Open Reduction of Supracondylar Humerus Fractures In Children For Failed Closed Reduction: Outcome of Delayed Treatment

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Abstract

Supracondylar fractures of the humerus are common occurrences in children, and the advocated treatments include closed reduction and percutaneous pinning. There are numerous debates on intervention period selection for delayed treatment in children. This phenomenon is prevalent in regions with limited healthcare support. The objective of this study was to compare the outcome of early and late groups, including preliminary presentations and the management for failed treatments. This research involved the prospective study and comparison of early and late open reduction, featuring Kirschner wire fixation for Gartland type III supracondylar fracture of humerus in children aged less than 18 years. The result from 22 and 26 cases were respectively examined in the early and late groups. Therefore, Flynn's criteria were used to evaluate the span of surgery, motion range, and functional outcomes. There were thirty-three (86.8%) male, and 15 (31.25%) female patients. Furthermore, the average Injury to surgery time was 49.72 ± 32.1 hours in the early group and 421.25 ± 82.16 hours in the late group ($p<0,002$), While the Bauman's angle recorded after 12 weeks was 82.04 ± 5.18 and 77.38 ± 6.43 ($p=0,622$), respectively. Moreover, pre-operative nerve injuries were observed only in 4 (8.33%) cases from the early group. The p-value between the functional outcomes of both categories were not significant statistically ($p=0,242$). The treating outcome for children with supracondylar humerus fracture Gartland type III was satisfactory in both groups.

Key Words: children, delayed, early, fracture, supracondylar.

Reduksi Terbuka Fraktur Supracondiler Humerus Pada Anak Dengan Gagal Reduksi Tertutup: Hasil Pengobatan Tertunda

Abstrak

Fraktur supracondiler humerus umum terjadi pada anak-anak, dan tatalaksana yang dianjurkan termasuk reduksi tertutup dan *percutaneous pinning*. Terdapat banyak perdebatan tentang pemilihan periode intervensi untuk pengobatan yang tertunda pada anak-anak. Hal ini banyak terjadi di wilayah dengan penunjang kesehatan yang terbatas. Tujuan dari penelitian ini adalah untuk membandingkan hasil dari kelompok dengan tatalaksana dini dan tertunda, termasuk gambaran klinis awal dan manajemen untuk tatalaksana yang gagal. Penelitian ini melibatkan studi prospektif dan perbandingan reduksi terbuka dini dan terlambat, dengan fiksasi kawat Kirschner untuk fraktur supracondiler Gartland tipe III pada anak-anak berusia kurang dari 18 tahun. Hasil dari 22 dan 26 kasus masing-masing diperiksa pada kelompok dini dan terlambat. Oleh karena itu, kriteria Flynn digunakan untuk mengevaluasi rentang operasi, rentang gerak, dan keluaran fungsional. Terdapat tiga puluh tiga (86,8%) pasien laki-laki, dan 15 (31,25%) pasien perempuan. Selanjutnya rata-rata waktu cedera menuju operasi adalah 49,72 ± 32,1 jam pada kelompok dini dan 421,25 ± 82,16 jam pada kelompok terlambat ($p < 0,002$), sedangkan sudut Bauman yang tercatat setelah 12 minggu adalah 82,04 ± 5,18 dan 77,38 ± 6,43 ($p = 0,622$), masing-masing. Selain itu, cedera saraf pra-operasi diamati hanya pada 4 (8,33%) kasus dari kelompok dini. Nilai p antara luaran fungsional kedua kategori tidak signifikan secara statistik ($p = 0,242$). Hasil pengobatan

untuk anak-anak dengan fraktur supracondiler humerus Gartland tipe III memuaskan pada kedua kelompok.

Kata kunci: anak, dini, fraktur, suprakondiler, tertunda.

