

When Should Surgical Treatment of Gartland Type III Supracondylar Humerus Fractures Take Place?

Gartland Tip III Suprakondiler Humerus Kırıklarının Cerrahi Tedavisi Ne Zaman Yapılmalı?

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Abstract

Objective	We evaluated the effects of surgery time on clinical and radiological outcomes among Gartland type III Supracondylar humerus fractures (SFH). (Sakarya Med J 2018, 8(4):840-846)
Materials and Methods	We retrospectively examined 72 patients treated for Gartland type III SHF. Patient's age, gender, surgery times, surgery durations, and complications were assessed. The radiological measurements of patients were assessed in comparison to the other elbow by using Baumann's and capitohumeral angles.
Results	72 patients (40 males, 32 females), mean age 7.5 years and mean follow-up 41 months. 40 patients were operated on within the first 24 hours, 32 after 24 hours. Thirty-five were operated at night, 37 on day. Mean surgery duration at night 72 minutes and at daytime 51. The difference was statistically significant (P<0.05). Mean surgery duration at first 24 hours was 61.5±30 minutes, while after 24 hours was 63±15.5 (p=0.63), mean Baumann's angle was 72±6.75 degrees on the operated side, and 70±3.93 degrees on the other side. The difference was statistically significant (p=0.003). While a significant difference existed among the Bauman's angles of night time patients, no such difference was found among daytime patients. The mean carrying angle obtained was 10.3±5.3 degrees on the operated side, and 12.02±3.6 on the other side. The difference was not statistically significant. Similarly, no statistical difference was observed for capitohumeral angles and clinical outcomes of patients operated on within and after the first 24 hours were compared to the non-operated side.
Conclusion	SHF treatment in ideal conditions results same functional outcomes and fewer complications than immediate surgery under suboptimal conditions.
Keywords	Supracondylar humerus fracture; Close reposition; Percutaneous pinning

Öz

Amaç	Gartland tip III suprakondiler humerus kırıklarının tedavisinde cerrahi uygulama zamanının klinik ve radyolojik sonuçlar üzerine etkisinin retrospektif olarak değerlendirilmesi. (Sakarya Tıp Dergisi 2018, 8(4):840-846).
Gereç ve Yöntem	Gartland tip III kırık nedeni ile opere edilen 72 hasta değerlendirilmeye alındı. Hastaların yaşı, ameliyat zamanı, ameliyat süresi ve komplikasyonları incelendi. Radyolojik sonuçlar Baumann ve Capitohumeral açısı, klinik sonuçlar ise dirsek taşımaya açısı ölçülerek değerlendirildi.
Bulgular	72 hasta çalışmaya alındı. Hastaların 40'ı erkek ve 32'si kızdı. 40 hasta ilk 24 saatte, 32 hasta 24 saatten sonra ameliyat edilmişti. 35 hasta gece ve 37 hasta gündüz ameliyat edilmişti. Ortalama yaş 7.5/yıl ve ortalama takip süreleri 41/ay idi. Gece yapılan operasyon süresi ortalama 72 dakika iken gündüz ortalama 51 dakikaydı (P<0.05). İlk 24 saatte opere edilenlerde operasyon süresi 61.5±30 dakika, 24 saat sonra opere edilenlerde 63±15.5 dakika (p=0.63). Baumann açısı opere edilen tarafta 72±6.75, edilmeyen tarafta 70±3.93 derece idi. İstatistiksel olarak anlamlı farklılık mevcuttu. Bu fark gece yapılanlardan kaynaklanmaktaydı (p=0.003, p=0.005). Opere edilen tarafta taşımaya açısı 10.3±5.3 opere edilmeyen tarafta ortalama 12.02±3.6 derece idi, gruplar arasında istatistiksel farklılık yoktu (p>0.05). 24 saat öncesi ve sonrası yapılanlar arasında radyolojik ve klinik sonuçlar açısından istatistiksel anlamlı farklılık bulunmamaktadır.
Sonuç	Suprakondiler humerus kırığının tedavisi geç ancak ideal şartlarda yapıldığında suboptimal şartlarında yapılmasına göre daha az komplikasyon ile aynı fonksiyonel sonuç elde edilmektedir.
Anahtar Kelimeler	: Suprakondiler humerus kırığı; Kapalı repozisyon; Perkütan pinleme

Introduction

Supracondylar humerus fractures are the most common childhood elbow fractures with a prevalence of 15%. They are generally seen among children aged 3-5.¹⁻³ Even though its more frequent type is extension. Early treatment is needed in displaced fractures with presence neurovascular injuries and compartment syndrome.⁴⁻⁷ Closed reduction and percutaneous pinning are the primary surgical treatment.^{3,5,8} The timing of surgical treatment of fracture without vascular injury or open fracture is debatable.⁴⁻¹³ Contrary to those who recommend immediate surgical treatment, there are report which claims delayed surgery does not increase the rate of complications.⁹⁻¹³

In this study, we evaluated the effects of surgery time (<24 hrs, >24 hrs, night, day) on clinical and radiological outcomes among Gartland type III supracondylar humerus fracture patients treated with closed reposition and percutaneous pinning.

