

# Underlying causes of pulled elbow in children: Could there be a physiopathology similar to transient synovitis of the hip?



Raheleh Faramarzi<sup>1</sup>, Mohammad Davood Sharifi<sup>2</sup>, Elnaz Vafadar Moradi<sup>2\*</sup>, Behnaz Alizadeh<sup>2</sup>

<sup>1</sup>Department of Pediatrics, Faculty of Medicine Sciences, Mashhad University of Medical Sciences, Mashhad, Iran

<sup>2</sup>Department of Emergency Medicine, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

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**\*Corresponding author:**

Elnaz Vafadar Moradi, MD,  
Department of Emergency  
Medicine, Faculty of Medicine,  
Mashhad University of Medical  
Sciences, Mashhad, Iran.  
Tel: +989151178625;  
Email: Vafadarme@mums.ac.ir

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## Abstract

**Objective:** Partial dislocation of radius head (pulled elbow) is the most common trauma observed in out-patient orthopedic treatment of children. The typical mechanism of this trauma includes exertion of longitudinal force along the forearm in a pronation position, causing partial dislocation of the radius head.

**Methods:** This Retrospective descriptive and cross-sectional study was undertaken on patients referring to the emergency ward of Imam Reza hospital of Mashhad with typical history of partial dislocation of radius head (pulled elbow). The present study was conducted between March 20, 2018 and March 20, 2019. Based on the number of patients at the emergency ward, the sample size was determined to be 80. Descriptive statistics such as mean and standard deviation were used to describe the collected data.

**Results:** From among 80 children diagnosed with partial radius bone dislocation, 66.23% were girls and 33.77% were boys. The age range of patients was 28.08 months for girls and 31.04 months for boys. Findings also showed that 32 patients had a history of recent respiratory infection within 1 week before the pulled elbow incident.

**Conclusion:** Findings revealed that, similar to previous studies, the pulled elbow injury was more common in girls than in boys. Successful reduction in first and second attempts, notwithstanding the maneuvers used indicated that the success rate of first attempts at reduction was 93%. The history of recent respiratory infections during 1 week before the injury was taken into account, where 40% of the children had some history of such respiratory infections.

**Keywords:** Epidemiology, Joint dislocation, Radius, Pulled elbow

## Introduction

Partial dislocation of radius head (pulled elbow) is the most common trauma observed in out-patient orthopedic treatment of children. Partial dislocation of radius head in children below the age of 7 particularly those between 3 and 5 years is very common (1), yet this type of dislocation is also probable in the form of partial dislocation of annular ligament of the elbow up to adolescent years (i.e., 18) (2). The typical mechanism of this trauma includes exertion of longitudinal force along the forearm in a pronation position, causing partial dislocation of the radius head and trapping the annular ligament in the glenohumeral joint (1). Clinical signs of this trauma are pain in the forearm area, limited movement of elbow and forearm, and keeping the involved limb at the side, as well as keeping the elbow in a flexion state (1, 3). Generally, the most common causes of this trauma are related to pulling

a child's hand, or falling while playing (4). The trauma is diagnosed by a typical history and clinical examination, and it is confirmed when the child uses the injured limbs after a reduction maneuver (1). Various studies have argued that this kind of trauma is more common in girls than in boys, and in the left hand more than the right hand (in girls) (3). Whatever the mechanism, the child avoids using the limbs and cries and resists any efforts to the injured hand (4).

Nearly all studies related to pulled elbow injury have described the causes of the trauma. There is a common belief indicating that the main cause is the slippage of radius bone underneath the annular ligament (5). The distal section of annular ligament, which covers the radius head, is weaker in children in comparison to adults. As the child ages, the annular ligament becomes stronger and reduces the chance of this injury (6). Given the 2.6%



occurrence rate of this trauma in children, and a 46% (7) chance of the injury relapsing as well as the anxiety of parents in facing this situation, we designed the present study.

Due to lack of sufficient information for Iranian patients, this study focuses on studying the trauma in terms of epidemiology, causes of repeated dislocation and causes behind delayed use of injured limbs and the number of reduction attempts. Epidemiological analysis of this trauma and studying relevant findings about its occurrence by taking into account the probability of its relapse, may be employed to train parents to prevent movements and actions causing this trauma or its relapse, or give them the required information on reduction maneuvers in case of its incidence.

## Methods

This descriptive cross-sectional study was undertaken on patients referring to the emergency ward of Imam Reza hospital of Mashhad with typical history of partial dislocation of radius head (pulled elbow). Based on the number of patients at the emergency ward, we included 80 patients in this study.

Eligible participants included children below the age of 7 suffering from pulled elbow in pronation state and patients with partial flexion of elbow joint referring to the emergency ward of Imam Reza hospital. The children entered the study after obtaining permission from their parents. Patients with suspicious or unknown history, those with a history of direct trauma to their elbows, having apparent deformity, edema, local swelling, ecchymosis in the elbow area, patients with multiple trauma, and patients with congenital bone defects were excluded from the study.

