



## Comparison between the lateral and medial approaches in terms of functional and cosmetic results in the surgical treatment of type III supracondylar humeral fractures in children

### *Çocuklarda suprakondiler humerus tip III kırıklarının tedavisinde lateral ve medial girişimler ile cerrahi tedavi sonuçlarının fonksiyonel ve kozmetik açıdan karşılaştırılması*

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**Amaç:** Çocuklarda suprakondiler humerus tip III kırıklarda lateral ve medial girişim ile cerrahi tedavi sonuçları fonksiyonel ve kozmetik açıdan karşılaştırıldı.

**Çalışma planı:** Çalışmaya, suprakondiler humerus tip III kırığı nedeniyle lateral (12 erkek, 8 kız; ort. yaş 7.2; dağılım 4-12) ve medial (16 erkek, 4 kız; ort. yaş 7.4; dağılım 3-11) girişim ve iki adet çapraz Kirschner teli ile tespit uygulanan iki hasta grubu alındı. Fonksiyonel ve kozmetik sonuçlar Flynn ve ark.nın ölçütlerine göre değerlendirildi. Ortalama izlem süresi lateral girişim grubunda 19.8 ay (dağılım 8-30 ay), medial girişim grubunda 19.5 ay (dağılım 12-27 ay) idi. Ayrıca, hastaların kesi yeri ile ilgili memnuniyetleri araştırıldı.

**Sonuçlar:** Lateral girişim grubunda, fonksiyonel sonuçlar 18 olguda (%90) mükemmel, bir olguda (%5) iyi, bir olguda orta; kozmetik sonuçlar ise 19 olguda (%95) mükemmel, bir olguda (%5) orta olarak değerlendirildi. Medial girişim grubundaki sonuçlar, fonksiyonel açıdan 19 olguda (%95) mükemmel, bir olguda (%5) iyi; kozmetik açıdan ise tüm olgularda mükemmel olarak değerlendirildi ( $p>0.05$ ). Lateral girişim grubunda bir olguda ameliyat sonrasında geçici ulnar sinir paralizisi, bir başka olguda hareket kısıtlılığı ile birlikte kübitus varus deformitesi gelişti. Lateral grupta olguların %25'i, medial grupta ise %70'i kesi yerinden memnun kaldığını belirtti.

**Çıkarımlar:** Çocuk suprakondiler humerus kırıklarının cerrahi tedavisinde lateral ve medial girişimler arasında fonksiyonel ve kozmetik sonuçlar açısından anlamlı fark olmamasına karşın, ulnar sinir yaralanması olasılığının daha düşük olması ve medial kesi skarının estetik açıdan daha kabul edilebilir olması nedeniyle medial girişim tercih edilebilir.

**Anahtar sözcükler:** Kemik teli; çocuk; kırık fiksasyonu, internal/yöntem; humerus kırığı/cerrahi/radyografi..

**Objectives:** We compared the functional and cosmetic results of lateral and medial approaches in the surgical treatment of type III supracondylar humeral fractures in children.

**Methods:** The study included two groups in which type III supracondylar humeral fractures were treated using either lateral (12 boys, 8 girls; mean age 7.2 years; range 4 to 12 years) or medial (16 boys, 4 girls; mean age 7.4 years; range 3 to 11 years) approaches and internal fixation. Functional and cosmetic results were assessed according to the criteria proposed by Flynn et al. The mean follow-up periods were 19.8 months (range 8 to 30 months) and 19.5 months (range 12 to 27 months) in the lateral and medial approach groups, respectively. Patient satisfaction was also inquired regarding the site of the incision scar.

**Results:** In the lateral approach group, functional results were excellent in 18 patients (90%), good in one patient (5%), and fair in one patient, while cosmetic results were excellent in 19 patients (95%) and good in one patient. In the medial approach group, 19 patients (95%) had excellent and one patient (5%) had good functional results, while all the patients had an excellent cosmetic result ( $p>0.05$ ). Complications were seen only in the lateral approach group, including transient ulnar nerve palsy in one patient, and cubitus varus deformity due to limited range of motion in another. The satisfaction rates concerning the site of the incision scar were 25% and 70% in the lateral and medial approach groups, respectively.

