



International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958

P-ISSN: 2706-6630

Impact Factor (RJIF): 6.72

IJOS 2025; 11(3): 42-48

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www.orthopaper.com

Received: 02-06-2025

Accepted: 09-07-2025

Bikash Neupane

Department of Orthopaedics,
Rapti Academy of Health
Sciences (RAHS), Ghorahi,
Dang, Nepal

Sagar Panthi

Department of Orthopaedics,
Rapti Academy of Health
Sciences (RAHS), Ghorahi,
Dang, Nepal

Rishishwor Shrestha

Department of Orthopaedics,
Rapti Academy of Health
Sciences (RAHS), Ghorahi,
Dang, Nepal

Rupesh Man Sherchan

Department of Orthopaedics,
Rapti Academy of Health
Sciences (RAHS), Ghorahi,
Dang, Nepal

Nischal Sharma

Department of Orthopaedics,
Rapti Academy of Health
Sciences (RAHS), Ghorahi,
Dang, Nepal

Prabha Paudel

Central Department of Statistics,
Tribhuvan University (TU),
Kirtipur, Kathmandu, Nepal

Pramila Paudel

Central Department of Statistics,
Tribhuvan University (TU),
Kirtipur, Kathmandu, Nepal

Corresponding Author:

Bikash Neupane

Department of Orthopaedics,
Rapti Academy of Health
Sciences (RAHS), Ghorahi,
Dang, Nepal

Analysis of the tansen technique for closed reduction and percutaneous fixation of type III supracondylar fractures of the humerus in children at a tertiary care center in Lumbini Province, Nepal

Bikash Neupane, Sagar Panthi, Rishishwor Shrestha, Rupesh Man Sherchan, Nischal Sharma, Prabha Paudel and Pramila Paudel

DOI: <https://www.doi.org/10.22271/ortho.2025.v11.i3a.3787>

Abstract

Supracondylar humerus fractures are the most common elbow fractures in children aged 4-10 years. Management varies depending on fracture type, ranging from conservative to operative treatment. Type III fractures generally require surgical intervention, as supported by existing literature. Proper classification is essential for guiding appropriate treatment.

Methods: This retrospective, cross-sectional study was conducted at Rapti Academy of Health Sciences from April 2021 to April 2024. It included all cases of type III supracondylar humerus fractures that were challenging to reduce by closed means. The census sampling technique was employed.

Results: A total of 45 children underwent treatment using the Tansen technique. The mean age was 7.64 ± 2.9 years (range: 3-13). Of these, 32 (71.1%) were male and 13 (28.9%) female. Left-sided injuries accounted for 64.4% (29 patients), and right-sided injuries for 35.6% (16 patients). Most injuries (80%) resulted from falls, while 20% were due to road traffic accidents. Type IIIA fractures were seen in 27 patients (60%) and IIIB in 18 (40%). The average surgical time was 42.58 ± 5.8 minutes, with a mean slab and K-wire duration of 5.44 weeks. Union occurred at an average of 5.56 ± 0.16 weeks. The mean hospital stay was 2.27 ± 0.78 days. Postoperatively, 88.9% had intact neurovascular status; 5 patients (11.1%) experienced transient ulnar nerve neuropraxia that resolved with follow-up. Pin site infection occurred in 5 patients (11.1%) but was managed with antibiotics and dressings. 9 (20%) had preoperative AIN injury, all of which resolved. According to Flynn's criteria, all of our patients achieved satisfactory outcomes.

Conclusion: The Tansen technique proves to be a safe, effective, and cosmetically favorable option for treating type III supracondylar humerus fractures in children, with high success rates, minimal complications, and short hospital stays.

