cannot control the rotational stability especially in higher grade of fracture. In supracondylar humerus fracture there is displacement and rotation of distal fragment. Along with this there is external rotation of the proximal fragment due to attachment of deltoid (lateral and posterior fibers) and supraspinatus.

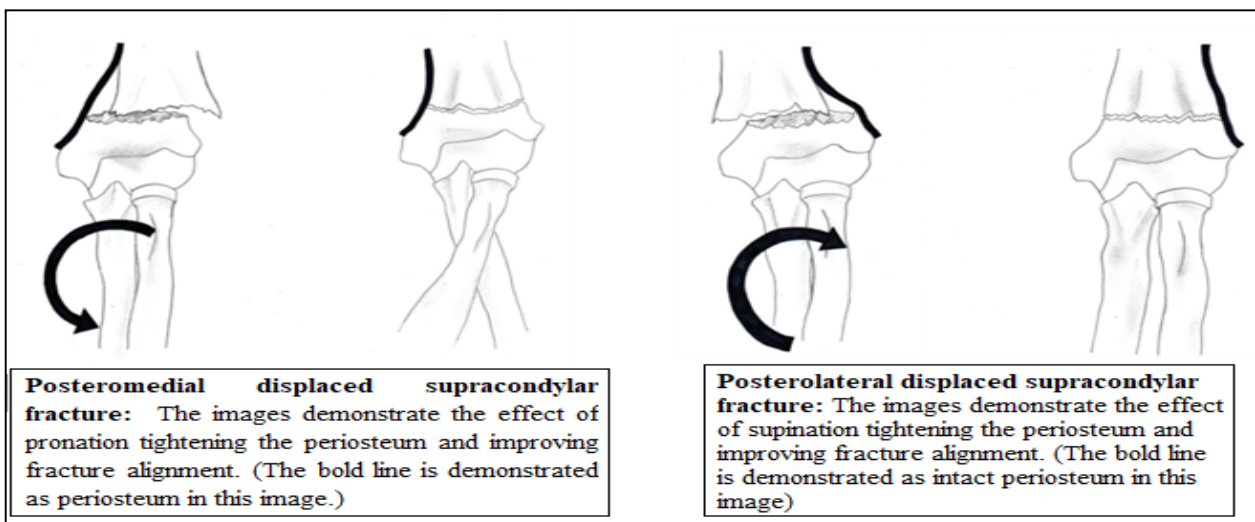


Figure 6: Periosteal Hinge theory as proposed by Rang and Smith.¹²⁻¹⁴

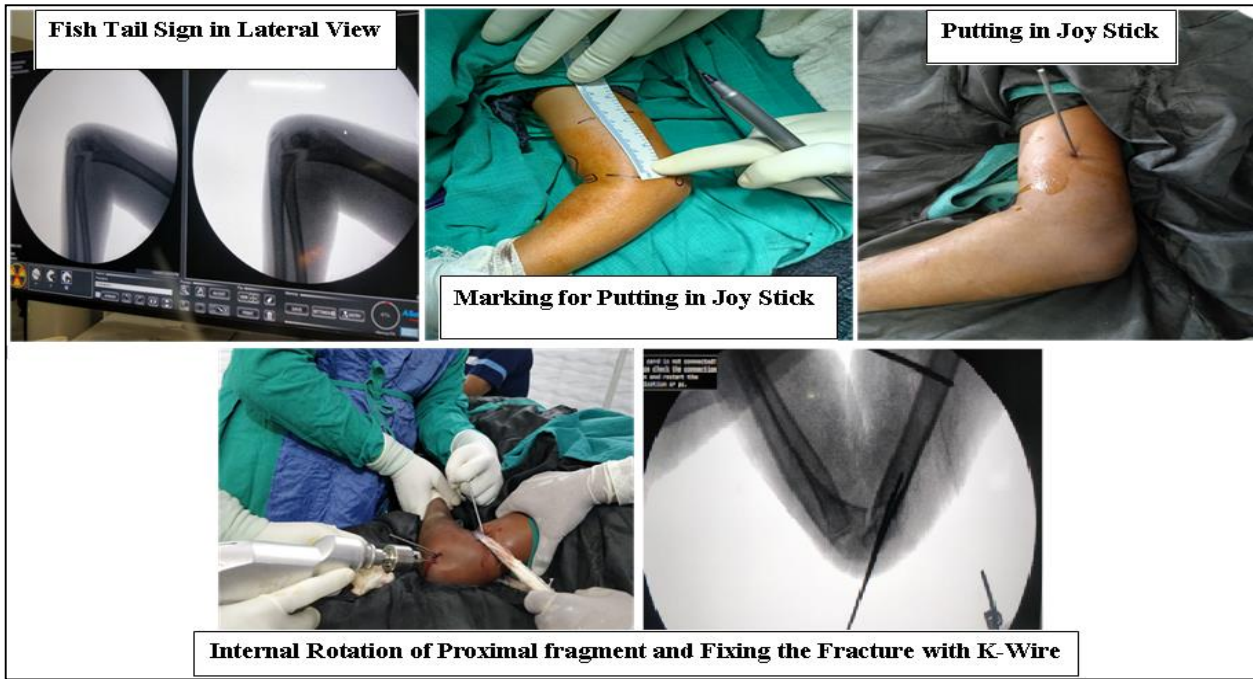


Figure 7: Steps in fracture reduction and percutaneous fixation.