**Conclusion:** Although no significant differences were found between the lateral and medial approaches in terms of functional and cosmetic results, the medial approach may be more convenient due to a lower risk for ulnar nerve injury and to a greater acceptability of the medial incision scar on the part of the patients.

**Key words:** Bone wires; child; fracture fixation, internal/methods; humeral fractures/surgery/radiography.

Supracondylar humerus fractures comes second in ranking only after forearm fractures during childhood period.<sup>[1]</sup> Traction, closed reduction and splint, percutaneous pinning and splint, open reduction and splint are among the treatment options for these fractures.<sup>[2-4]</sup> Closed reduction with percutaneous pinning has gained support as the preferred method of treatment. In situations where closed reduction fail, open reduction and internal fixation is applied. Angular deformities are not rare after traction treatment where as neurovascular complications are probable with percutaneous pinning.<sup>[5,6,7]</sup> Anterior, medial, lateral, posterior and double incision (medial and lateral) approaches can be used for open reduction. In posterior approach, since the intact periosteum has to be preserved, reduction can be more difficult and the incidence of joint stiffness is higher in posterior approach.<sup>[8]</sup> The aim of this retrospective study is to compare the functional, cosmetic and radiological results of lateral and medial approach in open reduction of type III supracondylar humerus fractures in children.

## Materials and methods

In this study, two groups of patients with supracondylar humerus fractures that were operated by two different approaches were evaluated retrospectively. The first group formed of 20 (12 boys, 8 girls; mean age 7.2, range 4-12; SD 2.03) patients with regular follow ups that were chosen among 29 patients that were operated by lateral approach in the other orthopedics clinic. The mean follow up period was 19.8 months (range 8-30, SD 5.3). The range of follow up had a lower limit of 8 months because of a patient that could not be traced after being seen with full range of motion and function at 8 months postoperatively. The second group consisted of 20 (16 boys, 4 girls; mean age 7.4; range 3-11; SD 1.91) patients that were chosen at random among 146 patients with regular radiological and clinical follow up (mean 19.5 months, range 10-27; SD 4.7) that were operated by medial approach.

Thirty nine (97.5%) patients had extension type of fractures. Thirty three (82.5%) patients had simple fall, four (10%) had fall from bicycle and three (7.5%) had fall from height. Thirty nine (97.5%) were closed fractures as one (2.5%) was Gustillo type II open fracture. The wound was on the lateral side in the patient with the open fracture.

After the neurologic examination, closed reduction and immobilization was attempted for the patients with displaced supracondylar humerus fractures. The presence of excessive edema and inadequate reduction led the treatment of choice to be open reduction and internal fixation.

A lateral curved incision that extended from the lateral condyle 5-6 cm proximally to the interval between the biceps and the brachialis muscles was used for the lateral approach as the patient was supine with the operated arm in slight adduction over the body. After incision of the fascia, the fracture line was accessed with blunt dissection between the forementioned muscles. After the reduction, fixation with crossed K wires was done.

The medial incision extended from the medial epicondyle 5-6 cm proximally to the intermuscular septum distal to the medial epicondyle as the patient was supine with the arm abducted 90°. Ulnar nerve was detected and protected. No release was done in the ulnar groove. Medial Kirschner wire was applied while palpating the continuity of the fracture line and visualisation of the medial colon. Lateral fixation was done percutaneously. Following reduction of the fracture, crosspin configuration of Kirschner wires was used (Fig.1c,d).

A posterior splint was applied for a mean period of 23 days and the Kirschner wires were pulled out at 30 days. The mean follow up was 19.5 months (8-30 months) the patients were called for follow up every third week until the third month of splint removal. After six months the patients were seen every six months until their last follow up.

The functional and cosmetic results were evaluated according to Flynn criteria<sup>[9]</sup> (Table I). For the functional results, the presence of loss in range of motion in comparison to the uninjured side and its relevance on the patient's functions was investigated. The change in physiological valgus angle in comparison to the other elbow was evaluated for the cosmetic results. Clinical observations and radiological evaluations were performed by one observer.