INTRODUCTION

Supracondylar fractures of the elbow accounts for 16.6% of all fractures cases in pediatric patients.[1,2] However, a broad range of nonoperative and operative methods have been developed to restore normal elbow anatomy, including long-arm plaster cast immobilization, application of axial traction with tape or a trans olecranon pin, elastic and stable intramedullary nailing, and external fixation.[2-4] Also, percutaneous pinning is widely adopted as the most advanced technique. Furthermore, open surgery is indicated in patients with unstable and compound fractures, as well as vascular complications.[1-3] The standard treatment for unstable supracondylar fractures of the humerus in children involve closed reduction, followed by stabilization with percutaneous Kirschner wires. Moreover, numerous studies have demonstrated satisfactory outcomes.[2-4]

Gartland type I and type II fractures have been accurately treated with conservative treatment. However, the modalities for type III include sidearm traction, overhead skeletal traction, closed reduction and casting with or without percutaneous pinning, as well as open reduction and internal fixation.[3-4] Furthermore, a displaced fractures are highly challenging to manage with closed reduction and pop cast. This results from the loss of reduction and missing the coronal tilt on a radiograph, therefore causing cubitus varus deformity.[5,6]

In addition, treatment delays are very common in developing countries.[9,10] The objective of this retrospective study, therefore, was to compare the results from early and late presentation and management cases.

METHODS

Sources of research data was secondary data, which is by looking at the outpatient and inpatient medical record data of orthopedic patients with osteogenesis imperfecta diagnosis with femur fracture after for supracondylar elbow fractures from January 2018 to January 2019, at the pediatric surgery department of Orthopedi & Traumatologi. Surgery was conducted on a total of 48 children for supracondylar elbow fractures. The patients were designated into Group A - children undergoing operative treatment within 7 days of injury, and Group B - children receiving operative treatment after 7 days of injury and within 30 days. Therefore, the results from 22 and 26 cases respectively obtained from the early and late groups were evaluated in the final analysis. The inclusion criteria were patients that declined treatment with closed reduction; included in category of Gartland type III Supracondylar Humerus Fracture; children below 18 years of age; and delayed treatment cases of more than 7 days.

The patients were treated with open reduction and k wire fixation by lateral approach and minimal incision to enable ulnar nerve visualization at the medial side, using two crossed k wires. Subsequently, immediate postoperative complications were recorded, and the wound was monitored for 2 days post-surgery. Therefore, the patient is discharged after 48 hours in the absence of any complications, and an above elbow posterior slab is used postoperatively for 3 weeks.

The patients were further reviewed after 2 weeks (pin tract infection, suture removal) and 12 weeks. The process involved the evaluation of pain, motion range, evidence of union, infection, or for any external malrotation, dorsal and volar angulation and myositic mass. Therefore, fresh radiographs were captured during every visit, and the final follow up evaluationwas based on the flexion-extension arc of both the injured

& uninjured elbow. In addition Bauman`s angle was used for the radiographic assessment of both elbows, while Flynn`s criteria was used to assess the patient in the last visit (12 weeks).

The data obtained will be analyzed using SPSS using *chi-square* and presented in tables and graphs. This study has already approved by ethical committee with ethical clearance number.

RESULTS

There were no significant differences between the early and late groups in terms of age, intraoperative time, hospital stays, postoperative changes in Baumann's angle, and loss of motion range at 12 weeks. In addition, all patients presented with fall injury, encompassing thirty-three (86.8%) males and 15 (31.25%) females. This data was highly similar to other studies, where 22 (45.8%) patients in the early group were admitted within 24 hours of injury, while 26 (54.1%) presented between day 1 to 6. Moreover, 2 patients in this current study demonstrated complications in the form of mild fever, swelling, and serous discharge, which was totally absent in the late groups. Furthermore, there were no participants with surgical site infection at the end of 12 weeks follow up period in either group, marked by the absence of pain.

Table 3 shows the excellent results in 17 (77.2%) patients from the early group, while 19 (73.1%) in the late group demonstrated the best outcome. In addition, 3 (13.6%) and 4 (15.3%) patients respectively had good results, while 2 (10%) and 3

(11.5%), correspondingly had a poor result. Moreover, no participant in either category had a fair result, at p-value of 0.242, which is not significant, being >0.05.

