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Original Research Article

Supracondylar Humerus Fracture Patterns in Children: A Prospective Study

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Abstract

Supracondylar fracture of the humerus is one of the most talked about and often encountered injury (only after clavicle and both bone forearm fracture) in pediatric age group.

Immediate complications associated with it are limb threatening (by virtue of involving neurovascular structures) whereas late complications are a serious concern to functional status of the patient. Due to the above reasons, they require a strict vigilance and a proper management protocol. In pediatric age group the more common age of presentation is 5-7 years (90% cases). In this study 6 different patterns of type-III supracondylar humerus fracture (extension type) in children were analyzed. It was found that Loss of carrying angle is observed most commonly in high sagittal fractures (28.6 %) followed by transverse type fracture (27.7%). Clinical varus deformity (loss of carrying angle more than 15%) is most commonly caused by medial oblique type (50%) followed by low sagittal type (11.8%). Clinical valgus deformity is most commonly caused by medial oblique type (25%). Among the coronal fracture types, medial oblique fracture is more prone for varus deformity than others. Among the sagittal fracture types, high sagittal fracture is more prone for extension malunion than others. Most common complication was found to be AIN palsy followed by vascular injury, other associated fracture, PIN palsy.

Keywords: Supracondylar humerus fracture, fracture, pediatric, Valgus, Varus.

Introduction

A type III supracondylar humerus fracture is a severe displaced fracture where the bone fragments are completely separated and not in contact with each other.[1] This is the most severe type of supracondylar humerus fracture and requires immediate medical attention. Type III supracondylar humerus fracture is a severe injury to the elbow joint that typically occurs in children.[2] This fracture involves complete separation of the bone fragments, with significant displacement and angulation. The injury can result in damage to the surrounding soft tissues, including nerves and blood vessels. Early diagnosis and treatment are essential to prevent long-term complications.[3]

Type III fractures typically involve significant damage to the surrounding soft tissues, such as the blood vessels and nerves. The fracture may be associated with a visible deformity of the elbow, swelling, and intense pain.[4]

Treatment for a type III supracondylar humerus fracture usually involves surgery to realign the bone fragments and stabilize them with pins, wires, or plates. The goal of surgery is to restore normal alignment and prevent any further damage to the surrounding structures.

After surgery, the patient may need to wear a cast or splint for several weeks, followed by physical therapy to help regain strength and mobility in the affected arm. Close monitoring of nerve and blood vessel function is essential, as any complications or injuries to these structures can lead to long-term disability.[5]

There are several classification systems used to describe the different patterns of type III supracondylar humerus fracture. One commonly used classification system is the Gartland classification, which describes five different patterns of type III fractures:[6,7]

1. Type IIIA: This is the most common type of type III supracondylar humerus fracture. It involves a displaced fracture with the distal fragment posteriorly displaced but still in contact with the proximal fragment.
2. Type IIIB: This pattern involves a displaced fracture with the distal fragment completely separated from the proximal fragment, but still held in place by the soft tissues.
3. Type IIIC: This pattern involves a displaced fracture with the distal fragment completely separated from the proximal fragment and not held in place by the soft tissues. The bone fragments may be significantly displaced, angulated, or rotated.
4. Type IIID: This pattern involves a displaced fracture with the distal fragment displaced laterally and the proximal fragment displaced medially.
5. Type IIIE: This pattern involves a displaced fracture with the distal fragment displaced medially and the proximal fragment displaced laterally.

These different patterns of type III supracondylar humerus fracture can affect the treatment approach and outcome, as they may require different surgical techniques or methods of stabilization.

Materials and Method

This study was conducted for 2 years August 2020 to July 2022. For this study, 72 Children undergoing surgical fixation in Department of Orthopaedics, Govt Medical College Kozhikode for type III supracondylar humerus fracture (extension type) were selected

Observation and Results

Total of 72 children were included from 3 to 12 year of age with Mean age was 6.9 years. There are 4 patterns in AP view. 65.3 %(47) of typical transverse type, which is normally observed in the long bones. This type of fracture generally happens when the bone breaks straight across its shaft perpendicular to its long axis.