Imam Reza hospital, part of Mashhad University of Medical Sciences, is a level 1 trauma center. The average number of patients referring to its emergency ward is around 200 per 24 hours. This study was conducted between March 20, 2018 and March 20, 2019. Patient data was recorded when they were examined by residents of the emergency ward and data were recorded into forms. Patient's age, sex, injured limbs, history of recent respiratory infections, and type of trauma were recorded and analyzed for each patient. Other information related to the patient's mother, family members, financial conditions, etc. were collected by completing checklists and questionnaires. Informed consent was granted from parents.

The sample size was estimated based on the number of all patients referred to the emergency department during a year and were willing to participate in the study (approximately 80 patients). The collected data were analyzed by using SPSS software version 22.  $P$  value of  $<0.05$  was considered statistically significant. Descriptive statistics such as mean and standard deviation were used to describe the collected data. Normality of test

variables was examined by Kolmogorov-Smirnov test.

Man-Whitney test and Chi square tests were used to compare continuous and categorical data. Statistical analysis was performed using SPSS software, Version 16 and a 2-sided  $P < 0.05$  was considered significant.

## Results

From among 80 children diagnosed with partial radius bone dislocation, 66.23% were girls and 33.77% were boys ( $P < 0.05$ ). The age range of patients was around 28.08 months for girls and 31.04 months for boys (Figure 1). Based on the data collected from questionnaires, 30 patients (39%) had a history of previous dislocation. Among those 30 patients, 8 had experienced dislocation in their right hands, and 2 in their left hands. The condition of the remaining 20 patients was unknown in this regard (Figure 2).

The relationship between dislocation and sex was also analyzed and no difference was observed between the two groups (male and female patients) regarding the right/left hand trauma rates ( $P = 0.109$ ). A comparison between successful reductions in first or second attempts demonstrated that 93% of the cases were successfully

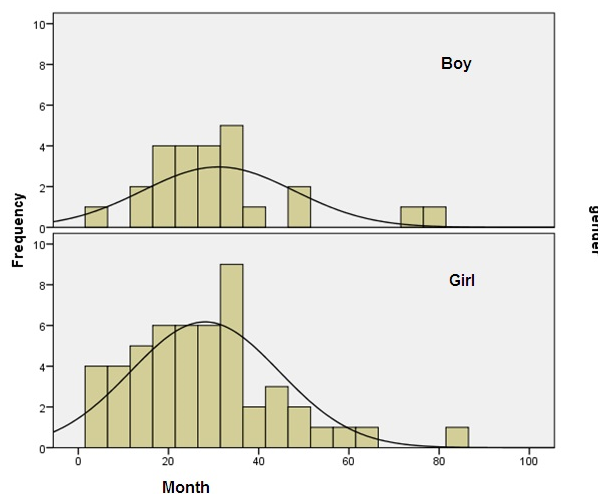


Figure 1. Age range of children based on gender.

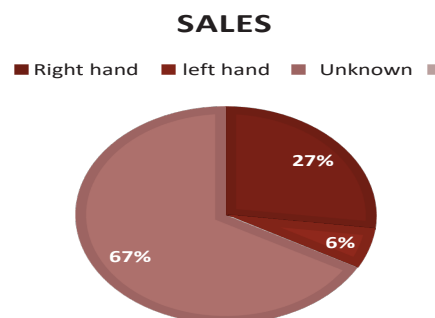


Figure 2. Frequency of previous dislocation.

performed in the first attempt regardless of reduction maneuver type.

Patients' histories of recent respiratory infection within 1 week before the pulled elbow incident were reviewed, and it was observed that from among 80 studied children, 32 had a history of recent respiratory infection. Among those 32 children, 22 were girls and 10 were boys. A significant relationship was observed between the recent respiratory infection and incidence of the trauma ( $P < 0.050$ ) (Figure 3). Inquiring into the level of education of children's parents, findings revealed that most of them had only finished high school (41%-45%). Concerning the relationship of the level of emolument and monthly household incomes, it was evident that more than 52% of individuals were in low medium conditions, and there was a significant relationship between medium and low economic income and the incidence of pulled elbow injuries ( $P < 0.05$ ).

### Discussion

Radius head dislocation requires clinical diagnosis, and its treatment is based on observation of the movements of a child's hand after reduction attempts. Endemic epidemiology of this injury and its underlying causes and backgrounds may help physicians in effective diagnosis and treatment of this injury.

Results of this study indicated that, similar to previous studies, the pulled elbow injury was more common in girls than in boys (1, 3, and 4). The study conducted by Irie et al in Japan showed that there was no difference between male and female subjects. This retrospective study focused on information collected during a period of 10 years for about 2331 children, and no difference was seen between the two genders ( $P = 1.00$ ) (8). The involved body side (left or right hand) in our study was similar to previous studies. We observed more cases of injury in the left side than the right side. This may be due to the fact that most parents are right-handed and tend to grab their children's arms by their dominant hand. So, the left hands of their children have a bigger chance of being injured by the same mechanisms.

