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Meta-Analysis

Comparison of Functional Outcome of Lateral versus Posterior Approach for the Treatment of Supracondylar Humeral Fracture in Children: A Systematic Review and Meta-Analysis

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Abstract

Introduction: Supracondylar humeral fracture (SHF) is a common elbow injury in children, comprising 55-75% of distal humerus fractures. Most cases require surgical treatment, particularly in displaced fractures (Gartland type 3 or 4). While closed reduction and percutaneous pinning (CRPP) is the preferred approach, open reduction and internal fixation (ORIF) is required in certain cases, necessitating a choice between surgical techniques. However, there is no consensus on the optimal approach, particularly between the posterior and lateral methods.
Methods: A systematic review was conducted according to PRISMA guidelines to compare the functional outcomes of lateral versus posterior surgical approaches for SHF in children. A comprehensive literature search of PubMed, Google Scholar, and Cochrane Library identified eligible studies from January 2015 to June 2022. Inclusion criteria encompassed randomized controlled trials and comparative studies evaluating functional outcomes. Data were analyzed using Review Manager 5.4, applying fixed or random effects models based on study heterogeneity.
Results: Four studies met the inclusion criteria. The lateral approach demonstrated superior functional outcomes compared to the posterior approach, showing higher odds of excellent (OR 2.63, 95% CI [1.28-5.39]) and good (OR 1.12, 95% CI [0.51-2.17]) results. The posterior approach had shorter operative times but resulted in greater soft tissue damage and potential triceps weakness.
Conclusion: Both lateral and posterior approaches yield satisfactory functional outcomes for SHF treatment in children. While the lateral approach offers better postoperative function and lower complication rates, the posterior approach provides a broader surgical field. Surgeon preference, expertise, and patient-specific considerations should guide the selection of the surgical approach. Further high-quality randomized trials are needed for definitive recommendations.

Keywords: Supracondylar Fractures, Humeral Fractures, Orthopedic Surgical Procedures, Elbow Injuries, Fracture Fixation, Internal

Introduction

Children's elbow injuries called supracondylar humeral fractures (SHFs) almost always need surgical treatment. Children between the ages of five and seven account for roughly 60–70% of all elbow injuries.[1] According to reports, the setting at kids playgrounds accounts for 25–40% of SHF cases in the USA.[2] Children can sustain injuries to the elbow joint, but 85% of those injuries occur in the distal humerus area, and between 55% and 75% of those fractures are supracondylar humerus fractures. The incidence of SHF is predicted to be 177.3 per 100,000 kids annually in the US. Additionally, there is a seasonal variation for the occurrence of trauma as the main cause of SHF. According to the literature, SHF is more common in the left elbow or non-dominant limb and occurs more during the summer.[3] SHF may also result in a medical emergency called compartment syndrome. In 0.3–1% of all SHF patients, this complication poses a risk to life and limb. According to research by Houshian et al., there are 308 elbow fracture events for every 100,000 people per year, with supracondylar humeral fracture accounting for 58% of these incidents.[4,5]

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There are two types of therapy options for SHF in children: non-operative and operational. The major treatment option is non-operative when the fracture configuration is either not displaced (Gartland type 1) or only moderately displaced (Gartland type 2). The gold standard for treating displaced fractures (Gartland types 3 or 4), however, is surgery using closed reduction methods and percutaneous pinning with Kirschner wire insertion (CRPP). If these efforts are unsuccessful, an open reduction and internal fixation (ORIF) procedure is then carried out to produce an ideal reduction. The effect on the functionality of the elbow joint depends on the anatomical healing of misplaced fractures.[6] Nevertheless, the lack of intraoperative fluoroscopic imaging makes CRPP frequently impractical in areas or nations with constrained conditions (i.e., C-arm). Thus, the only option in this case is open reduction surgery.[7]

