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CONSERVATIVE VERSUS OPEN REDUCTION INTERNAL FIXATION (ORIF) FOR PEDIATRIC SUPRACONDYLAR HUMERUS FRACTURES GARTLAND TYPE II AND III: A SYSTEMATIC REVIEW

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Abstract

Background: *Displaced supracondylar humerus fractures in pediatric patients constitute a challenge for surgeons, since the optimal treatment remains debatable in terms of functional and cosmetic outcomes as well as surgical risks.*

Aim: *The objective of this study is to compare the outcomes of conservative versus Open Reduction with Internal Fixation (ORIF) for pediatric supracondylar humerus fractures gartland type II and III.*

Methods: *A systematic review was conducted using PubMed and Google Scholar in accordance with the PRISMA guidelines. Studies comparing conservative versus ORIF surgery for Supracondylar Humerus Fractures Gartland Type II and III, with Flynn criteria as the primary outcome, were considered eligible. Excluded were studies of only one surgical procedure modality, Gartland type I, as well as case reports.*

Results: *A total of 128 patients aged 1–15 years old were included in the analysis. Study designs were all cohort prospective (Level II-III). From 128 patients, 69 patients were treated conservatively and 59 operatively by ORIF. From 69 conservatively treated patients, most were Gartland type II whereas in the ORIF group, most were Gartland type III. Based on Flynn's Criteria, satisfactory outcomes (excellent or good) were achieved in the majority of patients in the conservative and in the ORIF group. However, compared to conservative treatment, ORIF have higher rates of satisfactory functional outcome.*

Conclusion: *ORIF delivers superior functional and cosmetic outcomes when compared to conservative treatment for pediatric supracondylar humerus fractures.*

Keywords: *Conservative, Open reduction internal fixation, Supracondylar humerus fracture.*

INTRODUCTION

Supracondylar humerus fracture is a fracture of the thin section of the humerus through the coronoid or olecranon fossa, just above the fossa, or through the humeral metaphysis. It accounts for 60% of all elbow fractures and 3% of all fractures in the pediatric population, particularly in children aged 5–7 years.[1] As a metaphyseal injury, the supracondylar humerus fracture occurs nearly exclusively in juvenile skeletons, and rarely in children beyond the age of ten. Commonly observed in developing skeletons, ligamentous laxity is also related with hyperextension of the elbow, focusing a bending stress on the vulnerable supracondylar region. In these instances, correct anatomical reduction in the coronal plane is crucial since residual deformity in this location is less likely to reconstruct.[2]

Fractures of the supracondylar region of the humerus that are not displaced typically require only basic immobilization for comfort and protection. In contrast, displaced supracondylar humerus fractures in children constitute a problem for surgeons, as the treatment of choice is still debatable in terms of functional and cosmetic outcomes as well as surgical risks. Open Reduction Internal Fixation (ORIF) and Closed Reduction with Percutaneous Pinning are two of the most frequent surgical treatments performed for this issue (CRPP). While some of the most popular conservative treatment options include closed reduction and cast immobilization, traction, and collar and cuff, surgical intervention is sometimes necessary.[1,3]

In cases of displaced supracondylar humerus fractures, conservative treatment has historically been advised; nonetheless, loss of reduction frequently occurs, necessitating recurrent manipulation to rectify malunion, varus or valgus deformity, and stiffness. In addition, surgical treatment is typically reserved for more complex situations or when non-invasive treatments fail. In recent years, there has been a tendency toward surgery fixation of displaced fractures, however there is no consensus on the best successful therapy. Given the paucity of publications on the appropriate care for such injuries, this systematic review and meta-analysis attempts to assess the efficacy of conservative versus open reduction with internal fixation for the disease (ORIF).

Method

Search Strategy

A systematic review was conducted using PubMed and Google Scholar in accordance with the PRISMA guidelines to find relevant papers, which were identified using the search terms "conservative" AND "Open Reduction Internal Fixation" AND "supracondylar humerus fracture" until February 2023. All authors then individually scanned and reviewed these data.

