

# Treatment of type I capitellar fractures in adolescents

## Adölesan dönemdeki tip I kapitellum kırıklarının tedavisi

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### BACKGROUND

Because fractures of the capitellum are rare in childhood and the young adolescent period, their treatment is still debatable and there appears to be no established treatment protocol. In the present study, we evaluated the results obtained in adolescents with type I capitellar fractures who were treated with open reduction and internal fixation with a 3.5 mm lag screw, directed from posterior to anterior.

### METHODS

Twelve type I capitellar fractures in adolescents were treated with open reduction and internal fixation with a single 3.5 mm cortical lag screw directed from the posterior to the anterior and the results were evaluated by an objective evaluation score (Broberg and Morrey's functional rating index). Mean age of the patients was 13.5.

### RESULTS

At final examination (24 to 90 months follow-up), mean Broberg and Morrey's functional rating index was 96.7 points (91 to 100 points). All fractures had healed in anatomic position and no avascular necrosis or heterotrophic ossification was observed.

### CONCLUSION

Since it is essential to obtain the full range of motion at the elbow, accurate open reduction and stable internal fixation are best to manage displaced type I capitellar fracture in children and adolescents. Single cortical lag screw directed from posterior to the anterior without penetrating the joint surface is suitable for this purpose.

**Key Words:** Capitellum; childhood fractures; elbow fractures; internal fixation; open reduction.

### AMAÇ

Çocukluk ve genç adölesan dönemde kapitellum kırıkları oldukça nadir olduğu için tedavisi halen tartışmalıdır ve görüş birliği oluşmuş bir tedavi yöntemi yoktur. Çalışmamızda açık redüksiyon ve posteriordan anteriora gönderilen 3,5 mm'lik tek kortikal çekirtilme vidası ile tedavi edilen, adölesan yaş grubundaki Tip I kapitellum kırıklı olguların sonuçları değerlendirildi.

### GEREÇ VE YÖNTEM

Çalışmamızda ortalama yaşı 13,5 olan ve aynı yöntemle tedavi edilen 12 adet Tip I kapitellum kırığının tedavi sonuçları objektif bir skala kullanılarak (Broberg ve Morrey) değerlendirildi.

### BULGULAR

Son kontrollerde (24 - 90 aylık takipte) ortalama Broberg ve Morrey fonksiyonel değerlendirme puanı 96,7 (dağılım 91-100) olarak bulundu. Tüm kırıklar anatomik pozisyonda kaynadı ve avasküler nekroz ya da heterotrofik ossifikasyon gözlenmedi.

### SONUÇ

Çocuk ve genç adölesanların deplase Tip I kapitellum kırıklarının tedavisinde dirsek eklemine tam hareket açıklığı elde edilmesi esas olduğu için, açık redüksiyon ve stabil bir internal fiksasyon iyi bir tedavi yöntemidir ve eklem yüzünü delmeden, posteriordan anteriora gönderilen tek bir kortikal çekirtilme vidası ile bunu sağlamak mümkündür.

**Anahtar Sözcükler:** Kapitellum; çocuk kırıkları; dirsek kırıkları; internal fiksasyon; açık redüksiyon.

Because the capitellum is nearly all cartilaginous, it is resistant to stress and difficult to fracture. The incidence of this fracture in the literature varies from 0.5% to 1% of all elbow injuries.<sup>[1-3]</sup> Falling on an

outstretched hand is more likely to cause supracondylar fracture than capitellar fracture especially in childhood and the young adolescent period; thus, this type of injury is quite rare and accordingly there

is no established treatment protocol for this type of fracture.<sup>[1,4-9]</sup>

Capitellum fractures are commonly classified into four types. In type I (Hahn Steinthal type), the fractured fragment contains a large portion of spongy bone of the lateral condyle. The second type (Kocher-Lorenz type) is nearly pure articular cartilage with little or no subchondral bone. This type of fracture is rarely seen in childhood and adolescence. Comminuted fractures of the capitellum were described as type III fracture by Broberg and Morrey.<sup>[1,4,6,8-11]</sup> Type IV fractures were described by McKee et al. as capitellum fractures reaching the trochlea.<sup>[12]</sup>

A review of the literature showed only a few reports about this type of injury, especially in children, and various methods were used in their treatment. Furthermore, none of the reports had used an objective evaluation score.<sup>[2,8,10,13,14]</sup>

In the present study, we report our results in type I capitellar fractures in childhood and the young adolescent period that were treated using open reduction and internal fixation with a single 3.5 mm cortical lag screw directed from posterior to the anterior.