Lateral oblique and Medial oblique both fractures are often seen in bones that have been twisted or rotated. This fracture happens at an angle across the bone's shaft, with the fracture line running from the outside towards the inside (Lateral oblique) or inside towards the outside (Medial oblique).

In this study Lateral oblique type of fracture was observed in the 26.4 % (19) of the children while the Medial oblique type of fracture was observed in the 5.6 % (4) of the children.

High fractures may be serious and may require surgery to repair. This type of fracture generally happens in the upper part of a bone, such as the head or neck of the femur or humerus. This type of fracture was observed in the 2.8% (2) of the children.

There are 2 patterns in Lateral view Low sagittal pattern & high sagittal fracture pattern. Low sagittal fractures generally

observed in the lower part of the leg. For treatment, immobilization or surgery, or both may be required. This type of fracture was observed in the 70.8% (51) of the children. High sagittal fractures generally observed in the upper part of the leg. For treatment, immobilization or surgery, or both may be required. This type of fracture was observed in the 29.2% (21) of the children (Table – 1)

Table 1: Distribution of fracture patterns

		Frequency	Percent	Valid Percent	Cumulative Percent
In coronal plane	Typical transverse	47	65.3	65.3	65.3
	Lateral oblique	19	26.4	26.4	91.7
	Medial oblique	4	5.6	5.6	97.2
	High fracture	2	2.8	2.8	100.0
	Total	72	100.0	100.0	
In sagittal plane	Low sagittal	51	70.8	70.8	70.8
	High sagittal	21	29.2	29.2	100.0
	Total	72	100.0	100.0	

There is multiple type of coronal deformities that are observed after the surgical process of a fracture is known as the Postoperative coronal deformities. In this study observed coronal deformities are as per following (Table- 2 & Fig -1).

- No coronal deformity refers to the alignment of the bone that is within the normal range of angulations. That means the fracture after the surgical treatment has a neutral coronal alignment. Highest no coronal uniformity (66.7%) was found in the High sagittal type of fracture.
- A loss in the carrying angle happens when the angle between the long axis of the humerus and the forearm become smaller or negative from the normal angle after surgery. Loss in the carrying angle was majorly observed in the High sagittal type of fracture (28.6%).
- Valgus type of deformity happens when the angle between the bone and the midline of the body increases this result in the bending of the bone. This deformity mostly happens in the Medial oblique type of fracture (25%).

Varus type of deformity happens when the angle between the bone and the midline of the body decreases this result in the bending of the bone to innerside. This deformity mostly happens in the Medial oblique type of fracture (50%).

Table 2: Statistics of coronal deformity

Statistics of coronal deformity										
	Typical Transverse Type		Lateral Oblique Type		Low Sagittal Type		High Sagittal Type		Medial Oblique	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
No Deformity	29	61.7	12	63.2	30	58.8	14	66.7	-	-
loss of carrying angle	13	27.7	5	26.3	12	23.5	6	28.6	1	25
Valgus	2	4.3	1	5.3	3	5.9	1	4.8	1	25
Varus Deformity	3	6.4	1	5.3	6	11.8			2	50
Total	47	100	19	100	51	100	21	100	4	100