The age was 28.08 months in girls, and 31.04 months in

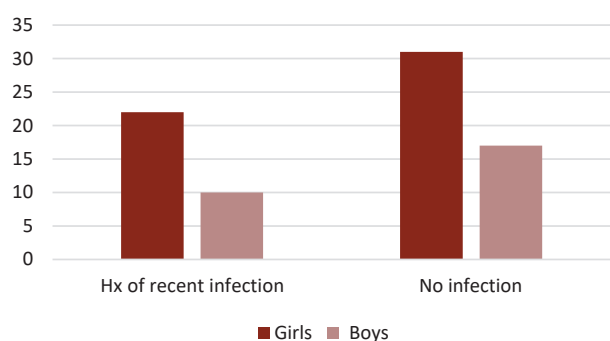


Figure 3. Recent upper respiratory tract infection.

boys. In the study by Vitello et al, participants' age was in a similar range (1). This may be due to the fact that children of these ages have relatively learned to walk independently, so they can walk with their hands held by their parents, without being carried in their bosoms. This independent walking may result in falling down or pulling of the hand by their parents.

A comparison was done between successful reduction in first and second attempts, notwithstanding the maneuvers used. Results indicated that the success rate of first attempts at reduction was 93%. Another study by Sevensan et al also worked on reduction success, focusing on success of reduction attempts and the maneuver used (9). The success rate of the first attempt was reported to be 86.36%. But in the present study the maneuver was ignored and a success rate of 93% was achieved. It is important to mention that if the reduction maneuver was also taken into account, this study would be of higher value. The relapse rate of this injury for our study was 39%, significantly different with results obtained by Irie et al, which was 14%. This may be due to training offered to the parents aimed at preventing relapse, and also the observance of such teachings by the parents in Irie and colleagues' study.

In the present study, the history of recent respiratory infections during 1 week before the injury was taken into account, where 40% of the children had some history of such respiratory infections. This analysis was performed due to the fact that similar to hip tenosynovitis, chance of this infection predisposes the child to get this kind of injury. In hip tenosynovitis, the non-specific inflammation of the hip joint is considered as an underlying factor in the emergence of the disease, which causes hypertrophic deformation of the joint. In the first acute phase of this disease, a child experiences pain in the involved limbs which is automatically limited within 48 hours. Other clinical signs of the disease are also cleared within 1 or 2 weeks (10). Whitelaw et al studied hip tenosynovitis and identified a viral antibody in the blood samples of many patients. Given this significant relationship between recent respiratory infection and the onset of hip tenosynovitis, and taking into account the results of this study in which 40% of patients had a history of recent respiratory infection, one can come to the conclusion that a similar mechanism may be involved in the dislocation of radius bone. Answering such hypotheses of course requires more studies with larger samples as well as simultaneous assessment of viral markers (11).

Pregnancy issues may also be a factor behind this injury. Such issues may occur in the course of pregnancy, before or during birth. The type of delivery may also affect the results, and cause some differences in a child's bone structures between the two genders (12). A case study from 2006 showed a traumatic disorder during pregnancy (13), and other studies in Spain resulted in similar results, reporting that the type of delivery or pregnancy issues

were also studied. In our study, pregnancy issues and caesarean section premature births were observed more commonly in injured children (with pulled elbow). Child gender was included in comparisons of various variables, and as reported in most studies (3, 14), the chance of injury was higher in girls.

In the present study, the level of education and occupation of parents were also analyzed. It was observed that most parents had medium-level education and jobs, being classified into the medium-low class of the society. There is no similar study in this field in Iran yet. Given the higher rate of incidence of this injury in people of medium and low classes, and taking into account other mechanisms increasing the chance of this kind of injury, it may be concluded that behavioral factors are significant in such people, and injury mechanisms are more common among them. Therefore, family training may result in the reduction of injury rates, and also reduce the financial and labor costs for families.

This study was performed in an academic center, but for improvement of its results, we recommend conducting similar studies in several other medical centers. The sample population of this study consisted of 80 patients, but better results may be achieved if a higher number of children are included in such studies.

### Conclusion

It is important to mention that there is a paucity of studies concerning the topic under investigation and no previous study has focused on the relationship of respiratory infection and the incidence of pulled elbow. This study has shed light on useful results. We recommend conducting future studies on larger samples and in various academic centers.

### Authors' contribution

RF, who was the master guide in this research, conceived and designed the experiments. MDS and BA performed the experiments. MDS and EVM analyzed and interpreted the data. EVM wrote the manuscript. All authors read and approved final version.

### Ethical issues

This study was performed with the financial support of the research deputy department of the Mashhad University of Medical Sciences with ethical code number ir.mums.sd.rec.1394.226 and under a proposal authorized with the permission code number 951358. The children were enrolled in the study by permission of their parents.

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Raheleh Faramarzi1, Mohammad Davood Sharifi2, Elnaz Vafadar Moradi2\*, Behnaz Alizadeh2

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