Pediatric Supracondylar Humerus Fractures: Does Surgical Delay Impact Time to Nerve Recovery?

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INTRODUCTION:

Nerve injuries in pediatric supracondylar humerus fractures occur in up to 16% of patients. While some evidence suggests recovery of an isolated anterior interosseous nerve injury (AIN) is not influenced by surgical delay, little is known about other nerve injuries or mixed nerve injuries. With this study, we examined the impact of surgical delay, both from injury and from arrival to the emergency room (ER), on the time to nerve recovery following surgical treatment of supracondylar humeral (SCH) fractures in pediatric patients.

METHODS:

This is an IRB-approved retrospective study was conducted of patients <18 years old who presented to a tertiary children's hospital from January 2009 to January 2019 with a SCH fracture using Current Procedural Terminology codes. Medical record review was then conducted to identify patients with SCH fractures who had traumatic nerve injuries and documented complete postoperative recovery. Patients with iatrogenic/postoperative nerve injuries and incomplete recovery were excluded. Charts were reviewed to collect demographic data, injury characteristics (injury type, nerve type, hand vascularity, etc.), various timepoints (injury, arrival, and surgery), and days to complete neurological recovery were collected. Statistical analysis was conducted with tests for normality and bivariate statistical analysis. Spearman's correlation was performed to examine the relationship between days of nerve recovery with delay in surgery from the ER and from injury. Alpha was set at $p<0.05$ to declare significance.

RESULTS:

A total of 2,282 patients with SCH fractures of which 158 had nerve injuries with complete recovery were identified and included. Mean age was 6.7 years at the time of injury (range: 2.4 – 16). Most fractures were closed injuries (96.2%, n=152/158) and extension Gartland type 3s (n=140/158, 88.6%) (Table 1). Vascularity was preserved in most cases with pulses present in 84.2% (n=133/158) and hands perfused in 98.1% (n=155/158) of fractures. Overall, the median time to nerve recovery was 30 days (14.5 – 61.25) while the mean surgical delay from injury and the median surgical delay from ER was 13.2 hours (5.7) and 9.6 hours (4.4 – 61.2). Most patients had single nerve distribution injury (88.6%, n=140/158) with the most common being that of the median nerve distribution (68.9%, n=109/158) (Table 2). No significant differences were noted in time to recovery and delay to surgery from injury or ER across all nerve injuries ($p>0.05$) (Table 2). No significant correlation was noted between surgical delay from the injury or ER and time to nerve recovery for all nerve injuries by distribution (p=injury, ER) – median (p=0.732, 0.601), ulnar (p=0.578, 0.354), radial (p=0.497, 0.526), or mixed (p=0.213, 0.135).

DISCUSSION AND CONCLUSION:

Our study examined the effect of delay in surgery on nerve recovery in supracondylar humeral fractures accounting for all nerve injuries and showed no impact on the time to nerve recovery. While fractures causing nerve injuries should ideally be reduced as soon as possible, our findings suggest that delaying treatment by 13 hours might not impact the timeline for nerve recovery and thus may not be an absolute indication for urgent surgery.

Table 1: Patient Characteristics (N=158)

		n/Mean/Median	%/SD/IQR
Age (mean years)		6.7	2.1
Sex	Male	86	54.4
	Female	72	45.6
Mechanism of Injury	Playground	58	36.7
	Trampoline	15	9.5
	Fall from standing	31	19.6
	Fall from height	34	21.5
	Fall from personal transport	8	5.1
	Sport	10	6.3
	Other	2	1.3
Fracture Type	Extension Gartland 2	5	3.2
	Extension Gartland 3	140	88.6
	Extension Gartland 4	9	5.7
	Flexion	4	2.5
Fracture Type (Open vs Closed)	Open	5	3.8
	Closed	152	96.2
Radial Pulse	Present	133	84.2
	Absent	25	15.8
Hand Perfusion	Perfused	155	98.1
	Not Perfused	3	1.9
Delay to Surgery from Injury (Mean hours) *		13.2	5.7
Delay to Surgery from ER (Median hours) *		9.6	4.4 – 12.1
Time to recovery (Median Days) *		30	14.5 – 61.2

*Mean, Median applicable based on normality assessed by Kolmogorov–Smirnov test

Table 2: Nerve Injury Characteristics (N=158)

Nerve Injury		n (%)	Recovery (Days)		Delay to Surgery (Hours)			
					From Injury		From ER	
			Median* (IQR)	p	Mean (SD)	p	Median (IQR)	p
Nerve Distribution	Median	109 (69.0%)	29 (15.5 – 58.0)	0.616[a]	13.1 (5.7)	0.389[b]	9.5 (4.2 – 11.9)	0.568[a]
	Ulnar	10 (6.3%)	30.5 (7.2 – 35.2)		14.6 (6.5)		10.1 (6.7 – 14.8)	
	Radial	21 (13.3%)	31 (9.5 – 69.5)		14.3 (5.8)		9.7 (4.9 – 12.2)	
	Mixed[%]	18 (11.4%)	31 (19 – 84.2)		11.5 (4.9)		8.4 (3.5 – 11.5)	
Isolated vs Mixed	Isolated	140 (88.6%)	30 (13.5 – 58)	0.387[c]	13.4 (5.7)	0.086[d]	9.6 (4.4 – 12.0)	0.722[c]
	Mixed[%]	18 (11.4%)	31 (19 – 84.2)		11.5 (4.9)		8.4 (3.5 – 11.5)	

% Includes patients with two distinct nerve distributions

[a]Kruskal–Wallis, [b]ANOVA, [c]Mann–Whitney U test, [d]One-sided independent t-test
*Mean, Median applicable based on normality assessed by Kolmogorov–Smirnov test