Keywords: Type III supracondylar fracture, children, Tansen Technique, closed reduction percutaneous fixation

Introduction

Supracondylar fracture is the most common elbow fracture in children. Accounting for about 70% of fractures around the elbow, and about 17% of all pediatric fractures, most fractures occur between five and eight years of age ^[1, 2]. While the prevalence is reported to be equal among boys and girls, there is a higher incidence on the non-dominant (left) side. Extension-type fractures with posterior deviation represent about 97% of cases ^[3]. However, some literature suggests that these fractures predominantly affect males and are mostly caused by an extension mechanism ^[4]. Most supracondylar humerus fractures (approximately 98%) are of the extension type. Flexion-type fractures are uncommon, comprising only 2-10% of cases. These injuries typically result from a direct fall onto the elbow, rather than a fall on an outstretched hand with elbow hyperextension ^[5, 1]. The Gartland classification is the most widely used system to categorize these fractures based on the degree of displacement. In 1996, Wilkins expanded this classification by introducing a B-type subdivision, which considered posterior humeral cortical contact with rotational deformity, indicated by translational displacement seen in either radiographic plane. In 2006, Leitch *et al.* added type IV,

which describes multidirectional instability. (6, 3). Type III fractures have significant potential for neurovascular complications and require urgent management. The pucker sign—caused by entrapment of the brachialis muscle—indicates that the fracture has pierced the brachialis, suggesting both difficulty in reduction and possible neurovascular compromise. Cubitus varus is a common long-term complication seen in neglected or malunited cases. Every orthopedician likely to encounter these fractures during clinical practice. The association of this fracture with neurovascular complications and deformity warrants an aggressive approach to management [7, 1, 8, 9]. Supracondylar humerus fractures can be managed conservatively or surgically, depending on the fracture type and post-reduction stability [10]. Type I fractures can be treated with immobilization in a cast or slab with regular follow-up, but displaced fractures require surgery. Operative treatment of type II fractures has become more popular recently. It is widely accepted that type III and type IV fractures should be managed surgically. Nowadays, closed reduction and percutaneous pinning are the gold standard for all displaced fractures [11].

Methods: This is a hospital-based Retrospective descriptive cross-sectional study with a Quantitative method. To analyze the Tansen Technique. Conducted in Rapti Academy of Health Sciences from April 2021 to April 2024. All patients with type III supracondylar fractures which were difficult in closed reduction were taken. A Census technique of sampling was used. Permission for the study was taken from the Rapti Academy of Health Sciences and Ethical approval was taken from the IRC of the Rapti Academy of Health Sciences (RAHS).).

Objective: The general objective is to analyze the functional outcome and efficacy of the Tansen technique in Closed Reduction and Percutaneous Fixation of Type 3 Supracondylar Fracture of the Humerus in Children. The specific objective is to evaluate the efficacy of the Tansen Technique in Closed Reduction and Percutaneous Fixation of Type 3, to determine the rate of complication, to assess the timing of surgery to identify post-operative distal neurovascular status, to assess the functional outcomes. Operations are carried out in the operating room under general anesthesia, under all aseptic and antiseptic precautions

painting and draping are done, patient is positioned supine, after confirming the anesthesia checklist and site of injury, the manipulation is done, the fracture is reduced first in AP and then in lateral and check under fluoroscopy. For highly displaced supracondylar fractures which are difficult to reduce by closed methods despite two to three attempts of reduction, we use the new Tansen technique which was first described by Bhim et. al in 2020. The following steps are carried out in this technique

- The first exact fracture site is confirmed in the image intensifier and we mark the point of fracture by the tip of artery forceps.
- Then small stab (nick) incision is given at the fracture site through the posterior aspect of the arm
- Then small mesquite or artery forceps are inserted through the incision with the tip directing downward for easy insertion in the fracture site.
- After confirming the position of the tip of the artery forceps the tip is moved upward to hook the proximal fragment and the handle of the artery is pushed down so the proximal fragment is pushed posteriorly and the distal fragment is pushed anteriorly.
- During this whole process position is maintained and checked in both anteroposterior and lateral view and fracture is gently manipulated to restore anatomical alignment
- After the reduction is confirmed with maintaining position artery forceps are hooked according to the required force for reduction the patient's elbow is placed in a lateral position.
- Fracture fixation done under the control of an image intensifier by 2 mm k wires under fluoroscopy and checked in AP and lateral views for the position of k wires
- After fixation the artery forceps are removed k wires are cut back slab is applied using suture materials for the skin.