Statistical analysis was performed by using NCSS 2004 (Number Cruncher Statistical System, NCSS Statistical Software Utah, USA) software program. Chi-square and Fisher's exact test were used to compare the data. The criterion for signifi-



**Figure 1.** Left type III supracondylar humerus fracture in a 6 year old child radiographs **a)** pre operative AP and **b)** lateral. Radiographs taken 4 weeks after ORIF by medial approach **c)** AP **d)** lateral

cance ( $\_$ ) was set at .005. The study had a power of 95% to yield a statistically significant result should a true difference exist between the groups.

**Results**

At the six month follow up, seventeen (85%) patients were evaluated as excellent, two (10%) patients as good and one (5%) patient as fair functionally in the lateral approach group. In the medial group, nineteen (95%) patients were excellent and one (5%) patient was good functionally. (Table 2). During the last follow up, one of the patients that were evaluated as a good result at sixth month had turned out to have an excellent score.

There was no loss of pronation or supination at the last follow up of the patients. The mean loss of

flexion was 2.1° (range 0-12°,SD 2.89) for the lateral approach patients and 2° (range 0-8°, SD 1.25) for the medial approach patients.

Using a goniometer and comparing with the other elbow, the loss of carrying angle was measured for the cosmetic results. The mean loss of carrying angle was 3.1° (range 0-14°; SD 2.89) for the lateral approach group and 2.3° (range 0-5°, SD 1.73 ) for the medial approach group. In terms of humeroulnar angle measurements for the radiological evaluation of carrying angle, a mean change of 2° (range 0-12°;SD 2.73) and 1.8° (range 0-5;SD 1.43) in the lateral and medial approach group respectively. Cosmetically, nineteen (95%) patients were excellent and one (5%) patient was fair in the lateral approach group as twenty (100%) patients were



**Figure 2.** Radiographs of the same patient taken at 24 weeks postoperatively **a)** AP **b)** lateral

**Table I.** The results of lateral and medial approach according to Flynn criteria in the last follow up

Result	Functional			Cosmetic		
	Loss of flexion	No of pts	%	Loss of carrying angle	No of pts	%
Lateral Very good	0°-5°	18	90	0°-5°	19	95
Good	6°-10°	1	5	6°-10°	–	–
Fair	11°-15°	1	5	11°-15°	1	5
Poor	>15°	–	–	>15°	–	–
Medial Very good	0°-5°	19	95	0°-5°	20	100
Good	6°-10°	1	5	6°-10°	–	–
Fair	11°-15°	–	–	11°-15°	–	–
Poor	>15°	–	–	>15°	–	–

excellent in the medial approach group (Table 3). The difference between the two groups was statistically insignificant for functional criteria ( $\chi^2=1.02$ ,  $p=0.59$ ) and cosmetic criteria ( $\chi^2=1.01$ ,  $p=0.99$ ). The measurements were done by one observer. Intraobserver variability was  $\pm 0.4^\circ$  in terms of loss of flexion and  $\pm 0.3^\circ$  for loss of carrying angle.

None of the patients had any major vascular injuries preoperatively. However, the radial pulse was not palpable in one of the lateral approach patients and capillary refill occurred in this patient. It was seen that the circulation was satisfactory after open reduction and internal fixation. There was radial nerve palsy in one and median nerve palsy in another lateral approach patient. In the medial approach group, there was one (5%) radial and one (5%) ulnar nerve palsy. Despite the fact that signs of iatrogenic ulnar nerve lesion developed in one (5%) of the lateral approach patients, there was no sign of neurological compromise after 12 months. In one lateral approach patient, loss of flexion of  $12^\circ$  and cubitus varus deformity of  $14^\circ$  was measured. Correction osteotomy is planned for this patient who is “fair” regarding the functional and cosmetic criteria of Flynn classification. The rate of the patients with a “very good” score was 5% totally at the third month follow up as this rate increased to 80% at six month follow up. The overall successful rates may be attributed to the early timing in surgery, remodelling and the effort the patients showed to mobilize the extremity in both groups.