Open reduction surgery for SHF uses a variety of surgical techniques. The lateral, medial, anterior, and posterior techniques are a few that are frequently used. A combination of them is frequently used because they each only allow vision of a portion of the fracture site. Except for the anterior route, the three operating approaches (lateral, medial, and posterior) might all involve reasonably simple operating procedures. A lateral technique is frequently employed because it significantly lessens damage to crucial neurovascular and soft tissue systems while yet providing enough exposure to relocate the fracture site. If necessary, this procedure can occasionally be paired with a medial approach, but doing so will result in the addition of a second scar and significant soft tissue exposure. An alternative method is the anterior approach, which has a number of benefits, one of which is the ability to remove hematoma from the fracture site since typically, hematoma would accumulate on the anterior side of the fracture site. However, the disadvantage of the anterior approach is its difficult technique because there will be many neurovascular systems (such as the median nerve and capitellar blood supply) that need extra consideration, making the operation more difficult. Furthermore, because it is straightforward and requires less identification of neurovascular structures, the posterior surgical approach is also frequently used, which reduces the length of the procedure[6]. Because simultaneous reduction and manipulation of the K-wires looks difficult, the anterior approach is therefore technically more difficult than the posterior method.[7]

There is still no definitive agreement on which surgical technique should be employed as the primary technique in open repositioning surgery for the treatment of SHF in children. In order to achieve the goal of high patient satisfaction, it is our intention to conduct a thorough systematic review to identify the best surgical approach in SHF, particularly comparing those that are frequently chosen and used globally (including in limited settings), namely the posterior and lateral surgical approaches.

Materials and Methods

Search Strategy

A systematic review was conducted in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Figure 1). A comprehensive literature search was performed to gather a full-length, peer-reviewed paper in English on the comparison of functional outcomes between lateral versus posterior approaches for supracondylar humeral fractures. We searched PubMed, Google Scholar, and Cochrane Library. The focus of this systematic review and meta-analysis is to compare functional outcomes for supracondylar humeral fractures in lateral versus posterior approaches. Keywords in the search matched the MeSH rule, and terms used are (“lateral approach”), AND (“posterior approach”), AND (“supracondylar humeral fracture”). This was performed from January 1, 2015 to June 1, 2022.

Inclusion Criteria

This study included unique articles providing details regarding (1) randomized controlled trials or comparative studies; (2) comparing the outcomes of patients with supracondylar humeral fractures with lateral versus posterior approach; and (3) articles satisfying at least one primary or secondary outcome. Insignificant articles and studies that neglected to meet inclusion criteria were rejected.

Quality Evaluation

Assessment of study quality and risk of bias was assessed using criteria developed by the Oxford Center for Evidence-Based Medicine, perspicacity defined by the Grades of Recommendation Assessment, Development and Evaluation (GRADE) Working Group, and sanction made by the Agency for Healthcare Research

