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Investigating the Necessity of Radiological Analysis in Pulled Elbow

Çekilmiş Dirsek Sendromunda Radyolojik Analizin Gerekliliğinin İncelenmesi

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ABSTRACT

Objective: Primary objective was to reveal the necessity of radiological analysis by investigating the differences in radiological findings in the pulled and intact sides of pulled elbow patients. The secondary objective was to examine pulled elbow patients' demographic and radiographic distributions to reveal recurrence-related risk factors.

Materials and Methods: In this retrospective prognostic study, 80 patients, treated for pulled elbow between August 2019 and January 2022 were examined. The patient's gender, age, side, and injury mechanism information were evaluated. The radio-capitellar line, the radial epiphyseal angle, and the humero-ulnar angle were evaluated on both injured and intact side X-rays.

Results: No missed fractures were detected, and no significant difference was found between injured and intact sides in the radiological analysis ($p>0.05$). Recurrent dislocations were detected in 14 patients (17.5%). No significant relationship was found between recurrent pulled elbow and gender, side, mechanism of injury, and radiological findings ($p>0.05$).

Conclusion: Although radiographic examination of the pulled elbow is not diagnostically and prognostically necessary, radiographs of the elbow can be taken and examined regarding fracture exclusion and medicolegal concerns. There is no obvious risk factor predicting recurrent dislocation.

Keywords: Humero-ulnar angle, pulled elbow, radial epiphyseal angle, radio-capitellar line, radiological analysis

ÖZ

Amaç: Birinci amaç, çekilmiş dirsek hastalarının yaralanmış ve sağlam taraflarının radyolojik bulgularındaki farklılıkları araştırarak radyolojik incelemenin bu hastalardaki gerekliliğini ortaya koymaktır. İkinci amaç, nüks ile ilişkili risk faktörlerini ortaya çıkarmaktır.

Materyal ve Metot: Bu retrospektif prognostik çalışmada, Ağustos 2019 ile Ocak 2022 tarihleri arasında çekilmiş dirsek nedeniyle tedavi edilen 80 hasta incelendi. Hastaların cinsiyeti, yaşı, tarafı ve yaralanma mekanizması bilgileri değerlendirildi. Radyo-kapitellar hat, radyal epifiz açı ve humero-ulnar açı hem kırık hem de sağlam taraf grafilerinde değerlendirildi.

Bulgular: Radyolojik analizde gözden kaçmış kırık saptanmadı ve yaralı ve sağlam taraflar arasında radyolojik açıdan anlamlı fark bulunmadı ($p>0,05$). 14 hastada (% 17,5) tekrarlayan çekilmiş dirsek saptandı. Tekrarlayan çekilmiş dirsek ile cinsiyet, taraf, yaralanma mekanizması ve radyolojik bulgular arasında anlamlı bir ilişki bulunmadı ($p>0,05$).

Sonuç: Çekilmiş dirseğin radyografik değerlendirilmesi tanısal ve prognostik olarak gerekli olmasa da kırık ekartasyonu ve medikolegal kaygılar açısından radyografik incelemeler gerekebilir. Tekrarlayan çıkığı öngören belirgin bir risk faktörü yoktur.

Anahtar Kelimeler: Çekilmiş dirsek, humero-ulnar açı, radyal epifiz açısı, radyolojik analiz, radyo-kapitellar hat

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INTRODUCTION

Pulled Elbow (Nursemaid's Elbow), with an annual incidence of up to 2.6%, is a rare elbow injury that can be explained by the slipping over of the radial head, because of the weak annular ligament and increased ligamentous laxity, usually after sudden and severe traction of the arm.[1,2] As with other ligamentous laxity-related pathologies, it is generally reported more commonly in girls.[2-4] and clinical projection is usually a frightened child younger than six years of age who, following a history of traction on the upper extremity, tries to keep the arm still and has pain with active movement.[1,2,5] The pulled elbow is usually diagnosed with an anamnesis and physical examination, and a radiological examination is not required for diagnosis. Closed reduction manoeuvres of hyperpronation or supination-flexion, which are applied in the emergency service, are recommended for the treatment.[2,5-7] Although its recurrence is reported to be low, recurrence rates of up to 46% have been reported in some series.[1]

Although direct radiographs are not usually required for diagnosis, comparative bilateral radiographs are usually requested in clinical practice in patients who apply to the emergency department suspected of a pulled elbow. The reasons for this include atypical findings accompanying pulled elbow, suspicion of child abuse, history other than traction of the upper arm, risk of fracture, and medicolegal concerns.[2,8-10] On the other hand, the necessity of a radiographic examination of the pulled elbow is still a matter of debate.