Postoperatively limb is elevated and on the next post-op day neurological and vascular status is checked and swelling is checked any abnormal findings or compromise in neurovascular status is recorded.

Surgical Technique

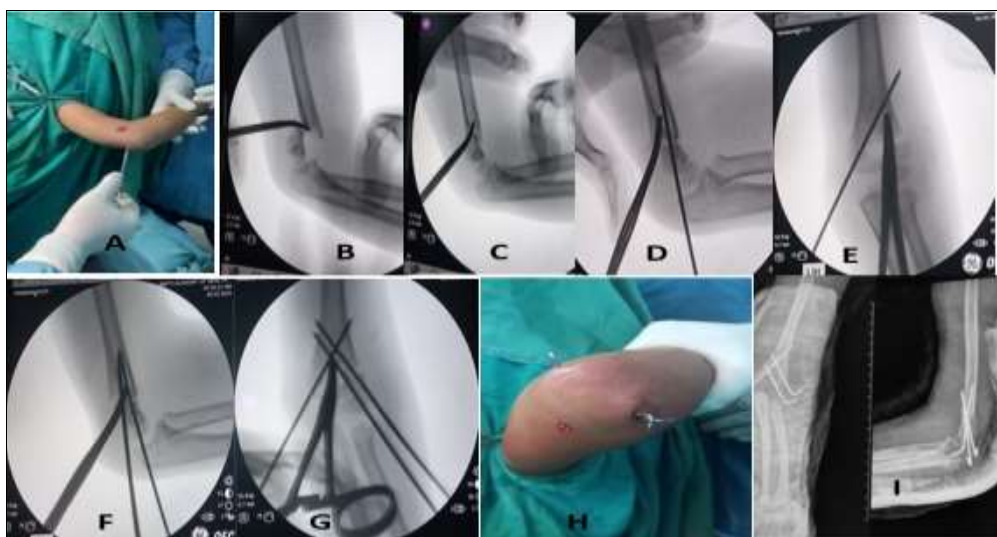


Fig 1. Stepwise images showing Tansen Technique

A. Posterior stab incision given and insertion of artery forceps. B. Inserting artery forceps through fracture with tip pointing downwards. C. Reducing the fracture pushing distal fragment anteriorly. D. lateral view after inserting first k wire. E. anteroposterior image after inserting first k wire. F. Lateral view after fracture fixation. G. Anteroposterior view after fracture fixation. H. elbow image showing incision site and after k wire cut. I. post-operative image after fixation

Results: Among 45 patient records that were carried out for the study, the mean age of patients was 7.64 years \pm 2.9 years ranging from 3 to 13 years. Among these 32 (71.1%) were males and 13 (28.9%) were females. 29 (64.4%) had left side injury 16 (35.6%) had right side injury. Among 45 records we also had a record of Mechanism of injury among which 9 (20%) had a history of road traffic accident other 36 (80%) had a history of fall injury. For types of fractures, 27 (60%) were IIIA 18 (40%) were type IIIB. The average duration of surgery was 42.58 ± 5.8 minutes a minimum of 28 to a maximum of 55 minutes. The average time for slab and k -k-

wires is 5.44 weeks. The average Union time is 5.56 weeks \pm 0.16. The mean hospital stay was 2.27 days \pm 0.78 days. Among 45 cases 40 (88.9%) had intact distal neurovascular status immediately postoperatively whereas 5 (11.1%) had ulnar nerve neuropraxia in immediate post-operative but was noted resolved in follow-up. 40 (88.9%) patients did not have any complications till union time however 5 (11.1%) were found to have pin site infection but daily dressing and use of antibiotics had resolved the infection which does not warrant earlier pin removal. 9 (20%) had preoperatively AIN injury but after fixation and on follow up none of the patients had post-operatively AIN injury the Bauman angle after surgery was measured and found 75.4 ± 2.4 degree. loss of carrying angle was compared with contralateral side among which 77.8% have excellent result, 13.3% have a good result and 8.9% have a fair result. Loss of motion was measured on the affected side, and elbow range of motion was measured among which 80% had excellent results, 13.3% had a good result and 6.7% had fair results. According to Flynn's criteria, we have a hundred percent satisfactory result. [Table 2].