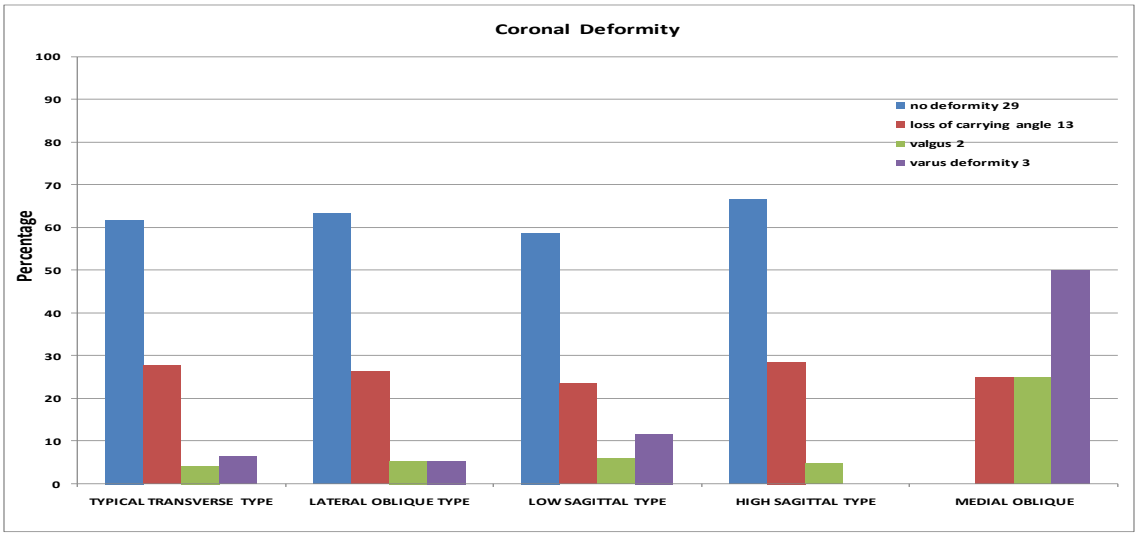

Figure 1: Statistics of coronal deformity

The occurrence of postoperative radiological coronal deformities can affect the functional outcome of the patient, and therefore it is important to closely monitor and manage such deformities after surgery. It is also important to note that radiological coronal deformities may not always translate to functional impairments, and the functional outcome of the patient should also be assessed and taken into consideration (Table-3 & Fig 2).

- No deformity/ Normal refers to the alignment of the bone that is within the normal range of angulations. That means the fracture after the surgical treatment has a neutral radiological coronal alignment. Highest percentage (70.2%) of no radiological coronal uniformity was observed in the Typical Transverse type of fracture.
- Valgus type of deformity happens when the angle between the bone and the midline of the body increases this result in the bending of the bone. This deformity mostly happens in the Medial oblique type of fracture (25%).
- Varus type of deformity happens when the angle between the bone and the midline of the body decreases this result in the bending of the bone to inner side. This deformity mostly happens in the Medial oblique type of fracture (25%).

Table 3: Statistics of Radiological coronal deformity

Statistics of radiological coronal deformity										
	Typical Transverse Type		Lateral Oblique Type		Low Sagittal Type		High Sagittal Type		Medial Oblique	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Normal	33	70.2	12	63.2	35	68.6	14	66.7	2	50
Varus deformity	9	19.1	4	21.1	11	21.6	3	14.3	1	25
Valgus deformity	5	10.6	3	15.8	5	9.8	4	19	1	25
Total	47	100	19	100	51	100	21	100	4	100