Our primary objective was to reveal the necessity of radiological analysis by investigating the differences in radiological findings in the pulled and intact sides of pulled elbow patients with elbow X-rays. Our secondary objective was to examine pulled elbow patients' demographic and radiographic distributions to reveal recurrence-related risk factors.

MATERIALS AND METHODS

Ethics Committee Approval: Our study was approved by the Clinical Research Ethics Committee of Ankara City Hospital (Date: 23.03.2022, decision no: E1-22-2500). The study was carried out under the International Helsinki Declaration of human rights.

Studying Group: In this retrospective prognostic study, patients consulted to our clinic with the suspicion of a pulled elbow between August 2019 and January 2022 were examined. All patients were included in the study with a confirmed case of the unilaterally pulled elbow and treated with either hyperpronation or supination-flexion manoeuvres implemented in the emergency department. Exclusion criteria were defined as; patients with recurrent or bilateral pulled elbows or a history of elbow fracture on either side, patients with accompanying systemic musculoskeletal diseases, patients who do not have a comparative bilateral elbow radiograph at the first admission, and patients who refused to come to follow-ups. Following inclusion and exclusion criteria, 80 patients were evaluated retrospectively.

Data Collection: In the radiological examination, all measurements were performed by the same radiologist (ISD) with more than ten years of experience. A total of four radiological examinations were performed on X-ray images, three in the anteroposterior and one in the lateral view. In addition, all x-rays were reevaluated for missed fractures. The radio-capitellar line, which has diagnostic significance in children with radial head dislocations,[11] were evaluated on both anteroposterior and lateral radiographs. In this measurement, it was examined whether the imaginary line drawn at the radius neck passed through the capitellum (Figure 1).

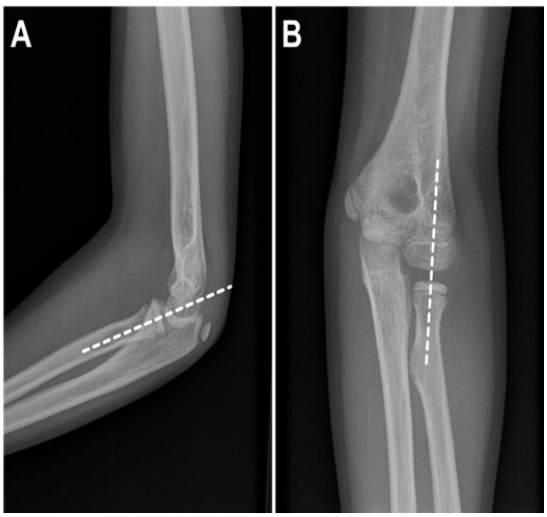

Figure 1. Radio-capitellar line. The radio-capitellar line, the imaginary line drawn passing through the center of the radius neck, should pass through the capitellum on both anteroposterior and lateral planes.

Radial epiphyseal angle (RE) and humero-ulnar angle (HU) were also evaluated on both fractured and intact side anteroposterior radiographs of all patients to evaluate the necessity of radiological examination of the pulled elbow (Figure 2).

The radial epiphyseal angle is defined as the angle at the proximal lateral edge of the point where the first line is drawn along the long axis of the humerus and the second line passing through the radial head epiphysis intersects. In contrast, the humero-ulnar angle is defined as the angle between the long axes of the humerus and ulna.[12] The patient's gender, age, side, and injury mechanism information were evaluated to determine recurrence-related risk factors. Injury mechanisms were categorised under two subheadings as direct upper extremity traction and fall. All patients' families were called for control follow-ups from the phone numbers in the patient files. In the control follow-ups, whether the patients had recurrent pulled elbows was questioned. In addition, it was evaluated whether there was a limitation in the range of motion of the joint in comparison with the opposite elbow.