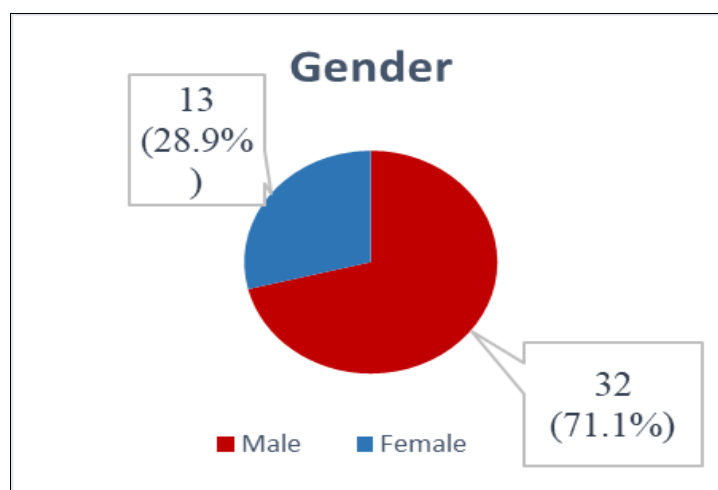


Fig 2. Pie chart showing male-female ratio

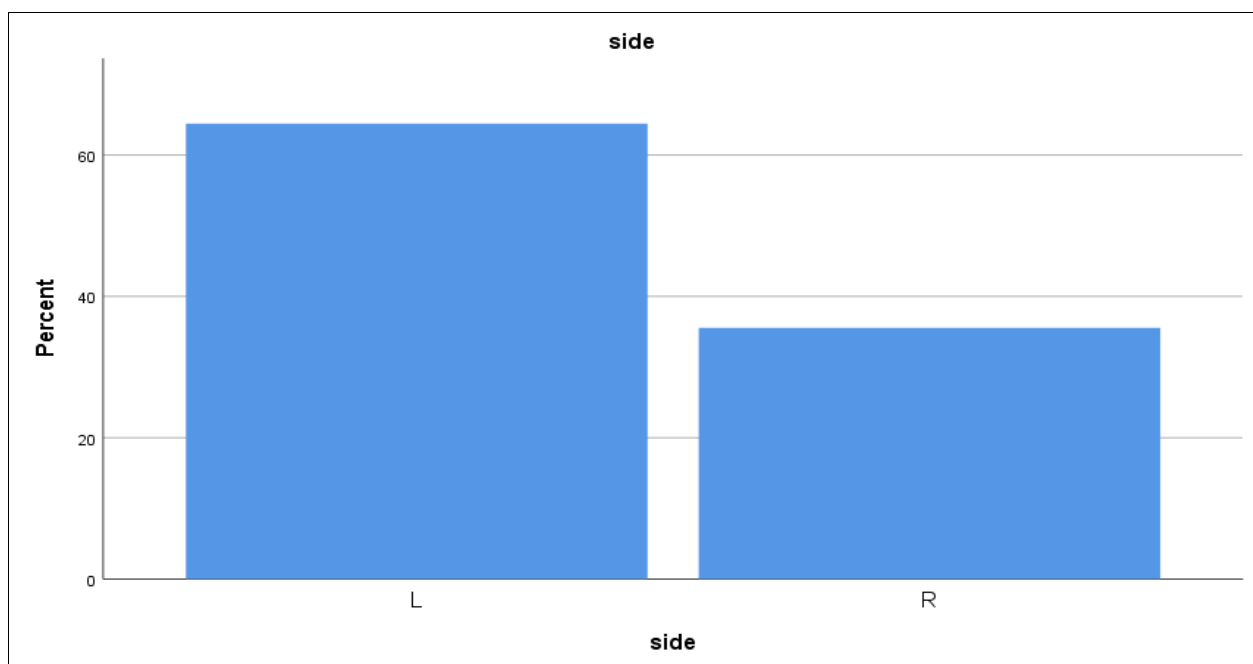


Fig 3. Histogram showing the frequency and percentage of side injury (left, right)

