



Does preservation of active range of motion after acute elbow injury rule out the need for radiography?

Akut dirsek travmasından sonra aktif eklem hareket açıklığının korunması radyografi gerekliliğini ortadan kaldırır mı?

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BACKGROUND

We aimed to evaluate the role of a normal elbow active range of motion (ROM) in predicting low fracture risk and avoiding elbow X-ray in patients with acute elbow injuries. Lack of any approved rules for this purpose led us to evaluate simple physical examination methods to predict elbow fractures.

METHODS

In this observational study, all patients with elbow injury who presented to two emergency departments were enrolled according to specific criteria. Patients were examined by emergency or orthopedics residents. Elbow radiographs were reviewed by a radiologist for fractures and soft tissue injuries. Results of the clinical examination and radiographs were recorded for statistical analysis. Sensitivity, specificity and positive and negative predictive values were calculated.

RESULTS

Elbow fractures were identified in 10 of the 102 enrolled patients (9.8%). Nine of the 10 had limited ROM in all movements. Limited active elbow ROM in predicting elbow fracture revealed a sensitivity of 90%, specificity of 92%, and positive and negative predictive values of 56% and 98%, respectively. Individuals with limitation in one or two directions had no signs of fracture in the X-rays.

CONCLUSION

Patients with elbow injury and a limited ROM in all directions of flexion, extension, supination and pronation require further X-ray investigations.

Key Words: Elbow injury; range of motion; fracture; radiography.

AMAÇ

Akut dirsek travması geçiren hastalarda düşük kırık riskini öngörme ve dirseğin radyografik görüntülemesinden vazgeçmede normal aktif eklem hareket açıklığı (ROM) rolünü değerlendirmektir. Bu amaçla kabul edilen kuralların olmaması bizi dirsek kırıklarını öngörmeye basit fiziksel inceleme yöntemlerini değerlendirmeye sevk etti.

GEREÇ VE YÖNTEM

Bu gözlemsel çalışmada dirsek travmasıyla iki acil servise gelen hastaların tümü spesifik ölçütlere göre çalışmaya alındı. Hastalar acil servis veya ortopedi asistanları tarafından incelendi. Dirsek radyografileri bir radyolog tarafından kırıklar ve yumuşak doku yaralanmaları açısından gözden geçirildi. İstatistiksel analiz için klinik inceleme ve radyografi sonuçları kaydedildi. Özgüllük, duyarlılık, pozitif ve negatif öngördürücü değerler hesaplandı.

BULGULAR

Çalışmaya alınan 102 hastanın 10'unda (%9,8) dirsek kırıkları tanımlandı. On hastanın 9'unda her dirsek hareketi (ROM) kısıtlanmıştı. Dirsek kırığını öngörmeye kısıtlanmış aktif dirsek ROM'un duyarlılık, özgüllük, pozitif ve negatif öngördürücü değerleri sırasıyla %90, %92, %56 ve %98 şeklindeydi. Bir veya iki yöne hareketlerde kısıtlaması olan kişilerin radyografilerinde hiçbir kırık belirtisi yoktu.

SONUÇ

Dirsek travması geçirmiş, her yöne fleksiyon, ekstansiyon, supinasyon ve pronasyon hareketlerinde ROM'u kısıtlanmış hastalara ayrıca radyografisini çekmek gerekmektedir.

Anahtar Sözcükler: Dirsek travması; hareket erimi; kırık; radyografi.

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Elbow injury is one of the common complaints in the Emergency Department (ED), ranging from a complex fracture with neurovascular damage or simply a subtle or occult fracture. Despite a high rate of radiographs in elbow injury, it is one of the most important locations for missed fractures, reported as 10.8% and 6% in two different studies.^[1-3]

Clinical decision rules for obtaining radiography in different injuries such as the Ottawa ankle and knee rules, cervical spine rules and Pittsburgh knee rules have led to efficient use of radiography in injuries.^[4-10] These rules have led to a reduced number of radiographs and eliminated unnecessary exposure to radiation in patients.^[10]

There are no validated clinical rules to predict the need for radiography in elbow injuries. Previous studies offered clinical rules by evaluating limitations in elbow active range of motion (ROM) to predict the need for an elbow X-ray.^[1,11-13] In several studies, the patient's ability to fully extend the elbow was suggested as a sensitive clinical screening test for patients with elbow injuries or in situations in which radiology facilities were lacking.^[1,11-14]

In this study, we evaluated the role of a normal elbow active ROM following acute trauma as the predictor of low risk fracture with no need for further radiography. We hypothesized that maintaining full ROM of elbow in all movements (flexion, extension, supination, pronation) after trauma demonstrated low fracture risk in patients and that X-ray radiographs for every patient may not be required.

MATERIALS AND METHODS

This prospective observational study took place from April to September 2010. Enrollment sites were the EDs of two academic hospitals, with a census of approximately 57,000 annual emergency visits. All patients presenting to the ED with elbow injury were included. The inclusion criteria were as follows: age >5 years old, admission to the hospital in the first 24 hours, no evidences of an altered mental status or intoxication, no previous history of elbow trauma, vascular dysfunction or any other medical condition limiting baseline mobility of the elbow, and no other distracting injuries. All eligible patients chosen by census sampling method were included.^[10]

Active ROM was examined and recorded by an orthopedics or emergency medicine resident. Participating physicians were instructed on how to perform the ROM and complete the enrollment form. Examination included active flexion of 90° with a full extension (0°) and a normal and complete pronation and supination.

Patients who did not receive radiographs were excluded. Only the patients that underwent radiographic

evaluations (according to the physician's clinical judgment) entered the study. All of them underwent routine X-ray in lateral and anteroposterior (AP) positions. Other views were prescribed in those patients who did not have fracture in AP and lateral views, but were clinically suspected of fracture.