When we tried closed reduction by conventional method, we had control over distal fragment only leading to fish tail sign in fluoroscopy. If not reduced anatomically it will result in rotational malunion which does not get remodeled. The rotational malalignment of proximal fragment can be controlled by putting a Kirschner wire of size 2.0-2.5 mm into it around 5-7 cm proximal to fracture line from lateral to medial direction (as there is no neurovascular structure at this area) in bicortical fashion at the center of cylindrical contour of the shaft and internally rotating the fragment. It will reduce the rotational malalignment and the fish tail sign will disappear.

Placing the K-wire at the center of the cylindrical contour of the shaft in bicortical fashion is important. Wrong placement can lead to fracture of shaft while internally rotating.

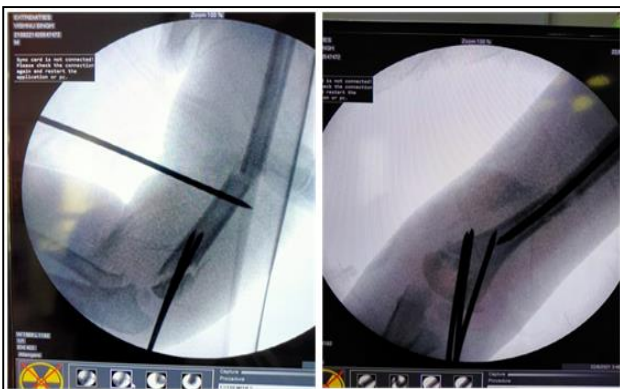


Figure 8: Iatrogenic intra-op fracture of shaft of humerus managed with intra-medullary K-wire.

Limitations

As the present study was conducted at a single center with a limited number of patients, our configuration cannot be judged to be superior to the other.



Figure 9: Radiological and clinical evaluation of patient after 3 months.

CONCLUSION

The “joy stick technique” helps in avoiding open reduction in most difficult supracondylar fractures. It is effective, safe, and easy to perform without the need for special instruments and at no additional cost. We recommend this technique as one of the methods to try and achieve closed reduction in difficult supracondylar fractures before deciding for open reduction.

Advantages of closed reduction and percutaneous pinning are easy to obtain reduction under C-arm, less surgical trauma to tissues, less hospital stay, no need of IV antibiotics, less postoperative stiffness, no ugly scar mark, cost effective.

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Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Omid R, Choi PD, Skaggs DL. Supracondylar humeral fractures in children. J Bone Joint Surg Am. 2008;90:1121-32.
2. Beaty JH, Kasser JR. Fractures about the elbow. Instr Course Lect. 1995;44:199-215.
3. Chai KK, Aik S, Sengupta S. Supracondylar fractures of the humerus in children – An epidemiological study of 132 consecutive cases. Med J Malaysia. 2000;55:39-43.
4. Young S, Fevang JM, Gullaksen G, Nilsen PT, Engesaeter LB. Deformity and functional outcome after treatment for supracondylar humerus fractures in children: A 5 to 10 year follow up of 139 supracondylar humerus fractures treated by plaster cast, skeletal traction or crossed wire fixation. J Child Orthop. 2010;4:445-53.
5. Ozkoc G, Gonc 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;124:547-51.
6. Aktekin CN, Toprak A, Ozturk AM, Altay M, Ozkurt B, Tabak AY. Open reduction via posterior triceps sparing approach in comparison with closed treatment of posteromedial displaced Gartland type III supracondylar humerus fractures. J Pediatr Orthop B. 2008;17:171-8.
7. Swenson AL. The treatment of supracondylar fractures of the humerus by Kirschner wire transfixion. J Bone Joint Surg Am. 1948;30:993-7.
8. Skaggs DL, Flynn JM. Supracondylar Fractures of the Distal Humerus. Rockwood and Wilkins Fractures in Children. Beaty JH, Kasser JR, editors. Wolters Kluwer, Philadelphia. 2010;487-527.
9. Staheli LT. Trauma/Supracondylar Fractures. Practice of Pediatric Orthopedics, 2nd edition. Lippincott Williams & Wilkins, Philadelphia, PA. 2006;306-9.
10. Chukwunyeremwa C, Orlik B, El-Hawary R, Logan K, Howard JJ. Treatment of flexion-type supracondylar fractures in children: the 'push-pull' method for closed reduction and percutaneous K-wire fixation. J Pediatr Orthop B. 2016;25:412-6.
11. Fahmy MA, Hatata MZ, Al-Seesi H. Posterior intrafocal pinning for extension-type supracondylar fractures of the humerus in children. J Bone Joint Surg Br. 2009;91:1232-36.
12. Rang M, Pring ME, Wenger DR. Elbow-Distal Humerus. Rang's Children's Fractures, 3rd edition. Hurley R, Sebring S, editors. Lippincott Williams & Wilkins, Philadelphia. 2005;95-118.
13. Smith HL. Position in the treatment of elbow-joint fractures: an experimental study. Boston Med Surg. 1894;131:386-9.
14. Rang M. Children's Fractures. JB Lippincott, Philadelphia. 1974.

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