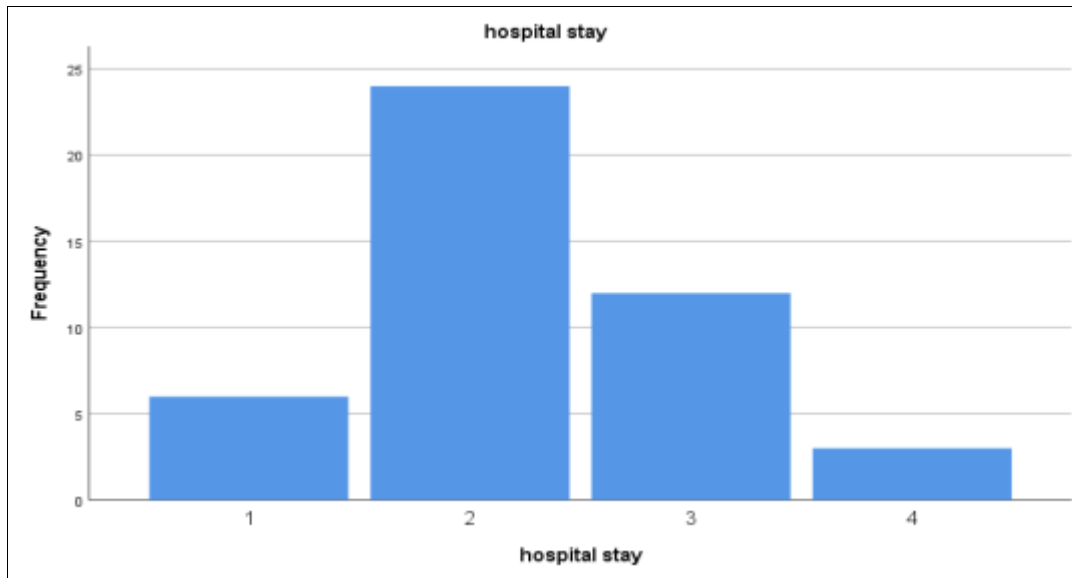


Fig 4. Histogram showing length of hospital stay

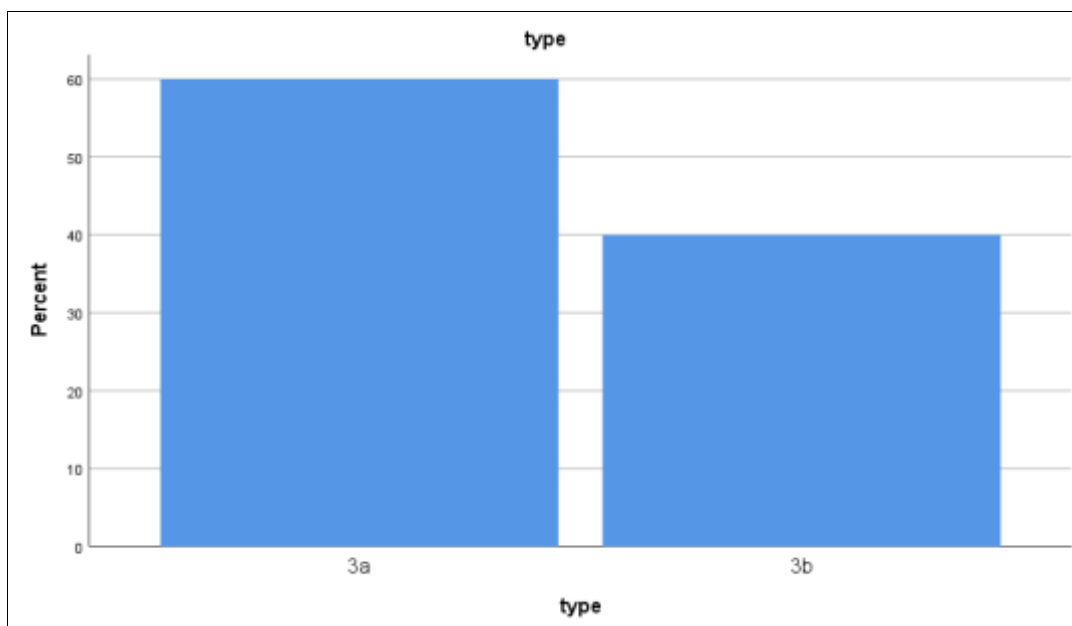


Fig 5: Showing types of fracture

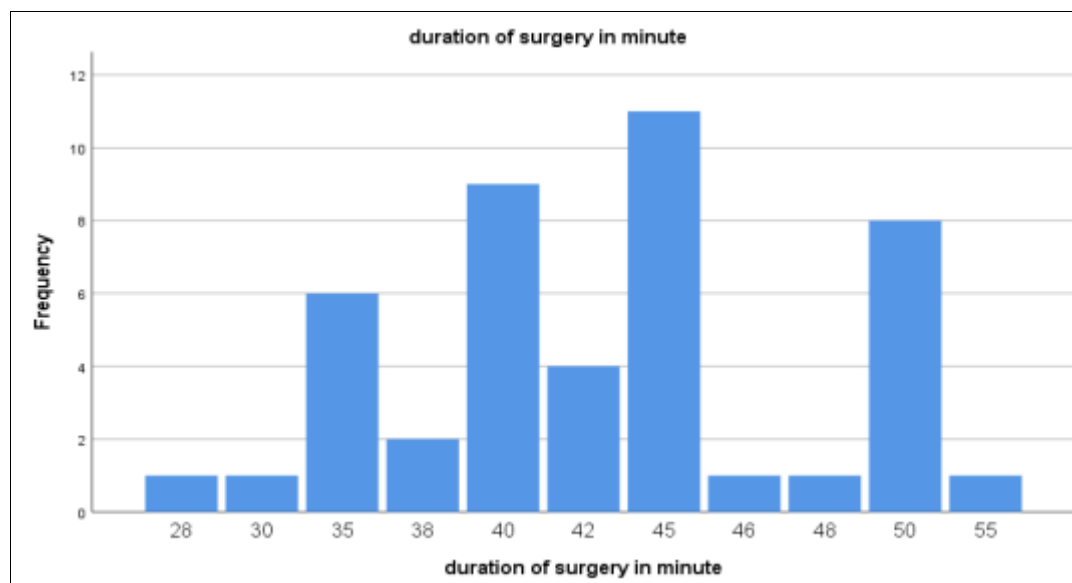


Fig 6: Histogram showing the duration of surgery in minute

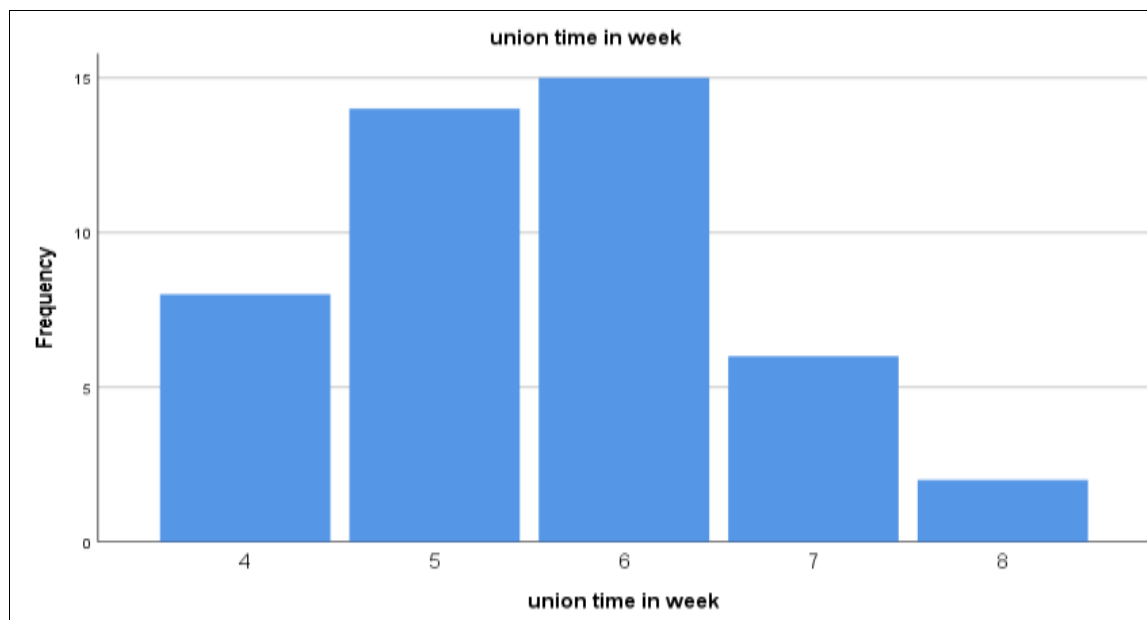


Fig 7. Showing union time in weeks

Table1: Showing mean and standard deviation of age, duration of surgery, timing of slab and k wires union time and hospital stay.

		Age	Duration of surgery in minute	Timing of slab +k wires in week	Union time in week	Hospital stay in days
N	Valid	45	45	45	45	45
	Missing	0	0	0	0	0
Mean		7.64	42.58	5.44	5.56	2.27