## MATERIALS AND METHODS

Between 1995 and 2004, we identified and surgically treated 12 displaced type I capitellar fractures in patients who admitted to our clinic with elbow trauma. The mean age of these patients was 13.5 years (range: 12 to 16 years). All of the fractures had resulted from a fall.

All capitellar fractures were operated on an urgent basis the same day. We used Kocher's lateral approach. Capitellar fragments were reduced anatomically. Stable internal fixation was then obtained with a 3.5 mm cortical lag screw directed from posterior to the anterior without penetrating the joint surface. Posterior splint was applied postoperatively. At the end of two weeks, the splint was removed partially (daytime) and gentle exercises were begun. At the end of third week, the splint was removed completely and physical therapy was started.

We removed the screws after complete healing. Mean hardware removal time was three months.

All patients were evaluated using the Broberg and Morrey functional rating index, which includes movement, strength, stability, pain, and the objective radiological criteria at the final examination.<sup>[15,16]</sup>

## RESULTS

The average follow-up time for these patients was 57.9 months (24-90 months). The average functional rating index was 96.7 points (91 to 100 points).

The results of all patients were excellent according to Broberg and Morrey's functional index, meaning that all had full range of motion (ROM) and had no pain, no limitation of activities and no complaint related to the fracture.

In one case, radiographs showed minimal narrowing in the radiocapitellar joint. This male patient had been treated conservatively for his nondisplaced lateral humeral condyle fracture at the same elbow as a result of a new fall after healing of the capitellar fracture.

Details of the patients are shown in Table 1. Radiographically, all fractures were found to have healed in anatomic position (Figs. 1a-e).

No avascular necrosis or heterotrophic ossification was observed in any patient.

## DISCUSSION

Clinically, a fracture of the capitellum is atypical, with pain, minimal swelling and tenderness on the lateral side of the elbow. The diagnosis is made on the lateral radiograph of the elbow, which shows a characteristic semilunar fragment detached from the humeral condyle and lying anterior to the distal

**Table 1.** Details of the patients

No	Age	Gender	Follow-up (months)	Broberg and Morrey's FRI	ROM
1	13	M	90	96	Full
2	12	F	85	98	10° loss of flexion
3	13	F	77	91	Full
4	14	F	72	100	Full
5	13	M	67	94	Full
6	15	F	64	100	Full
7	14	F	55	93	Full
8	16	M	51	96	Full
9	13	F	45	100	10° loss of flexion
10	12	M	38	96	Full
11	13	M	29	100	Full
12	14	F	24	97	Full

M: Male; F: Female; Broberg and Morrey's FRI: Points from Broberg and Morrey's functional rating index at the final follow-up; ROM: Range of motion.

humerus. Anteroposterior view may appear normal.<sup>[13]</sup>

Because capitellar fractures are rare injuries, there has been no consensus regarding treatment of these injuries.

The results of treatment of capitellar fracture by closed reduction and immobilization in a cast are controversial. It is difficult to obtain good anatomic reduction especially in type I fractures. For this reason, operative treatment of these fractures has been advocated. K wires, cortical or malleolar lag screws, absorbable screws and Herbert screws have been reported for fixation of these fractures. K wire fixation does not allow obtaining enough stability when compared with screw fixations. Headless screws such as Herbert screw and biodegradable screws can be used without the need for removal; however, these are substantially expensive and special instruments and experience are needed when compared with standard convenient screws.<sup>[2,3,5-8,10,14,17]</sup>

A review of the literature revealed only limited articles about type I capitellar fractures, especially in children.<sup>[8,10,13]</sup>

Poynton, in his study, divided patients into two groups consisting of K wire fixation and Herbert screw fixation, and then reported better results in the screw group.<sup>[8]</sup>

Letts reported six adolescent cases who were treated with various treatment modalities including nonoperative treatment in one, K wire fixation in three, Herbert screw fixation in one and cannulated screw in one. Five children did well with their respective treatments, but one required reoperation to remove an exostosis block to flexion. The author recommended open reduction and internal fixation for the displaced capitellar fracture in children in order to restore elbow function.<sup>[10]</sup>

Most of the other reports consisted of mixed age groups and different treatment modalities or case reports, so we were unable to compare our results with the other studies except De Boeck's.<sup>[13]</sup> On the other hand, none of the previous studies had used an objective evaluation scale.

In our series, we used Broberg and Morrey's functional rating index. This numerical score will allow future series to compare their results with ours.