Eligibility Criteria

Inclusion criteria were studies comparing conservative versus ORIF surgery for supracondylar humerus fractures Gartland type II and III, with Flynn criteria as the primary outcome, were considered eligible. Exclusion criteria were studies of only one surgical procedure modality, Gartland type I, as well as case reports. Studies with samples older than 18 years of age were removed from the analysis, as the World Health Organization (WHO) defines pediatric population as those ≤18 years of age. The Gartland type I fracture was omitted due to its limited degree of displacement, and case reports were excluded due to their insufficient sample size.

Data Extraction and Outcome

Results

Databases searching identified a total of 48 articles (Fig. 1), and they were screened based on the inclusion and exclusion criteria included in the study selection. After duplicates removed, there is 31 articles. Of these, 10 articles passed the screening process and resulted in 8 articles for full-text assessment. The two articles did not compare the outcome of two interventions of interest. Hence, we found 5 appropriate studies included in this review (Figure 1).

A total of 128 patients aged 1–15 years old were included in the analysis. Study designs were all cohort prospective (Level II-III). Three studies were published in 2016, one in 2017, and one in 2020. From 128 patients, 69 patients were treated conservatively and 59 operatively by ORIF. From 69 conservatively treated patients, most were Gartland type II whereas in the ORIF group, most were Gartland type III. Conservative treatments included cast, splint, and closed reduction followed by collar and cuff. Operative treatment includes Open Reduction Internal Fixation, with plate-screw and intramedullary pinning as fixation modality.

Patients were functionally evaluated using Flynn's criteria. Flynn's criteria comprise two factors: "cosmetic factor" (angle loss) and "functional factor" (degrees of motion loss). This study categorized Flynn's criteria into good and unsatisfactory outcomes. Fair and poor performances are deemed unsatisfactory, whereas excellent and good results are deemed satisfactory.