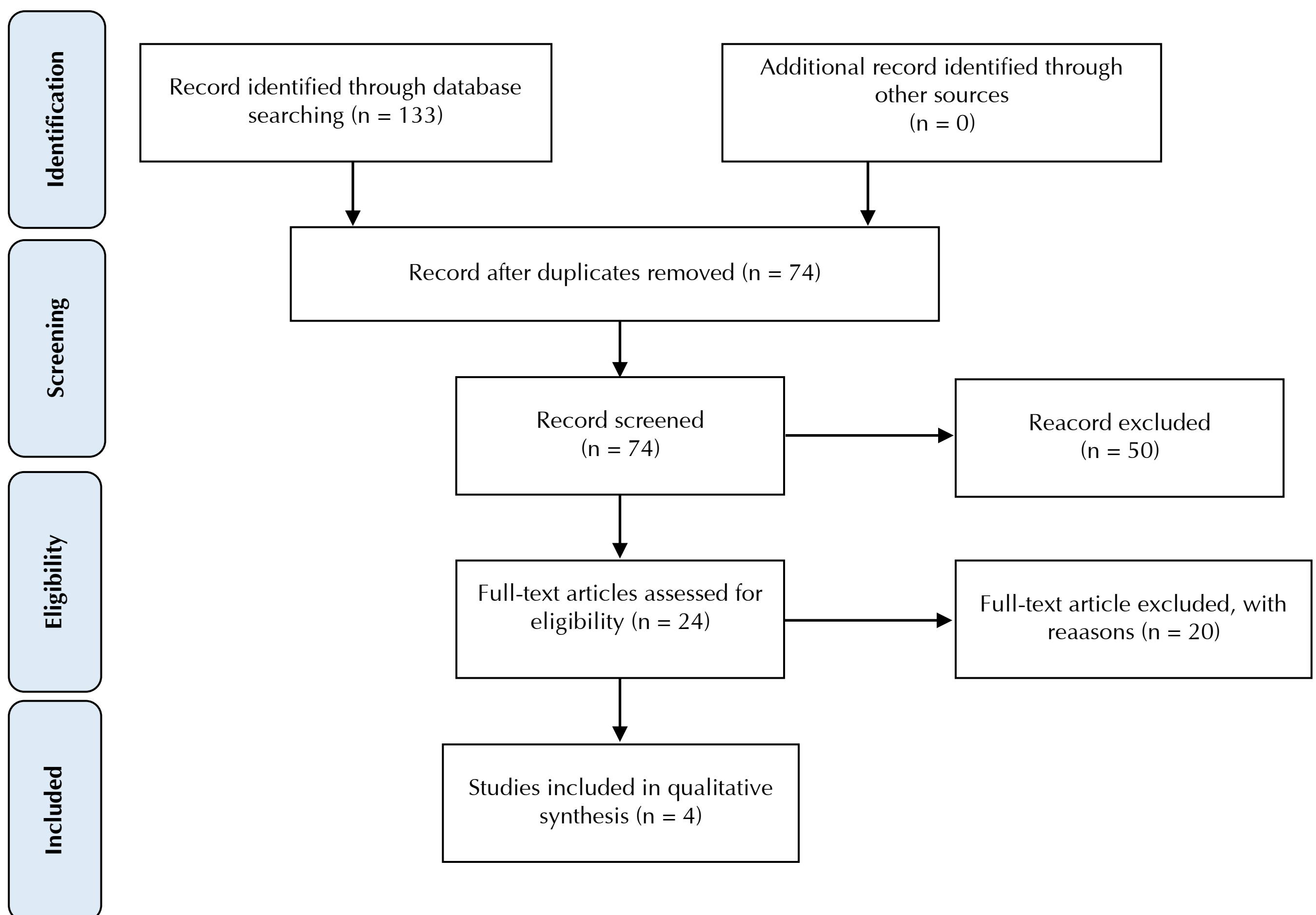


Figure 1. Flowchart (PRISMA methodology)

and Quality (AHRQ). While the class of evidence is categorized into "class I" for good-quality RCT, "class II" for moderate-to poor-quality RCT and good quality cohort, "class III" for moderate-or poor-quality cohorts and case-control studies, and "class IV" for the case series.

Results

Literature Search, Study Selection, and Study Characteristics

The electronic research resulted in 133 records from various databases. After the process of identification, screening, eligibility, duplication elimination, and exclusion, the remaining 4 studies were included in qualitative and quantitative synthesis. The remaining articles were excluded due to lack of mean and standard deviation data and did not meet the inclusion and exclusion criteria.