Std. Error of Mean		.432	.876	.148	.161	.116
Std. Deviation		2.901	5.876	.990	1.078	.780
Minimum		3	28	4	4	1
Maximum		13	55	8	8	4

Table 2: Functional results according Flynn's criteria.

Results		Cosmetic factor Loss of carrying angle in degree	Functional factor Loss of motion in degree
Excellent	Satisfactory	0-5 (n 35 =77.8%)	0-5 (n 36 =80%)
Good	satisfactory	6-10 (n 6 = 13.3%)	6-10 (n 6 = 13.3%)
Fair	Satisfactory	11-15 (n 4 = 8.9%)	11-15 (n 3 = 6.7%)
Poor	Unsatisfactory	>15 (0)	>15 (0)

Discussion

The most effective ways to treat pediatric supracondylar humerus fractures are a matter of debate. To find the best treatments, carefully planned randomized controlled trials comparing treatment choices are required. Level of Evidence: Level II ^[12]. Swenson published the first description of percutaneous fixation after closed reduction in the Journal of Bone and Joint Surgery in 1948 for a supracondylar fracture of the humerus ^[13]. Then, different literature mentions a variety of treatment techniques that yield satisfactory results, such as open reduction and k-wire fixation using various approaches, closed reduction and percutaneous fixation, joystick technique, auxiliary joystick methods of reduction, double joystick methods of reduction, new castle approach, ^[14, 15, 16, 17, 18, 19, 20, 21]

