Comparison of Supination Flexion and Hyperpronation Technique in Reduction of Pulled Elbow Patients Presenting to a Tertiary Health Center in Western Nepal

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ABSTRACT

Background

Pulled elbow (Nursemaid's elbow) or radial head subluxation is a common upper extremity injury in young children and a frequent reason for visiting the Emergency Department. Supination flexion and hyperpronation are two methods described in the literature for reducing this subluxation. The purpose of this study was to identify the most effective method of reduction for pulled elbow in our setting.

Method

This was an observational cross-sectional study including children below 5 years with a provisional diagnosis of pulled elbow and divided into two groups based on the type of reduction method used. The success at the first attempt of the reduction and pain perceived during the reduction using the Wong Baker Faces Pain Rating Scale score were taken as indicators of effectiveness, and age, gender, laterality, and mechanism of injury as demographic indicators were calculated.

Results

Among 84 patients included in the study, the mean age of presentation was 2.92 ± 1.27 years, girls were 51.2%, left side involvement was 66.6% and pulling of the arm (80.95%) was the most common mechanism of injury. The hyperpronation mechanism was more successful than supination flexion during the first attempt reduction (88.1% vs 76.2%) but was not statistically significant (p=0.15). Pain levels perceived during reduction were also less (5.762 ± 1.1 vs 7.33 ± 1.3) in the hyperpronation group as compared to the supination flexion group, and this was statistically significant (p <0.001).

Conclusion

The hyperpronation method is more effective than the supination flexion method for the reduction of pulled elbow in children in our setup.

Keywords: child; pronation; radial head subluxation; reduction, orthopedic; supination.

Introduction

Pulled elbow or Radial head subluxation (RHS), or nursemaid's elbow, is one of the most common upper extremity injuries in young children and a common reason for Emergency Department visits[1]. It typically occurs when axial traction is applied to an arm that is extended while the forearm is pronated[2]. Children between the ages of 1 and 4 are most susceptible to this type of injury, and it is slightly more common in girls and in the left arm[3]. Sudden longitudinal traction causes radial head

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Received: 26/September/2025
Accepted: 27/Nov/2025
DOI: https://doi.org/10.3126/gmj.v5i2.87574

subluxation, and the annular ligament is entrapped in the radio-humeral joint[3]. These injuries are managed by manual reduction methods commonly, supination of the forearm often combined with flexion and hyper-pronation[4].

Numerous clinical trials have compared these two methods regarding the success of these methods and the pain at the time of reduction. The classic reduction technique involves supination at the wrist followed by flexion at the elbow[5]. Studies that have sought to determine the success rates of this technique have described success rates ranging from 80.4% to 92%[6]. The dramatic nature with which we as practitioners reduce an RHS (supinating the wrist followed by flexing the elbow) may be frightening to both the patient and the parent[1]. Many textbooks of orthopaedics and paediatrics still suggest supination flexion (SP) as the preferred method[7]; however, few have quoted hyperpronation (HP) as a superior method[8]. Reviews by Lewis 2003, and Knuistingh Neven 2008 concluded that the pronation method was more effective than the supination method. They also proposed that pronation with or without elbow flexion should be "the first line method of reduction for pulled elbows".[9,10]

These dilemmas have created a gap in our knowledge. Furthermore, no such study has been conducted in Nepalese settings. Though some research done in other countries has shown better results with hyperpronation techniques, those findings have not been corroborated in our setting. Since the studies are also lacking in a clear outline of the effectiveness of these maneuvers and the pain involved in these two reduction methods, this study aims to clarify the success of the first attempt reduction and to find the least painful method of reduction in children with RHS in our setting.

Material and Methods

This is an observational cross-sectional study conducted at the Emergency and orthopedics OPD in Pokhara Academy of Health Sciences (PoAHS) over 1 year from 1 October 2023 to 30 September 2024. The study was conducted after obtaining ethical approval from the Institutional Review Board, PoAHS (Reference number:192/080). The sample size was calculated using the observational comparision of two independent proportions taking allocation as 1:1 (80% power) with a first-attempt success-rate as 75% for supination flexion and 90% for hyper pronation (15% absolute difference), applying the normal approximation formula, obtaining a base requirement of 38 per group (total 76)[11,12]. Convenience sampling was used, and a total of 84 patients, with 42 in each group, were included.

