

The effect of dorsal cortical comminution on radiographic results of unstable distal radius fractures treated with closed reduction and K-wire fixation

Kapalı redüksiyon ve K-teli ile tedavi edilen radius alt uç kırıklarında dorsal korteks parçalanmasının radyografik sonuçlara etkisi

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Amaç: Bu çalışmada, kapalı redüksiyon ve K-teli tespiti uygulanan instabil radius alt uç kırıklarında eşlik edebilecek dorsal korteks parçalanmasının radyografik sonuçlara etkisi değerlendirildi.

Çalışma planı: Radius alt uç kırığı nedeniyle kapalı redüksiyon ve K-teli ile tespit uygulanan 42 hasta değerlendirildi. Kırıkların tümü eklem dışı, dorsale açılanma gösteren instabil kırıklardı. Hastalar radius alt uç metafizinde dorsal yüzde parçalanma ve buna bağlı yan grafide görülen radyoopasite olup olmamasına göre iki gruba ayrıldı. Otuz hastada (13 erkek, 17 kadın; ort. yaş 56; dağılım 22-77) dorsal kortekste parçalanma görülmedi. Bu grupta takip süresi ortalama 8.8 aydı (dağılım 3-106 ay). On iki hastada (8 erkek, 4 kadın; ort. yaş 48; dağılım 18-76) dorsal kortekste parçalanma izlendi. Bu grupta ortalama takip süresi 5.5 aydı (dağılım 3-131 ay). Kırık sonrası ve kaynama sonrası çekilen yan grafilerde palmar eğim açısı, arka-ön grafilerde radial eğim açısı ve radial uzunluk ölçüldü; sonuçlar iki grup arasında karşılaştırıldı.

Sonuçlar: Her iki grupta da radial eğim açısı, palmar eğim açısı ve radial uzunluk ameliyat sonrasında anlamlı düzleme gösterdi ($p<0.05$). Tüm hastalarda, uygulanan tedavi sonucunda standart kabul edilen referans değerlere ulaşıldı ve kabul edilebilir sonuçlar elde edildi. Dorsal kortekste parçalanmanın açısal değişimlere anlamlı etkisi olmadığı görüldü ($p>0.05$). Hiçbir hastada önemli bir komplikasyona rastlanmadı.

Çıkarımlar: Dorsal metafizer kortikal parçalanma radyografik sonuçları etkilememektedir. Kapalı redüksiyon ve K-teli ile tespit, dorsal korteks parçalanmasının eşlik ettiği kırıklarda dahi güvenli ve etkin bir tedavi yöntemidir.

Anahtar sözcükler: Kemik teli; kırık tespiti/yöntem; radius kırığı/cerrahi/radyografi; el bileği yaralanması/cerrahi.

Objectives: The purpose of this study was to evaluate the effect of dorsal cortical comminution on radiographic outcome of unstable distal radius fractures after treatment with closed reduction and K-wire fixation.

Methods: Forty-two patients were treated with closed reduction and K-wire fixation for unstable, extra-articular distal radius fractures with dorsal angulation. The patients were evaluated in two groups depending on the presence or absence of dorsal metaphyseal cortical comminution observed as a radiopacity on lateral radiographs. Thus, 30 patients (13 males, 17 females; mean age 56 years; range 22 to 77 years) did not have dorsal cortical comminution, whereas 12 patients (8 males, 4 females; mean age 48 years; range 18 to 76 years) did. The mean follow-up period was 8.8 months (range 3 to 106 months) in the former, and 5.5 months (range 3 to 131 months) in the latter groups. Radiographic parameters were compared including palmar tilt measured on lateral, radial inclination and radial length on posteroanterior radiographs obtained before treatment and after union.

Results: Radial inclination, palmar tilt, and radial length showed significant improvements in both groups ($p<0.05$). The results were acceptable in all the patients with achievement of standard reference values. The presence of dorsal cortical comminution did not have any significant effect on radiographic parameters ($p>0.05$). No significant complications were encountered during the follow-up period.