Statistical Analyses: In descriptive statistics, median, interquartile range, minimum and maximum values are used for continuous data, and frequency and percentage values are given in categorical data. Compliance of continuous data with normal distribution was checked with the Kolmogorov-Smirnov test. The Mann-Whitney U test was used to compare whether there was a difference between the groups in the data that were not normally distributed. Categorical comparisons were made using Pearson chi-square and Fisher's Exact tests. Statistical Package for Social Sciences (SPSS) 26.0 program was used in the evaluations, and the statistical significance limit was accepted as $p<0.05$.

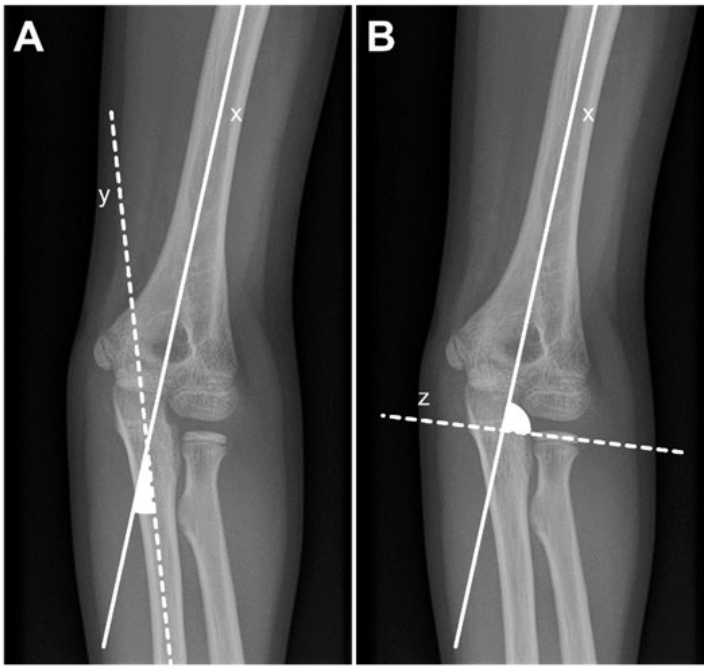

Figure 2. Radial epiphyseal angle and humero-ulnar angle. **A.** Humero-ulnar angle is defined as the angle (scanned area) between the long axes of the humerus (line x) and ulna (line y). **B.** Radial epiphyseal line is defined as the angle at the proximal lateral edge of the point (scanned area) where the first line drawn along the long axis of the humerus (line x) and the second line passing through the radial head epiphysis intersect (line z).

RESULTS

Of the 80 patients evaluated, the mechanism of injury was found to be traction in 27 patients (33.8%), while the pulled elbow was observed in 53 patients (66.3%) after falling. No loss of range of motion was detected in any of the patients. Detailed distribution of the patients can be seen in Table 1.

No missed fractures were detected in any patient in the radiological analysis. The radio-capitellar line was disrupted in 10 patients (12.8%) in the anteroposterior radiographs and 18 patients (23.1%) in lateral radiographs. The median RE and HU angles of the injured side were 92.2° (Range: 81.9-170.8 degrees) and 170.8° (Range: 90-176.3 degrees). No significant difference was found between the injured and intact sides in terms of radiological measurements ($p>0.05$ for each) (Table 2).

Recurrent dislocations were detected in 14 patients (17.5%). No significant relationship was found between recurrent pulled elbow and gender, side, mechanism of injury, and radiological findings ($p>0.05$ for each) (Table 3).

Table 1. Demographic profile of the patients.