Materials and methods:

In this study, we retrospectively examined 94 patients treated in our clinic from 2012-2016 for fully displaced Gartland type III supracondylar fractures (Figure 1, 2).¹⁴ All patients who presented to the clinic with a Gartland type III supracondylar humerus fracture immediately received closed reposition and plaster splint in the emergency service to reduce the amount of displacement. Patients with open fractures and those who had clinical vascular and nerve injury after or before reposition were excluded as they were immediately treated with open reposition and K-wire. Patients with less than 12 months follow-up were also excluded. A total of 72 patients who fit the study criteria were included in the study.



Figure 1: The lateral view of grade 3 supracondylar fracture



Figure 2: The Anterior-posterior view of grade 3 supracondiler fracture

Under general anesthesia patients were sterilized. Supracondylar humerus fractures were closed reposed by using traction and flexion under fluoroscopy. Following the closed reposition, it was fully evaluated in posterior anterior and lateral fluoroscopy images, and fixation was obtained with percutaneous medial and lateral K-wires (Figure 3,4). The extremity was immobilized in a long arm plaster splint. Patients were discharged on postop day 1. 4 weeks after the operation, the plaster splint was removed, mobility was achieved. The treatment ended 6 weeks after the operation

when K-wires were removed in the clinic (figure 5,6).



Figure 3: Early postoperative anterior-posterior view of the elbow



Figure 4: Early postoperative lateral view of the elbow



Figure 5: Late postoperative anterior-posterior view of the elbow. The K-wires are removed



Figure 6: Late postoperative lateral view of the elbow. The K-wires are removed

Patient's age, gender, surgery times, surgery durations, and complications during follow-up were assessed. The radiological measurements of patients who were called for follow-up were assessed in comparison to the other elbow by using Bauman's and capitohumeral angles. In clinical assessment, elbow carrying angles and flexion and extension intervals were assessed comparatively with the other elbow.

The results were evaluated according to surgery time as night, daytime <24 hrs and >24 hrs. SPSS (version 20.0, SPSS, Inc.) package program was used for statistical analyses. Parametric values between the groups were analyzed based on student-t test results, and nonparametric values based on chi-square test results. $P < 0,05$ was considered statistically significant.

This research has been approved by the IRB of the authors' affiliated institutions (Sakarya University).

This study is a cross-sectional type research.

Results:

For the 72 patients studied (40 males, 32 females), mean age was 7,5 (range 2-13) years and mean follow-up duration 41 (range 12-87) months. While 40 of the patients admitted to the study were operated on within the first 24 hours, 32 were operated after 24 hours. Thirty-five were operated on at night (during night shifts), the remaining 37 were operated on during the day (during regular work hours). Mean surgery duration was 61 minutes for all patients, with mean night time value being 72 minutes and mean daytime value 51 minutes. The difference was statistically significant ($P<0.05$). Mean surgery duration of the 40 patients operated on within the first 24 hours was 61.5 ± 30 minutes, while that of the patients operated on after the first 24 hours was $63\pm15,5$ minutes ($p=0,63$) (Table 1).

Table 1: This table shows the angles of Baumann, capitellohumeral angle, elbow carrying angle, flexion of the elbow, extension of the elbow and complication. These angles compared with nonoperated elbow.

	72	40	32		35	37	
Patients	72	40	32		35	37	
Age	7,6±3,1	7,8±3,4	7,5±2,7	0,63	6,7±3,1	8,5±2,9	0,06
Follow-up duration	41,5±18	45,7±19	37,3±17	0,24	42,3±17	38,9±19	0,67
Surgery durations	60±24,6	61,5±30	63±15,5	0,63	72,2±27	51,5±18	<0,05
Baumann Angle							
- Operated (O)	72±6,75	71,5±6	73±7,7	0,16	72±8,6	71,8±4,9	0,36
- Nonoperated (N)	70±3,3	70±4,25	70±3,4	0,39	70,5±3,8	69,4±4,1	0,005
Capitohumeral angle							
- Operated (O)	45,5±7,1	47±8,2	44,4±5,34	0,62	46,8±9,2	42,4±3,8	0,723
- Nonoperated (N)	44,1±7,1	44,2±7,3	43,4±7	0,339	44±8	44,1±6,3	0,064
Elbow carrying angles							
- Operated (O)	10,3±5,3	11,2±5,7	9,6±5	0,26	10,2±4,6	10±6,1	0,30
- Nonoperated (N)	12±3,6	12,5±3,1	11,2±3,5	0,43	12±3,33	12±4,13	0,19
Flexion intervals							
- Operated (O)	140±6,2	141±6,04	140±7,1	0,27	142±6,6	138±5,5	0,841
- Nonoperated (N)	141±6,7	143±7	140±6,3	0,88	142±6,1	140±7,2	0,937