In this study, we aimed to evaluate the functional outcomes and effectiveness of the Tansen Technique. to our knowledge this method was first described by Bhim *et al.* at the United Mission Hospital in Nepal and published in the peer-reviewed *Christian Medical College Journal of India* in 2020 ^[22]. Our team then began using the TANSEN TECHNIQUE to treat type III supracondylar fractures, which failed to close reduction after two to three tries. And accomplished the remarkable outcome with success. A thorough documentation of the neurovascular

evaluation is necessary. Determining hand perfusion is essential for assessing the urgency of treatment. Rock, paper, scissors method is also used where The ulnar nerve is tested by "scissors," the median nerve by "rock," the radial nerve by "paper," and the anterior interosseous nerve by OK. Sign. ^[23]. in 2024, Lee *et al.* published a paper. The medial side of the proximal shaft fragment is pushed from the anterior to the posterior using the K-wire push technique. Using a 1.6 mm diameter K-wire percutaneously, the operation time was 47.97 (± 28.32) minutes ^[19]. Whereas in our study the mean operating time was 42.58 \pm 5.8minutes. So in terms of operating time, our study has a shorter operating time. In comparison to Bhim *et al.* in 2020, however, we agree. Our operational duration is lengthy, but the outcomes are nearly identical. However, we cannot ignore the fact that a surgeon's expertise, the availability of resources, and the availability of highly qualified manpower also affect operating time. Due to the inadequate resources and the absence of highly qualified C arm technicians we used to have prolonged operating time. The auxiliary k wires methodology was described by Dong *et al.* in 2019, yet the study's noted limitations included sample size follow-up and average c-arm images ^[20]. However, our study's average intraoperative image count is 18 \pm 4.1, and our sample size is larger than theirs. Kazimoglu *et al.* (2009)

found that open reduction and internal fixation is a successful secondary treatment strategies for type III supracondylar fractures, with results comparable to closed reduction and pinning ^[24]. However, we discovered that with the Tansen Technique, all type III supracondylar fractures could be significantly reduced. Km. Kc et.al. 2024 also published an article outlining its simple, reliable, and successful method for treating and reducing type III supracondylar fractures; however, the title was modified from the Tansen technique to the Artery Forceps Technique ^[25]. We agree with R. Degliute et al. 2003 Open fractures, fractures exacerbated by vascular damage, and inadequate closed reduction because of unstable fractures are among the conditions that call for open reduction and internal fixation. However, we disagree with open reduction or inadequate closed reduction resulting from unstable fractures, as the Tansen technique can successfully fix type III supracondylar humeral fractures. The main treatment objectives for these injuries are stable fixation, minimizing complications, and achieving a satisfying result, regardless of the approach or timing of care ^[26]. Kow Ry et.al 2016 proposed lateral external fixation with the lateral k wires technique ^[27]. But compared to sample size, hospital stay duration of surgery, and rate of pin site infection our study has better results than theirs. Based on our experiences and findings, we can conclude that this treatment is safe, simple, dependable, affordable, and can even be cosmetically accepted for type III supracondylar Humerus fractures. It also requires a short stay in the hospital. This approach is easy for new surgeons to use.

Limitation

The primary limitation of this study was its retrospective nature. Multi center Prospective studies may be needed in the future to confirm our findings. This study is not comparative however further comparative study with a large sample size may be necessary to say it is superior to other techniques. Nonetheless, this Study is meaningful because the Tansen Technique showed favorable and satisfactory outcomes in Treatments of pediatric supracondylar fracture of the humerus.

Conclusion

According to the study's findings, the Tansen technique is a highly simple, safe, aesthetically pleasing, and dependable method for treating type III supracondylar fractures in the humerus with satisfactory functional outcomes and no long-term neurovascular problems. Additionally, we strongly recommend this method for treating type III supracondylar fractures before deciding on an open reduction.

Conflict of interest

The author denies any conflict of interest

Financial support: None

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How to Cite This Article

Neupane B, Panthi S, Shrestha R, Sherchan RM, Sharma N, Paudel P, Paudel P. Analysis of the tansen technique for closed reduction and percutaneous fixation of type III supracondylar fractures of the humerus in children at a tertiary care center in Lumbini province, Nepal. *International Journal of Orthopaedics Sciences*. 2025;11(3):42.48

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