Statistical Analysis

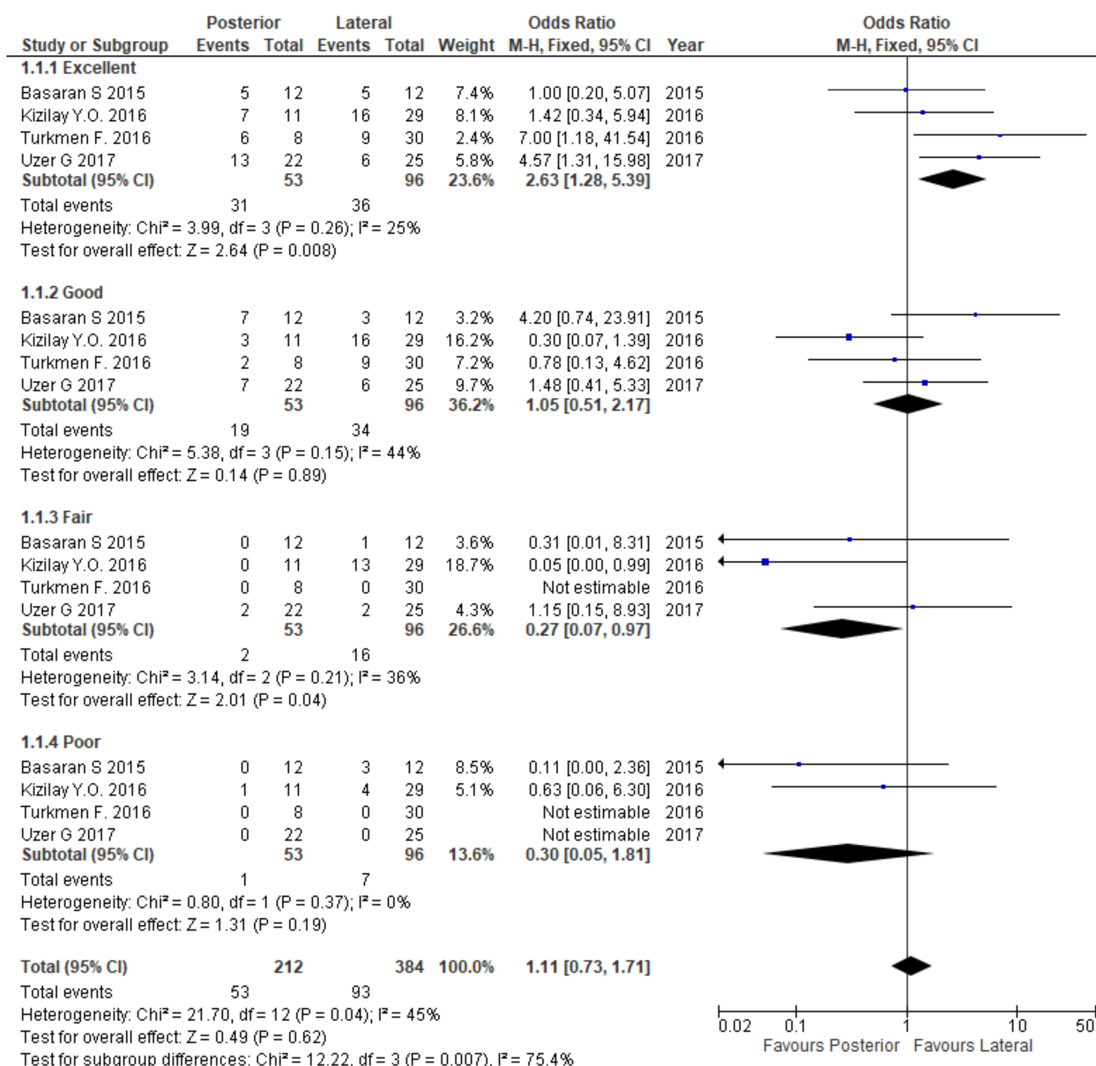
We utilized the Review Manager version 5.4 software (RevMan; The Cochrane Collaboration, Oxford, England) to perform all statistical analyses. Based on the heterogeneity of the current study, we performed a sensitivity analysis to further assess the overall results. The heterogeneity across studies was examined through the I^2 statistic, described as follows: low, 25% to 50%; moderate, 50% to 75%; or high, >75%. We applied the fixed-effect models to calculate the total MDs/ORs when low heterogeneity was seen in studies. In other cases, we used the random effects model. Studies with a *P*- values less than .05 were thought to have statistical significance. Forest plots showed the findings of our meta-analysis.

Functional Outcome

Subgroup 1.1.1 shows the functional outcome of the meta-analysis in the excellent subgroup, while Subgroup 1.1.2 shows the meta-analysis' functional outcome in the good subgroup. The lateral approach was 163%

(OR 2.63, 95% CI [1.28-5.39]) and 5% (OR 1.12, 95% CI [0.51-2.17]) more likely to result in the excellent and good results, respectively, compared to the posterior approach. These differences were statistically significant in excellent subgroup (P = 0.008) and not statistically significant in the good subgroup (P = 0.89).

Moreover, the lateral approach resulted in lower fair and poor results by 73% (OR 0.27, 95% CI [0.07-0.97]) and 70% (OR 0.30, 95% CI [0.05-1.81]), respectively, compared to the posterior approach (Subgroup 1.1.3 and 1.1.4). These differences were statistically significant in the fair subgroup (P = 0.04) and not statistically significant in the poor subgroup (P = 0.19).



Discussion

Supracondylar humeral fracture (SHF) is a type of elbow injury in children that most often requires operative therapy compared toother injuries. 60 to 70% of all elbow injuries in children occur between five and seven years of age.[1] The SHF types that often require ORIF are those that fall into Gartland classification type 3 or 4. There is a shift from the fracture location in these types, making the configuration very unstable. Moreover, the unsuccessful reduction of minimally displaced fractures (i.e., Gartland type 2) also needs ORIF.