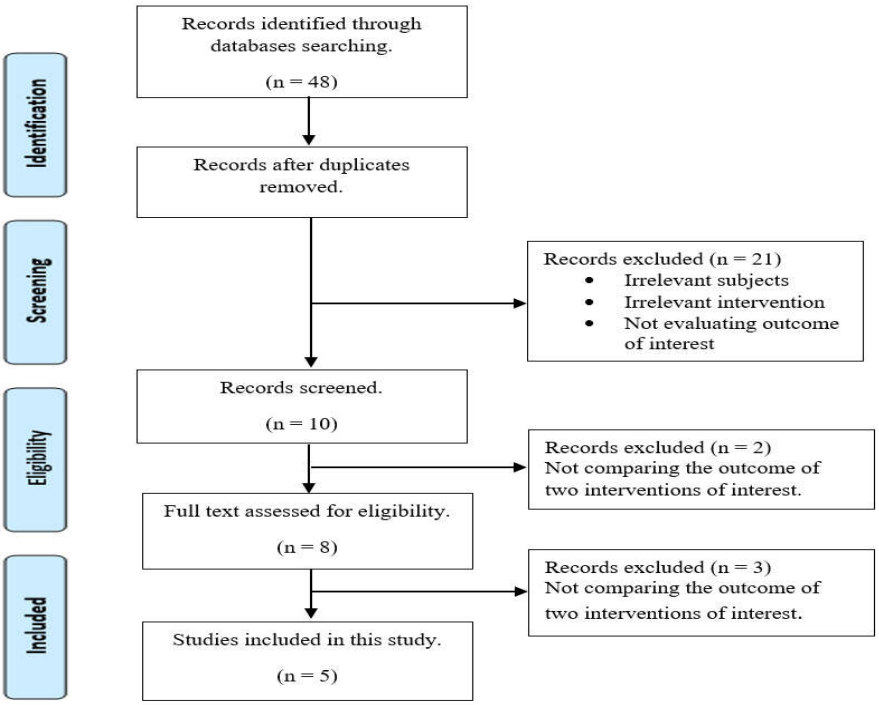

Figure 1. PRISMA flow diagram

Table 1. Patient characteristics of the included studies

Author (Year)	Patient Characteristics					Procedure	
	Sample size	Age (years)	Sex	Grade			
				Conservative	ORIF	Conservative	ORIF
Kular and Kaur (2016)[4]	42	2–15	N/A	Gartland Type II and III	Gartland Type II and III	Closed reduction: 23	19
Sinikumpu et al. (2016)[2]	28	6.3 (1.2-14.6)	Male: 12 (43%) Female: 16 (57%)	Gartland type II: 17 (60.71%) Gartland type III: 1 (3.57%)	Gartland type II: 2 (7.14%) Gartland type III: 8 (28.57)	Splinting: 18 (64.29%)	10 (35.71%)
Joshi et al. (2016)[3]	3	9.5±2.1 (6-14)	Male: 2 (66.7%) Female: 1 (33.3%)	Gartland Type III: 1	Gartland Type III: 2	MUA Cast: 1 (100%)	Mini open Intramedullary pinning: 1 (50%) Debridement + ORIF: 1 (50%)
Sachin and Asimuddin et al. (2017)[1]	20	1–14	Male: 12 (60%) Female: 8 (40%)	Gartland type III: 10 (50%)	Gartland type III: 10 (50%)	Closed reduction + Splint + Collar and Cuff: 10 (50%)	10 (50%)
Vinay and Anand (2020)[5]	35	<4-14	Male: 25 Female: 15	Gartland type III: 17	Gartland type III: 18	Closed reduction and POP slab: 17	18

Table 2. Outcome and complication of the inclided studies

Author (years)	Outcomes						Complications		Follow-up (months)
	Functional		Hospital stays (days)		Other outcomes				
	Conservative	ORIF	Conservative	ORIF	Conservative	ORIF	Conservative	ORIF	
Kular and Kaur (2016)[4]	Excellent: 36% Good: 16% Poor: 48%	Excellent: 52% Good: 32% Poor: 16%	N/A	N/A	N/A	N/A	Cubitus varus: 12	Superficial wound infection:2 (8%) Deep wound infection:1 (4%) Cubitus varus: 3 (12%)	6
Sinikumpu et al. (2016)[2]	12 (66.67%)	9 (90%)	N/A	N/A	Mayo Elbow Performance Scores 96,4 ± 8,2		N/A	N/A	145.2 (123.6 – 193.2)
Joshi et al. (2016)[3]	Good:1(100%)	Good:1(50%) Fair:1(50%)	N/A	N/A	N/A	N/A	N/A	N/A	12.9 ±3.9
Sachin and Asimuddin et al. (2017)[1]	Excellent: 3 (30%) Good: 1 (10%)	Excellent: 6 (60%) Good: 3 (30%)	2 days	12 days	N/A	N/A	Vascular Injury: 1(2.5%) • Radial Nerve Injury: 1 (2.5%) • Elbow Stiff ness: 2 (5%) • Cubitus Varus: 3 (7.5%) • Cubitus Valgus: 1 (2.5%) • Superficial Pin Tract Infection: 1 (2.5%)		8.6
Vinay and Anand (2020)[5]	Excellent: 0 Good: 4 (23.52%) Fair: 5 (29.41%) Poor: 8 (47.05%)	Excellent: 11 (61.11%) Good: 5 (27.77%) Fair: 1 (5.55%) Poor: 1 (5.55%)	N/A	N/A	N/A	N/A	N/A	N/A	6

Discussion

Supracondylar humerus fractures are the most prevalent fractures of the elbow in children, with an estimated incidence of 177,3 per 100,000 and a male predominance of 16% of all pediatric fractures. 90% of all instances appear between the ages of 5 and 7 years old, and the non-dominant arm is more frequently affected.[6] Due to the most common mode of injury, which is a fall onto the outstretched hand with the elbow in full extension, 97 to 99% of these fractures appear clinically in extension. The substantial risk of potentially limb-threatening acute consequences due to the involvement of neurovascular structures necessitates strict observation and protocol management. Possible complications associated with these fractures include cubitus varus deformity, prolonged immobility, and social repercussions for the kid and family.[7]