		Pulled Elbow (n=80 patients)	
Age		**24.5 months (IR: 21) (Range: 4-71 months)**	
Gender	Male	37	46.3%
	Female	43	53.8%
Side	Right	31	38.8%
	Left	49	61.3%
Injury Mechanism	Traction	27	33.8%
	Fall	53	66.3%
Recurrence	No	66	82.5%
	Yes	14	17.5%
Follow-up		**12.5 months (IR: 11) (Range: 8-32 months)**	
Range of motion at the last follow-up	No limitation	80	100
	Limited	0	0

N: number of patients; IR: interquartile range.

Table 2. Radiographic analysis of pulled elbow.

		Injured Elbow (N= 80 patients)	Intact Elbow (N= 80 patients)	p
Anteroposterior Radio-capitellar Line	Available	70 (87.5%)	N/A	N/A*
	Disrupted	10 (12.5%)		
Lateral Radio-capitellar Line	Available	62 (77.5%)	N/A	N/A*
	Disrupted	18 (22.5%)		
Radial Epiphyseal Angle (degrees)		92.2° (IR: 7.25°) (81.9° - 170.8°)	91° (IR: 7.1°) (80° - 104.2°)	0.580
Humero-ulnar Angle (degrees)		170.8° (IR: 6.45°) (90° - 176.3°)	170° (IR: 6.1°) (160° - 176.4°)	0.406

N: Number of patients; p: Statistical significance value; IR: Interquartile range; *: No statistics were computed because Radio-capitellar line is a constant for intact elbow.

Table 3. Analysis of the Recurrency-related Demographic and Radiological Factors.

		No Recurrency (N=66 patients)	Recurrent Cases (N=14 patients)	p
Age (months)		25.5 (IR: 20) (4 – 71)	20.5 (IR: 14) (7 – 55)	0.121
Gender	Male	30 (81.1%)	7 (18.9%)	0.757
	Female	36 (83.7%)	7 (16.3%)	
Side	Right	26 (83.9%)	5 (16.1%)	0.797
	Left	40 (81.6%)	9 (18.4%)	
Injury Mechanism	Traction	23 (85.2%)	4 (14.8%)	0.763
	Fall	43 (81.1%)	10 (18.9%)	
Anteroposterior Radio-capitellar Line	Available	58 (82.9%)	12 (17.1%)	0.824
	Disrupted	8 (80%)	2 (20%)	
Lateral Radio-capitellar Line	Available	51 (82.3%)	11 (17.7%)	0.916
	Disrupted	15 (83.3%)	3 (16.7%)	
Radial Epiphyseal Angle (degrees)		91° (IR:7°) (81.51° - 170.8°)	94° (IR: 5.77°) (87.3° - 104.2°)	0.075
Humero-ulnar Angle (degrees)		170.8° (IR: 6.8°) (90° - 176.4°)	170.4° (IR: 6.17°) (164.6° - 175°)	0.924

N: Number of patients; p: Statistical significance value; IR: Interquartile range.

DISCUSSION AND CONCLUSION

The necessity of radiological evaluation in the diagnostic process of the pulled elbow is controversial since the diagnosis is usually easily made by sufficient anamnesis and optimal physical examination.[1,13,14] Although the prevailing opinion in the literature is that no additional diagnostic tests are necessary, some studies[13-15] in recent years suggest elbow ultrasonography to assist the diagnostic process. On the other hand, the absence of radiography raises some ethical and medicolegal concerns, such as missed fractures and overlooked child abuse, especially considering the possibility of families' concealment of information. Our study aimed to investi-

gate the diagnostic and prognostic importance of radiographic examination in the pulled elbow and to examine the relationship between radiological findings and recurrence. To the best of our knowledge, there is no large-scale radiological study regarding pulled elbow in the literature, constituting our study's main strength. Our most important finding was that the radio-capitellar line, the radiological indicator of radial head dislocation, was disrupted in only 10 (12%) patients in the anteroposterior plane and only 18 (23.1%) patients in the lateral plane. There was no significant difference between the values of the elbow angles on the injured and intact sides ($p>0.05$ for each). Moreover, no recurrence-related radiological parameter was detected ($p>0.05$ for each).