All children aged one to five years presenting with sudden acute upper limb pain with avoidance of moving the affected arm and holding it close to his or her body with no obvious swelling or deformity and having a typical history of pulling the child along by the hand or the child tossing and turning with his or her arm under the body were included in the study. Children with high velocity injury, gross swelling and deformity of the elbow were excluded. The Orthopedic surgeon present in the emergency or orthopedic OPD of PoAHS reduced the pulled elbow according to their comfort either with a supination flexion or hyperpronation technique. During the procedure, the pain perceived by the child was noted. This was calculated by the Wong Baker Faces Pain Rating Scale (WPFRPS) scoring system[2]. (Figure 1) The child was examined every 5 minutes for the return of function of the involved extremity till 15 minutes. If the return of function of the extremity did not occur till 15 minutes,

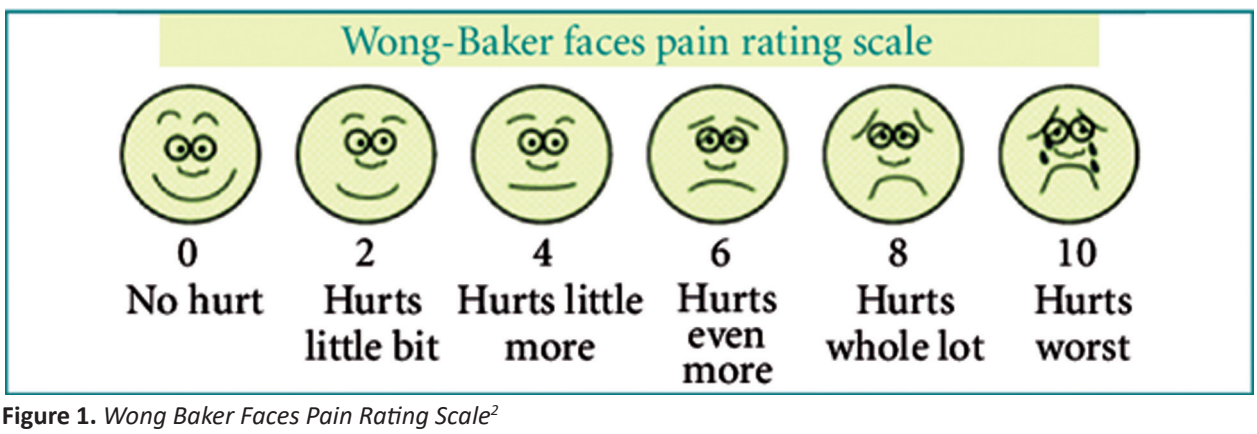

Figure 1. *Wong Baker Faces Pain Rating Scale*[2]

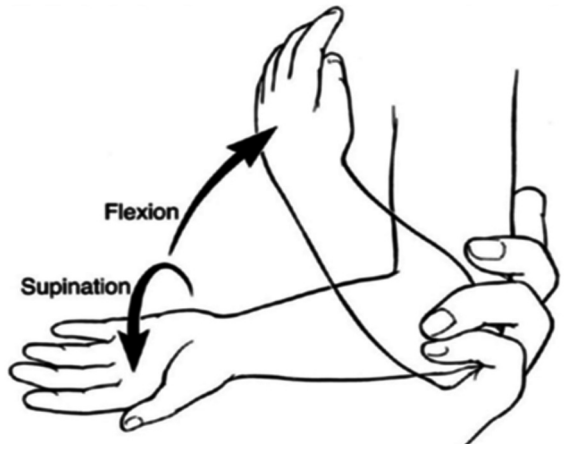

Figure 2. *Supination Flexion reduction technique for pulled elbow*[1]

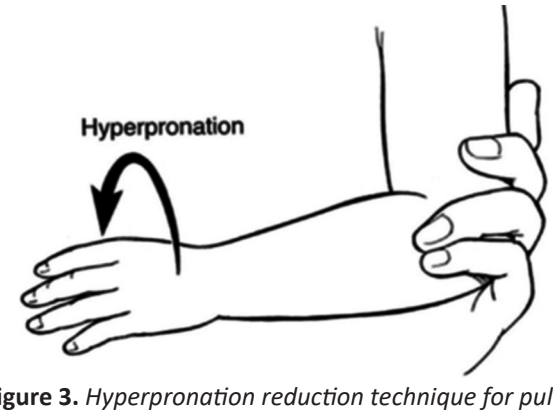

Figure 3. *Hyperpronation reduction technique for pulled elbow*[1]

the procedure was deemed unsuccessful and the other method was applied for reduction. If both the methods were unsuccessful then the case was considered to be treatment failure[1].