Included in displaced supracondylar fractures are types II and III Gartland fractures. The Gartland type II fracture is displaced (by more than 2 mm), and the posterior cortex is likely intact but hinged. In contrast, a Gartland type III fracture is a dislocated supracondylar fracture with no significant cortical contact. Moreover, in Gartland type III fractures, there is both a translational and a rotational displacement, which can explain the higher percentage of lateral rotation. In displaced supracondylar humerus fractures, compromised soft tissue due to severe trauma may limit precise reduction and stable fixation utilizing closed techniques. Additionally, an unstable fracture architecture and a short lever arm can enhance the chance of reduction loss. 6 Closed reductions with plaster of Paris slab immobilization has historically been suggested for displaced supracondylar fractures, however loss of reduction and the need for repetitive manipulation are likely to result in malunion resulting in varus or valgus elbow deformity and elbow stiffness. On the other hand, immobilization with a plaster cast/moulded gutter-shape slab in extension has also been recorded, albeit with cubitus varus fractures in flexion.[8]

To restore normal elbow architecture, numerous nonsurgical and surgical techniques have been devised, such as long-arm plaster cast immobilization, application of axial traction with tape or a trans olecranon pin, elastic and secure intramedullary nailing, and external fixation. In addition, percutaneous pinning is widely recognized as the most advanced method. In addition, individuals with unstable and complicated fractures, as well as vascular problems, are candidates for open surgery. Standard treatment for unstable supracondylar humerus fractures in children is closed reduction followed by percutaneous Kirschner wire stabilization. In addition, multiple studies have demonstrated favorable outcomes.[9,10]

The conservative and surgical treatment of Gartland type IIB SCHF is not superior to each other if anatomic reduction is achieved. Complications of each treatment can be prevented by following strict treatment principles. Although the management of supracondylar fractures of the humerus in children should focus on achieving fracture union and gaining a pain-free full range of motion at the end of treatment, conservative methods may still be considered for low-demanding patients and patients for whom surgery cannot be performed due to severe comorbidities. However, when conservative treatment fails to satisfy surgically eligible, physically-active patients, surgical intervention is unavoidable. Therefore, despite the dangers associated with surgery, operative techniques such as ORIF should be regarded the preferred treatment for the pathology.[8,10]

There are limited studies comparing the outcome between conservative and ORIF in supracondylar humerus fracture in children. In this study, ORIF was found to be superior than conservative treatment in achieving satisfactory functional outcome. Closed reduction and percutaneous pinning are the treatment of choice for pediatric supracondylar humerus fractures with Modified Gartland's type II and type III. Appropriate pinning technique ensures a successful outcome with cross configuration providing excellent outcome with good rotational stability. Closed reduction and percutaneous pinning is a safe, cost-effective, less morbid procedure.[11] Umur et al. found that the conservative and surgical treatment of Gartland type IIB in supracondylar humerus fracture is not superior to each other if anatomic reduction is achieved. Complications of each treatment can be prevented by following strict treatment principles.[12] According to Arunodhaya et al. all type IIA fractures can be managed conservatively without risk of loss of reduction or need for another operative procedure, also percutaneous cross K-wiring for type IIB fractures gives excellent outcome.[13]

There were several limitations in this systematic review: (1) only 5 studies were included, therefore it may not represent the whole results and prone to wrong conclusion;(2) the management of the conservative treatment was different from one study to another, and thus may contribute to the heterogeneity of the outcomes; more RCTs are needed to further accurately identify the clinical outcomes of these two managements.

Conclusion

ORIF delivers superior functional and cosmetic outcomes when compared to conservative treatment for pediatric supracondylar humerus fractures.

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