For all patients, the presence of fracture or displaced fat pad sign was followed by radiographs. An attending radiologist who was blinded to the results of the physical examination reviewed all radiographs. All data including baseline demographics were recorded on a standard form.

Patients were divided into two groups of normal and abnormal active ROM. Similar ROM on both sides was considered normal, so some normal cases had equal limitations in both hands.

Fracture and soft tissue injury (displaced fat pad sign) in the two groups were determined by means of radiographs.

Descriptive statistical tests were performed using the Statistical Package for the Social Sciences for Windows, version 18 (SPSS Inc., Chicago, IL). Mean, standard deviation (SD), percentage frequency, chi-square, and difference of means were calculated by a statistician investigator. Sensitivity, specificity, predictive values, and likelihood ratios were calculated.

RESULTS

One hundred and two patients (66.7% males) with a mean age of 32.2±21.6 years (range, 5-87 years) were enrolled according to the specific criteria. The most common mechanism of trauma was a fall and the most involved bone was the humerus.

Limited active ROM was identified in 26 patients (Table 1). Six patients had similar limitation on both sides and were considered normal. Twenty patients had significant limitations in the injured elbow compared to the non-injured side.

The X-ray showed fractures in 10 patients. Ninety-two patients (90.2%) had no sign of fracture on the X-ray.

Table 1. Results of elbow range of motion examination and radiographic evaluation (n=102)

Limitation in ROM	No fracture	Fracture
No limitation	81	1
All movements	7	9
Supination + pronation	2	0
Flexion + extension	1	0
Extension	1	0

ROM: Range of motion; p<0.001.

Table 2. Types of fractures in 10 patients with positive X-ray sign for fracture

Type of injury	Mechanism of trauma	n
Condylar fracture	Car accident	3
Olecranon fracture	Falling	2
Articular surface fracture	Falling	2
Intercondylar fracture	Falling	1
Lateral epicondylar fracture	Falling	1*
Radial head fracture	Violence	1

* A 26-year-old male with normal physical examination who had a fracture on X-ray.

Of 20 patients with limited ROM in the injured elbow, 9 (45%) had elbow fractures on the X-ray. Humerus condyle fracture was the leading type of fracture, followed by olecranon fractures (Table 2). Of 82 patients who were considered normal, only 1 had radiographic fracture (Table 1).

All 9 patients with radiographic fractures had limitations in all movements ($p=0.001$).

Soft tissue injuries were detected in 15 patients (14.7%). Of 20 patients with limited ROM, 13 (65%) had soft tissue injury ($p=0.001$). All 9 patients with radiographic fracture had soft tissue injuries. Of 82 patients who were considered as having normal ROM, 2 (2.4%) had soft tissue injury.

Limited active ROM in injured elbows had a sensitivity of 90%, specificity of 92%, positive predictive value of 56%, and negative predictive value of 98%.

Patients with limitation in one or two movements (for instance, limited extension/flexion and normal supination/pronation) had no sign of fracture on X-ray.

DISCUSSION

This prospective observational study showed that a normal active elbow ROM examination following acute trauma may suggest the lack of acute fracture, with no need for further elbow radiography. Only one patient who presented with a normal active ROM was found to have a fracture on the elbow X-ray. Two other patients with normal examinations had a soft tissue injury on the X-ray.

In the literature, linear fracture of the head of the radius^[1,10-12] and fracture of the olecranon^[10-12] were two injuries observed in patients with normal ROM. However, the addition of point tenderness at the olecranon, epicondyles and radial head did not improve the sensitivity or specificity of the active ROM maneuvers in the detection of elbow fractures.^[10-12]

In our study, patients with partial limitation in one or two movements had no sign of fractures on the X-ray. However, almost all patients with fracture had limited range in all movements. Thus, presence of lim-

itation in all movements is more suggestive for predicting elbow fracture. In other words, limited elbow ROM in all movements is a good indicator for possible significant injury to the elbow, which may require further X-ray investigations. This study does not show any association among the different kinds of limited ROM in one direction and elbow fracture, which can be explained by the small number of patients in these groups.

We found limited elbow active ROM as a sensitive test for detecting fractures (90%). Several studies have shown the sensitivity of elbow ROM in detecting fracture (92% in the study of Lamprakis et al.,^[13] 96.8% in the large study by Appelboom^[12] and 100% in the study of Darracq^[10]).

This test also showed acceptable specificity in our study (92%). Lennon and Darracq both reported high specificity in active ROM tests as well, with rates of 91% and 97%, respectively.^[1,10] Studies which relied only on full extension had lower specificity (69.4% and 48.5% in the studies of Docherty and Appelboom, respectively).^[12,14]

The active ROM is an easy test to perform in the ED and has been proven to be sensitive. Thus, the elbow clinical examination could help clinicians to efficiently use radiography for injured patients.

The possible explanations for the patient with a false-negative result of the examination (a positive elbow fracture with normal ROM examination) might be explained by the following factors: 1. Opioid addiction or opium consumption; 2. Diabetic neuropathy; 3. Presence of more severe pain and injury in different locations or confusion following head injury; or 4. Cervical spinal cord injury with upper extremity numbness. In the latter scenario, the patient cannot have normal active ROM, but can have normal passive ROM.

We found that individuals with preservation of full active ROM after acute elbow trauma have a very low risk of associated fracture and may not require radiographic investigation. The limitations of this study included the relatively small sample size. Further multicenter studies should be performed with larger numbers of patients and of longer duration with defined mechanism of injury, types of fractures, risk factors, outcomes of fracture, and disability rates.

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