Approximately one-fourth of childhood injuries involve the elbow area.[16] Although most of them are supracondylar fractures, the pulled elbow should be kept in mind, especially in children under six years of age with a history of sudden traction.[1,2,5,6] As mentioned before, the prevailing view in the literature is that the diagnosis of the pulled elbow should be made clinically, and unnecessary radiation should be avoided. On the other hand, radiographic examinations are also requested in the pulled elbow for reasons such as atypical history and suspected fracture. There are many radiographic measurements described in the literature for pediatric elbow examination.[10-12] Since pulled elbow is a pathology associated with the radial head, in this study, the radio-capitellar line, which is an indicator for radial head dislocation,[11] and radial epiphyseal angle, which is directly related to the radial epiphysis,[12] was examined. In addition, the humero-ulnar angle, which was clinically correlated with the bearing angle,[12] was also evaluated. Unfortunately, we found that the radio-capitellar line was disrupted in the anteroposterior, and lateral planes in very few of our pulled elbow cases. Moreover, no significant difference was detected between the injured and healthy side values of RE and HU angles. In line with the findings of our study, we concluded that radiographic examination is not necessary for the diagnostic process of the pulled elbow. Although it can be interpreted as a dislocation, the fact that the underlying pathology of this clinical picture is ligament-related may explain this situation. Moreover, when the relationship between radiological analyses and recurrent pulled elbow cases was examined, no significant association was found between recurrency and radiological measurements ($p>0.05$ for each). This situation can be interpreted as the radiological examination is not prognostically critical in the pulled elbow. On the other hand, the fact that no significant relationship was found not only between recurrency and radiological analyses but also between recurrency and demographic characteristics and injury mechanisms suggests that recurrency is unpredictable and families should avoid sudden and rapid upper extremity traction.

Considering the pulled elbow occurs with the sudden and rapid traction of the upper extremity pathophysiologically, traction must be present in the anamnesis. On the other hand, contrary to both theoretical knowledge and literature, two-thirds of the patients in our study were injured after falling. We believe the reason behind this contradiction is the involuntary deficiencies of families in explaining the mechanism of injury. Moreover, how a child is lifted off the ground after falling is also important. If someone is lifted from the ground by holding a single upper extremity and pulling it suddenly after a slight fall, the family will give an anamnesis of the fall. Still, pulled elbow will be seen after traction. The crucial point is, regardless of the reason, in a child younger than six years old who applied to the emergency department with anamnesis of falling and complaining of elbow pain, both emergency physicians and general practitioners will order comparative bilateral radiographs to exclude fracture and protect themselves medicolegally. At this point, taking the correct anamnesis from the patient and the family and an effective physical examination may reduce the need for a radiographic examination. Still, medicolegal problems that may arise are a separate topic of discussion.

One of the most important steps in the patient evaluation process for a patient with a pre-diagnosis pulled elbow is to consider child abuse. The child and family should be evaluated carefully, and other accompanying injuries of the child should be examined. In the suspect of abuse, the whole body should be examined in detail for extensive bruises in the body, and fractures at different healing stages on the X-ray should be checked.

There are some limitations in our study. First, the small number of patients, the retrospective nature of the study, and the absence of a control group significantly reduce the power of the study. In addition, the measurement of radiographs taken in the emergency room after an acute scenario is an important limitation. Incorrect positioning regarding acute pain will affect measurements. Finally, apart from the measurements included in the study, many radiographic measurements were defined to evaluate the pediatric elbow. The necessity of radiological analysis can be investigated in more detail with studies conducted with more extensive patient series and including all defined measurements.

In conclusion, although a radiographic examination of the pulled elbow is not diagnostically and prognostically necessary, radiographs of the elbow can be taken and examined in terms of fracture exclusion

and medicolegal concerns. There is no obvious risk factor predicting recurrent dislocation demographically and radiologically, and care should be taken regarding child abuse.

Ethics Committee Approval: Our study was approved by the Clinical Research Ethics Committee of Ankara City Hospital (Date: 23.03.2022, decision no: E1-22-2500). The international Helsinki Declaration of human rights carried out the study.

Conflict of Interest: No conflict of interest was declared by the authors.

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