Conclusion: Dorsal cortical metaphyseal comminution does not have an adverse effect on radiographic results. Treatment with closed reduction and K-wire fixation is safe and effective even in the presence of dorsal cortical comminution.

Key words: Bone wires; fracture fixation/methods; radius fractures/surgery/radiography; wrist injuries/surgery.

Radius distal fractures account for approximately %15-20 of all fracture cases applying to emergency services.^[1-3] There is not one single definite opinion about classification,treatment and radiological and functional results of these fractures but there is agreement of opinion about taking into account of these fracture types while making the treatment plan.^[1-2] There are various methods of treatment about these fractures.Frequently used methods are closed reduction followed by cast bracing, percutaneous fixation with Kirschner wires,external and internal fixation.Excluding the fractures with more than one cortex destruction, currently used treatment method of radius distal fractures is closed reduction and percutaneous Kirschner wiring.

The purpose of the study is to evaluate the radiological results of the radius distal fractures treated with closed reduction and Kirschner wiring and the effect of dorsal cortex destruction on results.

Patients and method

42 patients with radius distal fractures treated with closed reduction and Kirschner wiring have been evaluated.All of the fractures were extraarticular,unstable fractures with dorsal angulation. Patients who had fractures with palmar displacement,open fracture,who had other systemic injuries and patients with previous wrist fractures were excluded from the study.Also fractures with inadequate Kirschner wiring that needed an internal or external fixation or bone grafts and fractures with more than one cortex destruction were excluded from the study.

A-P and lateral graphies were obtained for all patients to determine the fracture types.Patients were put into two groups according to the dorsal surface destruction and presence of the radioopacity due to the dorsal surface destruction on lateral graphies.

Group 1 is composed of 30 patients of radius distal fractures without dorsal cortex destruction (pic 1). 13 of the patients were male and 17 were female.Their mean age was 55.7 (22-77 years) and their mean follow up period was 8.8 months (3-106 months) 12 of the cases were on the right wrist and 18 were on the left.Group 2 is composed of 12 patients with dorsal cortex destruction (pic 2) 8 of the patients were male and 4 were female.Their mean age was 48.3 years(18-76 years).Their mean follow up period was 5.5 months (3-131 months) 7 of the cases were on the right wrist and 5 were on the left. All of the patients had completed their skeletal maturity and fractures occurred after low energy trauma.Same treatment modality was used for both groups.

Palmar slope angle on lateral graphies following the fracture and after fracture healing was obtained.Radius inclination angle and radial lengths were measured on A-P graphies and the results were compared both between the two groups and with the standard reference values. The effect of the accompanying dorsal cortex destruction on radiological results and the efficacy of Kirschner wire fixation in these types of fractures were evaluated. All measurements were made by a single orthopaedician.As standard measurement values, radial inclination



Figure 1. (a) Distal radius fractures without dorsal cortical comminution (b) postoperative control x ray



Figure 2. (a) Distal radius fractures with dorsal cortical comminution (b) postoperative control x ray

angle was accepted to be 23.^[13-33] Palmar slope angle as 10-12.^[4-22] and radial length was accepted to be 12mm.^[4,5,10]

Surgical technique

Under Axillary block Anaesthesia, fluoroscopy was used in all cases. Following 8-10 kg of longitudinal traction with finger traps (5-10 minutes) the manipulation was made by hands and the quality of the reduction was evaluated by the fluoroscopy. After the reduction was accepted to be sufficient, 3 or 4 Kirschner wires of 1.5 mm were percutaneously fixed with stab incisions and under fluoroscopy short arm cast brace was used for all patients for a minimum of 6 weeks (6-8 weeks) postoperatively. Patients were discharged the same day from the hospital. They were taught finger and elbow ROM exercises. Patients were called for wound dressing and radiographies. Beginning from the third week all patients had the same physiotherapy programme about joint ROM and strengthening exercises. Kirschner wires were pulled back according to the fracture healing on plain films about 6th to 8th week after performing a local anaesthetic.