After receiving informed consent from the parents or legal guardian, the proforma was filled out after a face-to-face questionnaire or from the medical records. The demographic information, like age, gender, mechanism of injury, and side of injury, was recorded. Age was recorded in years completed according to the birth document. Sex was taken as male or female. Mechanism of injury was recorded as pulling by a guardian or hanging, compression injury secondary to tossing around the bed or ground, and fall injury. Side of injury was recorded as right, left, or bilateral. The Supination hyperflexion technique is done by placing the child on the parent's lap and then grabbing the elbow with one hand and the distal forearm with the other. A supination of the forearm is done, followed by a feeling of a clunk on the elbow by the other hand[1,5] (Figure 2). In the hyperpronation technique, the examiner proceeds after placing the child on the parent's lap, grabbing the elbow with one hand and the distal forearm with the other. A hyperpronation force is applied to the distal forearm, and a clunk is felt.[1,4] (Figure 3)

The collected data were entered, cleaned and coded in Microsoft Excel 2010 and then exported to Statistical Package for the Social Sciences (SPSS) version 23 for statistical analysis. For descriptive statistics, frequency, percentage, proportion, median, and mean were calculated. For inferential statistics, chi square test for categorical and the independent t-test for continuous variables were applied. A *p*-value of <0.05 was taken as statistically significant at a confidence interval of 95%.

Results

Out of the total 90 patients included in the study, six patients were excluded due to identifiable fractures, spontaneous reduction, and ill-defined reduction maneuvers. Among the total 84 patients of pulled elbow, 51.2% were females, and 66.7% had left side involvement. The average age of presentation was 2.92±1.27 years. Out of the total patients 80.95% reported pulling of the arm as the mechanism of injury. (Table 1)

Based on the mechanism of reduction, both groups had an equal 42 patients. Both groups were similar with no significant difference with respect to age (p=0.827), gender (p=0.827), and mechanism of injury (p=0.312). Comparing the two groups based on the success of the first attempt reduction, no significant difference was found (p=0.151). The hyperpronation method had an 88.1% success rate

Table 1: Demographic distribution of pulled elbow patients (n=84)

Gender	
Male	41 (48.8%)
Female	43 (51.2%)
Age distribution	Range:1-5years Mean age: 2.92±1.27 years
Side of involvement	
Right	28 (33.3%)
Left	56 (66.7%)
Mechanism of injury	
Pulling of the arm	68 (80.95%)
Fall injury	8 (9.52%)
Others (roll on the bed/ unclear)	8 (9.52%)

Table 2: Comparison of hyper pronation method and supination flexion method of reduction for pulled elbow

	HP method (n=42)	SF method (n=42)	
Age (mean)	2.87±1.25	2.98±1.31	*p*=0.827 (independent t-test)
Gender			*p*=0.827 (chi-square test)
Male	20	21	
Female	22	21	
Mechanism of injury			*p*=0.312
Pulling of the arm	32 (76.2%)	36 (85.7%)	
Fall injury	6	2	
Unclear(Roll in the bed/unclear)	4	4	
First attempt successful reduction	37 (88.1%)	32 (76.2%)	*p*= 0.151
Pain score during reduction (WPFRPS) (mean)	5.76±1.1	7.33±1.3	*p*= <.001(independent t-test)

while the supination flexion method had a 76.2% success rate. Comparing both groups based on pain during the reduction maneuvers using the WPFRPS method, the hyperpronation method had a lower score as compared to supination flexion, and the difference was statistically significant (p<0.0010). (Table 2) Fifteen children who were not reduced in the first attempt, second attempt was tried after 15 minutes. Five from hyperpronation and ten from supination flexion group did not reduce and thus the other method was applied. Three of the cases from hyperpronation reduced by supination flexion and five from the supination flexion group reduced by hyperpronation technique. The unreduced cases were kept as treatment failure.

Discussion

Radial head subluxation more commonly known as pulled elbow is one of the most common upper extremity injuries in young children. We did a comparative observational study between the two methods of reduction for pulled elbow, where the group were identical. Our findings were comparable to previous literatures.

