Risk factors for failure of closed forearm fracture reduction in the pediatric emergency department

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BACKGROUND

Forearm shaft fractures account for one-third of all fractures in childhood. Combined closed reduction and cast immobilization are done under procedural sedation in the emergency department (ED). Closed reduction failure defined as an unacceptable alignment of the fracture, at the end of the procedure, is one of the most common indications for surgery.

OBJECTIVES

To explore risk factors for failure of forearm fracture closed reduction in the pediatric ED, and to suggest indications for initial surgery.

METHODS

This retrospective cohort study included all patients aged 0-18 years who presented to our pediatric ED with an extra articular forearm fracture treated with closed reduction between 5/2017 and 4/2021. We explored risk factors for procedural failure, defined as a need for surgical intervention within 6 weeks of the closed reduction attempt. A risk score was created by relying on the adjusted odd ratio (aOR) of each independent predictor.

RESULTS

Of 375 patients (median age 8.1 years, 294 males [78.2%]), 44 patients (11.7%) sustained a reduction failure, of whom 42 (95.5%) had both radius and ulna fractures.

A total of 259 patients presented with forearm fractures involving both the radius and the ulna.

RESULTS

Table 1. A comparison of demographic and clinical characteristics of patients with fracture of both forearm bones according to ED reduction outcome

	Successful ED reduction (n=218)	Failed ED reduction (n=41)	P value
Age (mean ± SD)	8.8 ± 3.0	10.0 ± 3.9	< 0.001
Refracture	4 (1.8)	8 (19.5)	< 0.001
Pain score (mean± SD	6.4 ± 2.6	7.1 ± 1.9	0.05
Procedural sedation medications (mean± SD)			
Ketamine dosage (mg/kg)	1.6± 0.57	1.9±0.73	0.003
Midazolam dosage (mg/kg)	0.08±0.1	0.07±0.2	0.62
Pre-procedural opioid administration Time from opioid administration to reduction, min (mean± SD)	157 (72.4) 158.4 ± 70.0	34 (81.0) 159.3 ± 78.3	0.22 0.94
Fracture characteristics *Fracture location, n(%)* Proximal	3 (1.4)	1(2.4)	0.50
Midshaft	90 (41.5)	26 (61.9)	0.01
Distal	124 (57.1)	15 (35.7)	0.01
Immature bone characteristics of the radius			
Complete fracture	134 (61.8)	36 (85.7)	0.002
Greenstick fracture	93 (42.4)	11 (26.2)	0.05
Plastic deformity	4 (1.8)	0 (0.0)	>0.99
Immature bone characteristics of the radius			
Complete fracture	108 (54.8)	28 (70.0)	0.08
Greenstick fracture	89 (45.2)	12 (30.0)	0.08
Translation and angulation (mean ± SD)			
Radial translation	37.5 ± 38.9	66.4 ± 39.3	<0.001
Radial angulation	28.1 ±22.4	32.5 ±27.2	0.27
Ulnar translation	25.0 ±35.8	38.9 ±39.8	0.02
Ulnar angulation	24.3 ±17.0	26.6 ±18.4	0.21
Dorsal angulation	174 (81.7)	32 (80.0)	0.82
Open fracture	8 (3.7)	7 (16.7)	0.004

RESULTS

The following parameters were independent predictors for reduction failure: refracture (aOR 17.6, p < 0.001), open fracture (aOR 10.1, p = 0.007), midshaft fracture (aOR 2.6, p = 0.004), radial translation rate ≥37% in either plane (aOR 5.1, p = 0.004), and age ≥10 years (aOR 2.9, p = 0.01).

Risk assessment score for failure of closed reduction of both forearm bones

Risk factor	Points
Refracture	5
Open fracture	4
Radial translation ≥ 37%	3
Midshaft frature	2
Patient's age ≥ 10 years	1

Low risk group: patients with a score <3 points had 5% prevalence of reduction failure.

Intermediate risk group: patients with scores between 3 to 5 points had a 31% prevalence of reduction failure.

High risk group: patients with a score >5 points had a 77% prevalence of reduction failure.

CONCLUSIONS

Most pediatric forearm fractures can be successfully managed by closed reduction in the ED. Two-bone fractures had the strongest association with reduction failure.

Refracture, open fracture, midshaft location, initial radius bone translation ≥37% (and not initial angulation),and patient age ≥10 years are independent risk factors for reduction failure in two-bone fractures.

We propose a risk score for reduction failure which can serve as a decision-making tool.