De Boeck reported his six patients in the adolescent age group treated by open reduction and inter-

nal fixation with small screw. He reported that they achieved good results with this method in capitellar fractures. They concluded that single small screw



**Fig. 1.** (a) Lateral radiograph of the right elbow of a 14-year-old boy after falling down. (b) Anteroposterior view of the same patient. (c) Postoperative lateral radiograph. (d) Postoperative anteroposterior view. (e) Final follow-up in the postoperative 35th month.

fixations help to obtain relative stable fixation and allow early active motion. Finally, they recommend open reduction and internal fixation for capitellar fractures in the pediatric age group.<sup>[13]</sup>

In his cadaveric study, Elkowitz reported that the screw fixation directed from posterior to the anterior was superior to that directed from anterior to the posterior.<sup>[18]</sup> We also fixed the fragments with the screw directed from posterior to the anterior instead of the intraarticular screw direction. In type IV fractures reaching the trochlea, more than a single screw may be needed in order to obtain enough stability against rotation, but in type I fractures, especially in children, a single 3.5 mm cortical lag screw allowed us to secure this relatively small fragment.

In conclusion, our results suggest that internal fixation of type I capitellar fractures with a single 3.5 mm cortical lag screw directed from posterior to the anterior without penetrating the joint surfaces produces satisfactory results in children and young adolescents. Although our series is one of the largest series in the literature with the longest follow-up, we believe larger series with longer follow-up and with control groups are necessary to draw more firm conclusions.

## REFERENCES

- Hotchkiss RN. Fractures and dislocations of the elbow. In: Rockwood CA, Green DP, Bucholz RW, Heckman JD, editors. *Rockwood and Green's fractures in adults*. Vol 1. 4th ed. Philadelphia: Lippincot; 1996. p. 958-65.
- Khan R, Zolczer L, Shedden R. Type II Fracture of the capitellum. Operative treatment of a rare injury. *E J Trauma* 2003;4:235-8.
- Kim WC, Hirasawa Y, Tamai K. Fracture of the humeral capitellum: Open reduction and internal fixation. *J Orthop Surg* 1998;6:59-65.
- Canale ST. Fractures and dislocations in children. In: Canale ST, editor. *Campbell's operative orthopaedics*. 10th ed. Philadelphia: Mosby; 2003. p. 1425-6.
- Clough TM, Jago ER, Sidhu DP, Markovic L. Fractures of the capitellum: a new method of fixation using a maxillofacial plate. *Clin Orthop Relat Res* 2001;(384):232-6.
- Hardy P, Menguy F, Guillot S. Arthroscopic treatment of capitellum fracture of the humerus. *Arthroscopy* 2002;18:422-6.
- Malki AA, Salloom FM, Wong-Chung J, Ekri AI. Cannulated screw fixation of fractured capitellum: surgical technique through a limited approach. *Injury* 2000;31:204-6.
- Poynton AR, Kelly IP, O'Rourke SK. Fractures of the capitellum-a comparison of two fixation methods. *Injury* 1998;29:341-3.
- Wilkins KE, Beaty JH, Chambers HE, Toniolo RM. Fractures and dislocations of the elbow region. In: Rockwood CA, Wilkins KE, Beaty JH, editors. *Fractures in children Vol 3*. 4th ed. Philadelphia: Lippincott Rawen; 1996. p. 776-80.
- Letts M, Rumball K, Bauermeister S, McIntyre W, D'Astous J. Fractures of the capitellum in adolescents. *J Pediatr Orthop* 1997;17:315-20.
- Schindler OS. Bilateral capitellum humeri fracture: a case report and review of the literature. *J Orthop Surg (Hong Kong)* 2003;11:207-12.
- McKee MD, Jupiter JB, Bamberger HB. Coronal shear fractures of the distal end of the humerus. *J Bone Joint Surg [Am]* 1996;78:49-54.
- De Boeck H, Pouliart N. Fractures of the capitellum humeri in adolescents. *Int Orthop* 2000;24:246-8.
- Sano S, Rokkaku T, Saito S, Tokunaga S, Abe Y, Moriya H. Herbert screw fixation of capitellar fractures. *J Shoulder Elbow Surg* 2005;14:307-11.
- Broberg MA, Morrey BF. Results of delayed excision of the radial head after fracture. *J Bone Joint Surg [Am]* 1986;68:669-74.
- Morrey BF, An KN, Chao EYS. Functional evaluation of the elbow. In: Morrey BF, editor. *The elbow and its disorders*. Philadelphia: Saunders; 1985. p. 73-91.
- Kramer M, Pamnani A, Strauch RJ. Internal fixation of a capitellum fracture using a biodegradable screw. *Orthopedics* 2002;25:765-6.
- Elkowitz SJ, Polatsch DB, Egol KA, Kummer FJ, Koval KJ. Capitellum fractures: a biomechanical evaluation of three fixation methods. *J Orthop Trauma* 2002;16:503-6.