Pulled elbow typically results from a sudden longitudinal traction applied to an extended, pronated forearm[3]. This mechanism allows the radial head to slip beneath the annular ligament, a structure that is anatomically weaker in children than in adults[13]. The underlying pathophysiology described in the literature aligns with the observations of our study, where the majority of patients (80%) sustained injury through a pulling mechanism[15,16]. This distribution closely mirrors findings from previous studies, including Porozan et al.[16], who reported a pull mechanism in 67% of cases, followed by fall injuries and other less frequent mechanisms.

Several studies report a higher incidence of pulled elbow among girls, a trend also reflected in our study population where 58.2% were female[1,3,15]. Although the reason for this gender predominance remains unclear, hypotheses include differences in parental handling, behavioural factors, or anatomical variations between boys and girls[15].

Historically, the SF technique has been widely recommended as the primary method for reduction of pulled elbow, and many textbooks continue to support its use[5,17,18]. However, a growing body of evidence suggests that HP may be more effective, not only as the first-line maneuver but also as a crossover technique when SF fails[1,19,20]. Multiple comparative studies have demonstrated higher first-attempt success rates with HP. Reports by Guzel et al.[2] (92% vs. 78%), Macias et al.[1] (95% vs. 77%), and Ulici et al.[21] (85% vs. 53%) all favor HP over SF. Similarly, Bek et al.[19] found HP significantly more effective (p = 0.007). In a study by McDonald et al[20], the first successful attempt reduction was achieved in 80% of patients with the PF method and 69% in the SF method. Our findings are consistent with this trend, with first-attempt success of 88.1% for HP compared to 76.2% for SF. Nevertheless, the literature is not entirely unanimous. Shunk et al.[22] reported no significant difference between the maneuvers, while Porozan et al.[16] observed a higher first-attempt success rate with SF compared to HP. Such variations may be attributed to differences in study design, practitioner experience, patient age distribution, or timing of assessment.

Pain during reduction is an important consideration, particularly in pediatric emergency settings. In our study, the HP technique was associated with significantly lower pain scores on the Wong–Baker Faces Pain Rating Scale. This concurs with the findings of Bek et al.[19], who reported that HP was both easier for providers to perform and less painful for children. Furthermore, a meta-analysis by Bexkens et al.[11] concluded that HP is generally less painful and more effective. Studies assessing pain perception from the perspectives of parents and physicians have yielded mixed results. McDonald et al.[20] reported that physicians perceived less pain with HP compared to SF, while parents did not report the same magnitude of difference. Conversely, Green et al.[23] found parents perceived HP as significantly less painful, whereas physicians did not. These contrasting results highlight the subjective nature of pain evaluation in children and the potential influence of observer bias. Other studies, such as those by Guzel et al.[2], Ulci et al.[21] and Porozan et al.[2], did not find significant differences in pain levels between the two techniques.

When we consider the comparable success in the final reduction rate of both maneuvers, it can be speculated that rotation of the radial head, whether with supination or pronation, is sufficient to address the partially slipped annular ligament. As a reversal of the mechanism of injury, most authors recommend supination followed by flexion of the elbow for the reduction of pulled elbow[24]. Although both maneuvers achieve high final reduction success rates, the more favorable initial success and lower pain scores associated with HP may be attributed to biomechanical advantages. When the annular ligament becomes trapped between the radial head and the capitellum, active supination is partially blocked, making the SF technique potentially more painful due to resistance during maneuvering[17]. Hyperpronation, on the other hand, appears to overcome this mechanical obstacle more effectively, resulting in a smoother and less painful reduction[17]. This biomechanical rationale is consistent with our clinical findings and those reported in previous studies[19,22].

Overall, our results add to the growing evidence supporting hyperpronation as a more effective and less painful option for the reduction of pulled elbow. Given its simplicity, comfort, and higher first-attempt success rates, HP could be considered as the preferred initial maneuver in clinical practice. However, our study has certain limitations. Our study is an observational study and carried out in a single center with multiple surgeons performing the maneuvers. We also did not take pre reduction pain ratings of the children, since pain perception is a subjective feeling.

Conclusion

The hyperpronation technique of reduction for pulled elbow has a higher rate of successful first attempt reduction (88.1% vs 76.2%). The hyperpronation technique is also less painful than supination flexion (5.76±1.1 vs 7.33±1.3). Thus, the hyperpronation technique seems to be more effective method of reduction in comparision to supination flexion method. Hyperpronation technique can be applied for pulled elbow reduction in our setting, rather than the classic supination flexion technique.

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