DISCUSSION

A fall often causes major injuries, and playing with bicycles was identified as the highest instigator in the early group (38.23%). Meanwhile, playing caused the maximum injury (45.2%) in the late group, which is consistent with other studies.[10-13] The treatment option besides closed reduction is open reduction with pinning. Open reduction is indicated in the cases of failed closed reduction, loss of pulse or poorly perfused hand following reduction and in the case of open fracture.[13]

Furthermore crossed medial and lateral pinning via lateral approach was performed with minimal incision on the medial side, to visualize ulnar nerve. Despite the cut made during the procedure, no postoperative ulnar nerve injury was reported, and there was also no case of reduction loss during attempts to engage the opposite cortex. However, recent literature show the use of only lateral pinning as sufficient for fixing supracondylar fracture.[11-15]

Bayisenga J. *et al* evaluated the early outcome of open reduction and internal fixation of Lagrange & Rigault stage IV supracondylar humerus fractures in children in Rwanda, using K-wires pinning. The result confirmed the method's effectiveness, especially in cases of delayed treatment and in settings with no intensifier imaging. Also, there was no increase in the complication rate.[20]

The results showed a nonexistence of non-union cases in both groups, as distal humerus is an unusual location.[16,17] Therefore, all patients experienced clinical and radiological union within 3 weeks, as well as united fractures at 12 weeks follow up. These findings are congruent with studies conducted by others, hence open reduction and internal fixation procedure is confirmed to not be a concern during union. Furthermore, the assessment using Flynn's criteria showed no significant difference between the outcomes of both treatment groups (P=0.242).[15-18]

Flynn`s criteria in the early group showed excellent and good results in 77.2%, and 13.6% cases, respectively, while 10% exhibited poor outcome. Moreover, the corresponding results for the late group were 73.1 %, 15.3% and 11.5% cases. The data obtained for arc of motion, range of motion, loss of flexion, extension, and change in Baumann's angle were comparable between both groups, with p-value > 0.05. This outcome possibly resulted from soft tissue injuries, posttraumatic remodeling, fibrous surgical scars, and malunion.[15, 16]

In an observational study of 31 children with supracondylar humerus fractures, Abdullah Eren *et al* reported on the presentation of severe swelling or skin problems around the elbow in delayed treatments, and also on unique health facility problems. Hence, surgical treatments, including sentiment manual reduction through a medial approach and percutaneous cross-pinning was provided. Based on the results, delayed presentation was confirmed to not increase complication rates or unsatisfactory results.[20]

Although there is growing agreement that pin fixation provides best results, there is some controversy regarding the timing of treatment. Some fracture, for example type III fractures were regarded as an orthopaedic emergency that has to be treated immediately. However, recent studies showed good result even if it's treated urgently.[20]

This study was limited by the small sample size and constrained follow up duration, resulting from poor patient cooperation. Based on the result, displaced Gartland type III supracondylar humerus fracture in children is effectively treated with anatomical reduction and stable fixation. In addition, the treatment outcome was adequate in both groups, and late complications are also avoided.

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TABLES

1. Table 1. Comparison of patient profiles between early and late surgery groups
2. Table 2. Comparison Between Arc of Motion
3. Table 3. Comparison of Functional Criteria by Flynn

Table 1. Comparison of patient profiles between early and late surgery groups

Variables	Group (Mean ± SD)		P value
	Early	**Late**	
Age (years)	9,33 ± 1,67	8,76 ± 2,66	0,346
Injury to surgery time (hours)	50,24 ± 23,5	373.79 ± 89,23	0,000
Hospital stays (days)	5,3 ± 4,55	4,8 ± 5,32	0,372
Baumann's angle (degree) 12 weeks	78,54 ± 4,37	75,43 ± 2,34	0,412

Table 2. Comparison Between Arc of Motion

Variables	**Early (mean ± SD)**	**Late (mean ± SD)**	**P value**
Arc of motion 12 weeks	128,62 ± 8,43	119, 93 ± 16,31	0,521

Table 3. Comparison of Functional Criteria by Flynn

Flynn's criteria	Group		p-value
	Early(%)	Late(%)	
Excellent	17 (77,2)	19(73,1)	0,242
Good	3 (13,6)	4(15,3)	
Fair	-	-	
Poor	2 (10)	3 (11,5)	
Total	22	26	