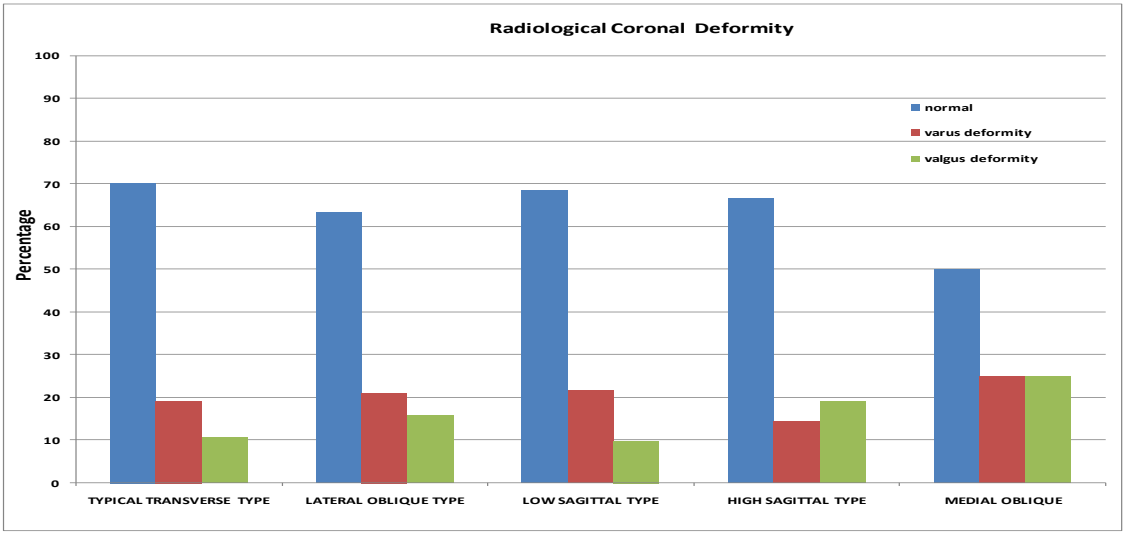

Figure 2: Statistics of Radiological coronal deformity

Discussion

Coronal and sagittal planes are two of the three anatomical planes that are commonly used to describe the orientation and direction of fractures.

A fracture in the coronal plane occurs when a bone is broken perpendicular to its long axis, resulting in two bone fragments that are separated anteriorly and posteriorly. This type of fracture is also known as a transverse fracture. Examples of coronal plane fractures include fractures of the femur, humerus, or tibia. In this study, it was found that the Typical transverse (65.3%) is more common fracture in the children than the other.

On the other hand, a fracture in the sagittal plane occurs when a bone is broken parallel to its long axis, resulting in two bone fragments that are separated laterally and medially. This type of fracture is also known as a longitudinal fracture. Examples of sagittal plane fractures include fractures of the metatarsals, metacarpals, or vertebrae. In this study it was found that the Low sagittal type (70.8%) is more common fracture in the children than the High sagittal type.

Similarly, as per the study Santosh *et al* [8] Typical transverse (56%) is more common in coronal plane and low sagittal (62%) is more common in sagital plane of fracture.

In our study Loss of carrying angle is observed most commonly in high sagittal fractures (28.6 %). Clinical varus deformity (loss of carrying angle more than 15%) is most commonly caused by medial oblique type (50%) followed by low sagittal type (11.8%). Clinical valgus deformity is most commonly caused by medial oblique type (25%).

Conclusion

Supracondylar fracture of the humerus is a very common problem of pediatric age group and one frequently has to deal with such a fracture, with or without complication.

In the studied subjects typical transverse type of fracture is most common in coronal plane and Low sagittal type is most common type in sagittal plane.

Among the coronal fracture types, medial oblique fracture is more prone for varus deformity than others. Loss of carrying angle is more prone in High sagital type fracture.

In summary, type III supracondylar humerus fracture is a severe injury that requires

prompt diagnosis and treatment to prevent long-term complications. Surgical intervention is often necessary, and the treatment approach may vary depending on the specific pattern of the fracture. Rehabilitation and close follow-up are essential to ensure a successful outcome. Among the coronal fracture types, medial oblique fracture is more prone for varus deformity than others. Among the sagittal fracture types, high sagittal fracture is more prone for extension malunion than others.

AIN palsy is the most common complication and is caused by transverse type fractures (10.6%), > low sagittal fractures (9.8%).

Second complication is vascular deficit and is caused by high sagittal fractures (19%) > transverse type (6.4%).

Third complication is other associated fractures which is caused by high sagittal fracture (4.8 %) > transverse type.

Fourth complication is PIN palsy which is most commonly caused by lateral oblique type (5.3%).

At 8 months follow-up, all complications were found to be completely resolved.

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