In the radiological assessment of patients, mean Bauman's angle was 72 ± 6.75 degrees on the operated side, and 70 ± 3.93 degrees on the other side. The difference was statistically significant ($p=0.003$). While a significant difference existed among the Bauman's angles of night time patients ($p=0.005$), no such difference was found among daytime patients ($p=0.36$). Clinical characteristics of patients was not significantly different. The mean carrying angle obtained was 10.3 ± 5.3 degrees on the operated side, and 12.02 ± 3.6 on the other side. The difference was not statistically significant ($p>0.05$). There was no significant difference between the Bauman's and carrying angles of patients operated on within and after the first 24 hours ($p>0.05$). Mean capitellohumeral angle was 46.8 ± 9.17 for patients operated during night time, and 42.2 ± 3.8 for those operated during daytime. There was no significant difference between the two groups ($p=0.723/0.064$). Similarly, no statistical difference was observed when the capitellohumeral angles of patients operated on within and after the first 24 hours were compared to the non-operated side ($p=0.620/0.339$).

Complications following the surgery included isolated ulnar nerve injury in one patient, ulnar nerve and median nerve injury in one patient, and malposition in three. The latter three patients underwent repeat closed reduction and pinning with K-wires. Statistically, an increased complication rate was seen among night surgery cases ($p=0.035$).

Considering the clinical characteristics of patients, mean flexion on the operated side was 138 ± 5.5 for daytime patients, and 142 ± 6.6 for night patients. The difference with the non-operated side was not statistically significant ($p=0.841/0.937$).

Extension deficit was 11.2 ± 5.9 degrees in the night group, and 9.8 ± 4 degrees in the day group. The difference with the nonoperated side was not statistically significant ($p=0.708/p=0.827$). Similarly, no statistically significant difference was found between the elbow range of motion in patients who underwent surgery within 24 hours of injury or after 24 hours of injury ($p>0,05$).

Discussion:

The surgical treatment of childhood supracondylar humerus fractures, particularly Gartland type III fractures, include closed reposition and percutaneous pinning. Despite the agreement in the literature on this surgical approach, there is no consensus on the timing of the treatment.

Early emergency treatment has been suggested due to complications such as compartment syndrome, iatrogenic nerve, vein injury risk, and reduced chance for closed reposition.¹⁻⁷ On the other hand, it is reported that delaying the treatment of type III supracondylar humerus fractures not accompanied by open fractures and vein injury for optimal conditions, does not lead to an increase in complication rates.⁹⁻¹³ However, there is no agreement in the literature on the timing of delayed surgery. Early surgery limit has been defined as 8 or 12 hours, while Mayne et al. reported 15.5 hours as mean surgery onset time and Leet et al. reported 21.3 hours as mean latest surgery onset time.⁹⁻¹³ In our study, mean operation starting time was 11.8 ± 9.5 (2-45) hours and early surgery was the first 24 hours. This time is generally related to the preparation of optimal surgery conditions. We are of the opinion that ensuring standard conditions is more important than the timing of surgery.

According to our results, surgery takes longer at night (during night shifts) when conditions for early surgery are suboptimal ($P<0.05$) and the radiological findings are statistically less favorable ($p=0.005$). The risk for complications within the first 24 hours is highest at night conditions. On the other hand, independently from surgery onset time (<24 hrs and >24 hrs), daytime surgeries (during regular work hours) have statistically higher success rates.

The failure rate for closed reposition in the surgical treatment of supracondylar humerus fractures ranges between 3% and 46%.^{9,12,15-17} Even though it is claimed that delayed surgical treatment would increase the need for open reposition, Gupta et al. and Mehlman showed otherwise with surgeries after 12 and 8 hours respectively.^{9,12} Our study found an open reposition requirement rate of 5.71%, but parallel to the literature, no links were found with the timing of surgery.

Leet et al. reported in their study that delayed surgical treatment is not an obstacle for closed reposition.¹¹ In our study, patients who were operated on >24 hrs did not experience any problems

with closed reposition. However, while daytime closed reposition success rate was 95%, night time closed reposition success rate was 93.75%.

Conclusion:

Based on the data we obtained in our study, delayed Gartland type III supracondylar humerus fracture treatment in ideal conditions results same functional outcomes and fewer complications than immediate surgery under suboptimal conditions.

Conflict of interest None.

Ethical standard All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Informed consent was obtained from all patients for being included in the study.

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