Statistical methods

In both of the groups the change of the values in measurements of the preoperative radiographs and graphs taken after fracture healing were compared by paired samples t test. Chi-square test was used to determine if the values we obtained were among the standard reference values. Mann-Whitney U test was used to determine if there was a significant effect of the radioopacity occurred on lateral films due to the dorsal cortical destruction to angular changes or not.

Results

The mean values of the results for both groups are given in Table 1. In both of the groups radial inclination angle, palmar slope angle and radial lengths were statistically significantly corrected. For all of the patients we could reach the standard reference values and acceptable results were obtained. (p:0.525) There was no significant effect of the dorsal cortex destruction appearing as radiographic opacity (pic 2 a,b) on angular changes. There was no complication in any patient that would necessarily change the treatment plan.

Table 1. Radiological measurement results.

	Palmar tilt angle (°)		Radial inclination angle (°)		Radial length (mm)	
	Preop	Postop	Preop	Postop	Preop	Postop
Group 1*	27.5 dorsal	8.7 palmar	15.4	22.8	7.2	10.7
Group 2**	22.8 dorsal	10.1 palmar	15.3	21.9	8.1	11.1

Discussion

The treatment aim in radius distal fractures is to have minimal radial shortening and fracture healing with the radial inclination and palmar slope angle values are within the reference value intervals and to reach maximum hand functions.

Conservative treatment with cast braces prevents surgical complications but will not be sufficient for the supplementation of the radial lengthening and preservation of reduction. Closed reduction and percutaneous fixation and casting is a cheap, uncomplicated and reliable method.^[6] Following unstable radius distal fractures in %20-30 of the cases alignment failure may occur. If the anatomical reduction is not obtained mechanical failure may occur in distal radioulnar joint and intercarpal joint. More than 20 degrees angulation may cause concentric loading on scaphoid and lunate fossae and the contact area may go further dorsally compared to normal wrist joint. 6-8 mm of radial shortening may cause ulnocarpal friction.^[7] In treatment of radius distal fractures high quality reduction and safe preservation of the reduction until fracture healing is mandatory to achieve a good result. The quality of reduction will be decided according to the comparison of the palmar slope angle, radial inclination angle and radial length with the reference values.^[8-10]

In radius distal fractures if the destruction of the cortex increases radial length will decrease and radial inclination angle and palmar slope angle will decrease.^[11]

Trumble and associates have informed that^[11] in colles fractures of young population with one cortex destruction, closed reduction and Kirschner wire fixation will be enough to obtain radial length but if there is more than two cortices destructed then extra fixation with an external fixator could be used to obtain normal radial length. In the same study^[11] they found out that in old population while treating colles fractures with one cortex destruction, closed reduction and Kirschner wire fixation would not be enough for the assessment of the radial length. In our study when we compared Group 1 in which there was no dorsal cortex destruction and Group 2 with dorsal cortex destruction the results were similar. So we found out that closed reduction and Kirschner wire fixation can safely be used for fractures with dorsal cortical destruction like in fractures without

dorsal cortical destruction. Brady and associates^[12] have informed that in their cases that they have performed interfocal K wires palmar slope angles may decrease by time. They anticipated that this angulation might be due to dorsal cortical destruction and the loss of the buttress effect and suggested bone grafting of the destructed cortex area to prevent dorsal angulation.

In this study following the fixation we have performed short arm cast braces and the K wires were pulled back after a minimum of six weeks. In our study the cast brace period was similar so in fractures with dorsal cortical angulation to prevent dorsal angulation after the K wires are pulled back interfocal K wire fixation seems to be a safer method.

In cases with dorsal cortex destruction if intrafocal K wires are performed we suggest to perform bone grafts as Brady^[12] and associates have suggested.

The handicaps of our study were the minority of the patients in the groups, we could not evaluate the efficacy of treatment in young and old populations separately and the follow up period was short because it has been informed that after radius distal fractures angular changes may be seen for almost one year.^[1, 10, 13]

Infection of the K wire, loosening of the wire, Sudeck atrophy, vessel and nerve injuries are among the possible complications but can be minimized with careful technical application.^[1, 14, 15]

Radiological evaluations and their relations to clinical results will illuminate the treatment of these fractures in studies with more number of cases.

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