The high incidence of SHF makes the decision of which surgical approach to perform crucial. Surgical approaches to manage elbow injuries can be performed with the anterior, lateral, medial, or posterior approach. There is no clear evidence of which approach is superior based on the functional. Some of the surgical approaches that are commonly performed are the lateral and posterior approaches. Our study found that the lateral approach gave superior results to the posterior approach in the excellent subgroup

assessment using Flynn's criteria for functional outcomes. It was also superior in the good subgroup for functional outcome. However, these differences were not statistically significant. A lateral approach is an approach with the less exposure to the elbow's essential structures than other approaches. It also has fewer surgical wounds that could interfere with elbow joint range of motion.[8]

This study also found that the lateral approach resulted in fewer poor outcomes than the posterior approach as evaluated using Flynn's criteria in the functional assessments. In other words, the lateral approach had an overall better result than the posterior approach, but this difference was not statistically significant. There is a considerable amount of damage to the triceps muscle in the posterior approach, which can interfere with the muscle's function postoperatively, causing as high as 6% muscle strength reduction compared to preoperative conditions.[9]

The lateral surgical approach is quite popular because it has the least risk of damaging vital structures such as the ulnar nerve, brachial artery, and capsule ligament at the elbow compared to other surgical approaches. Based on this study, the lateral approach's surgical wound is preferred because it is less visible than the other approaches. Moreover, the lateral approach is a safe approach due to the good visual field of the elbow anatomy and adequate exposure to the radiocapitellar compartment. This approach is easily carried out through the internervous plane, which minimizes nervous injury so that the risk of iatrogenic nerve damage is minimal. Besides, the lateral approach has a better fracture perspective than other approaches.[8–12]

In addition, the lateral approach is safer because less soft tissue is dissected, avoiding ulnar nerve damage. In cases requiring ORIF, the lateral approach is minimally invasive with minimal soft tissue dissection compared to the posterior approach. This is associated with the dissection or division of the triceps muscles, which often experiences more postoperative adhesions.[12] However, soft tissue swelling is frequently found in the lateral approach, especially when combined with the medial approach to obtain better surgical exposure. Still, there is no consensus on which approach is superior.[13] In addition, patients treated with a lateral approach tend to have fewer unstable fractures, complications, and re-operations. Previous research has shown that the lateral approach results are very satisfying, which shows that approximately 67-91.8% of them were successful.[14] This finding is similar to the study conducted by Sarrafan et al., who reported that 90.9% of 33 patients who underwent the lateral approach obtained excellent results.[12]

Meanwhile, on the other hand, the posterior surgical approach is popular because it has a shorter operating time compared to other approaches.[15] However, this surgical approach is sometimes avoided by some surgeons because the triceps muscle is damaged in the process of reaching the fracture line.[16] Nevertheless, a study conducted by Chen et al. reported the posterior approach's superiority compared to anterior and medial approaches in terms of surgery duration and blood loss during elbow surgeries. They found that the shortest surgery duration was the posterior approach (62.9 ± 7.4 minutes), which was shorter than the anterior and medial approaches (64 ± 7.6 and 73.7 ± 7.3 minutes, respectively). Besides, the posterior approach resulted in less blood loss compared to the anterior and medial approaches (135.8 ± 44.7, 147.1 ± 42.7, and 171.3 ± 34.6 ml, respectively).[17]

In the present study, both lateral and posterior surgical approaches resulted in satisfactory results in more than 90% of the cases analysed. Although the posterior approach has been associated with several complications, such as decreased strength of triceps muscles, previous studies have shown that the functional results were comparable to medial and lateral approaches. Moreover, the posterior approach's advantage, such as a wider surgical field of view, allows a trouble-free reduction process, resulting in shorter surgery time. Thus, the posterior surgical approach should always be considered whenever appropriate.[18]

The limitation of the current study is the language restriction to only English-language articles; thus, we may have missed other eligible studies written in other languages. Another limitation is the low number of studies that were included in the analysis. Moreover, all of the included studies were level III studies. Thus, the present review's evidence level may not be the highest, as we did not find any randomized controlled trials (RCTs). However, we believe that our search strategy was comprehensive and robust. Moreover, we conducted a thorough bias analysis based on the Cochrane recommendation. Thus, our results represent

the current best evidence on this topic. Future studies should conduct high-quality original research, preferably RCT, to provide better evidence. Moreover, a study comprising a direct comparison of all existing approaches for SHF management is still needed.

Conclusion

According to Flynn's standards, both lateral and posterior surgical techniques produced positive functional outcomes. In terms of providing ideal functional outcomes for the therapy of SHF in children, the two surgical procedures were equivalent. However, a surgeon's selection of a surgical method should be based on an assessment of their experience and skill.

Conflict of Interest

The authors declare no conflicts of interest.

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