The patients in the medial approach group had either “very good” or “good” scores and one patient in the lateral approach group with cubitus varus

deformity had “fair” score cosmetically. The results were satisfactory in all (100%) of the medial group patients as this rate was 95% in the lateral approach group although the indifference was statistically insignificant. The patients or their families (in case the patient was too small and/or not cooperative) were questioned about their satisfaction regarding the location of the scar and if the scar bothers them or not. Five (25%) of the lateral approach group stated that they were happy and the same satisfaction rate was 70% for the medial approach patients (Table 2). There was a significant difference among the groups regarding the scar satisfaction ( $\chi^2=14.35$ ,  $p=0.0008$ ).

## Discussion

Supracondylar humerus fractures account for 70% of the elbow fractures in childhood and 97% of these fractures are extension type.<sup>[1]</sup> The mean age of incidence is six years.<sup>[1]</sup> The connective tissue laxity, the process of metaphyseal remodelling and the thin cortex in the supracondylar area are the anatomic factors that play a role in pathophysiology.

Pirone et al<sup>[1]</sup> have compared the results of 78 closed reduction and percutaneous pinning patients with 9 open reduction and internal fixation. They reported that the results were poor with 22% of the patients with the open reduction group versus 5% of

**Table II.** Satisfaction regarding the location of the incision scar

Incision	No of pts	Satisfied	Not satisfied	Undecided
Lateral	20	5 (%25)	10 (%50)	5 (%25)
Medial	20	14 (%70)	–	6 (%30)

the percutaneous pinning group. It is a striking fact that the number of patients in the open reduction group is so few and the approaches used for open reduction are anterior and medial. Flynn et al<sup>[9]</sup> have reported 13% neural and 18% vascular complications in 52 patients with closed reduction and percutaneous pinning.<sup>[12]</sup> There are no reports comparing lateral and medial approaches in the literature.

The necessity of cross K wire fixation for maximal stabilization has been proved biomechanically.<sup>[12]</sup> With posterior approach, time is necessary for the elbow to regain its functional range of motion since the intact triceps muscle is severed.<sup>[2]</sup> There are only a few reports on lateral approach.<sup>[13]</sup> The incidence of cubitus varus deformity is higher in lateral approach and percutaneous pinning technique since medial column can not be judged. Weiland et al<sup>[13]</sup> have stated 25% incidence of cubitus varus deformity with lateral approach. Danielsson and Pettersson<sup>[14]</sup> have reported one case of cubitus varus deformity with 17 cases operated using lateral and medial –two incision approach. Shifrin et al<sup>[15]</sup> have had no cubitus varus deformity among 100 medial approach cases and had only one infection as complication. In our study, there was no cubitus varus deformity in medial approach group and only one (5%) case in lateral group. In cases with ulnar nerve instability or in elbows with too much edema, location of the ulnar nerve by palpation may be misleading and iatrogenic ulnar nerve injury may occur.<sup>[17]</sup> The rate of ulnar nerve lesions is reported to be 7-16% after percutaneous pinning.<sup>[2]</sup> Lyons et al<sup>[17]</sup> have suggested that the ulnar nerve lesions that occur after percutaneous pinning have a tendency to heal spontaneously. On the other hand, Rasool<sup>[18]</sup> have reported that one of six patients with ulnar nerve lesions had no healing after a 14 month follow up. Zaltz et al<sup>[19]</sup> have reported incidence of 17.7% and 7.7% in the 0-5 years and 6-11 years group respectively. This instability is frequently bilateral and mobility of the ulnar nerve in both elbows and joint laxity may be the clinical findings encountered during physical examination. Royce et al<sup>[6]</sup> proposed a medial incision of 1-2 cm in such situations. With medial approach, since the ulnar nerve is protected during surgery it is rare to have an ulnar nerve lesion.<sup>[8]</sup> In our study, transient ulnar nerve palsy was seen with a lateral approach patient. Vascular injuries, pin tract infection, malunion, loss of flexion, myositis ossifi-

cans ara among the other possible complications. When the patients were questioned about their satisfaction regarding the location of the scar, it was seen that the medial incision was preferred cosmetically. For displaced supracondylar humerus fractures, we came to the conclusion that the medial approach is more appropriate since the incidence of ulnar nerve injury is less and less cubitus varus deformity is seen because the medial column can be judged accurately. It is also preferred by the patients cosmetically.

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