

Acute Median Neuropathy and Carpal Tunnel Release in Perilunate Injuries *Can We Predict Who Gets a Median Neuropathy?*

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Abstract This study addressed the following null hypotheses: 1) There are no demographic differences between patients with perilunate dislocation (PLD) or fracture-dislocation (PLFD); 2) There are no factors associated with the development of median nerve symptoms in the setting of a PLD or PLFD; and 3) There are no factors associated with carpal tunnel release. Using a retrospective search of a prospective trauma database, we identified all patients who had sustained a radiologically confirmed PLD or PLFD over a 10-year period at two trauma centers. From the medical records we identified median nerve symptoms and carpal tunnel release in addition to demographic and injury characteristics. Among the 71

patients treated for PLD or PLFD, acute median neuropathy was diagnosed in 33 patients (47 %). The only significant difference between PLD and PLFD was a younger age with PLFD. No demographic or injury factors were associated with symptoms of median neuropathy. Carpal tunnel release surgery during the initial operative management was related to the presence of median nerve symptoms and the trauma center. We report a high incidence of acute median neuropathy accompanying perilunate injuries. As there are no demographic or injury factors associated with symptoms of median neuropathy; all patients with PLD/PLFD merit equally high vigilance for acute median neuropathy.

Level of Evidence: Level III, prognostic study

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Introduction

Perilunate dislocations (PLDs) and fracture dislocations (PLFDs) are uncommon injuries that are usually the results of high-energy trauma. Acute median neuropathy can develop secondary to direct compression from the dislocated lunate or from increased pressure within the carpal tunnel due to blood and edema [1]. The documented incidence of acute carpal tunnel syndrome at presentation ranges from 23 to 45 % [2–6]. An understanding of any predictors of median nerve symptoms occurring with PLD or PLFD may help to optimize the management of these injuries.

This study addressed the following null hypotheses: 1) There are no demographic differences between patients with perilunate dislocation (PLD) or fracture-dislocation (PLFD); 2) There are no factors associated with the development of median

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nerve symptoms in the setting of a perilunate dislocation (PLD) or fracture-dislocation (PLFD); and 3) There are no factors associated with carpal tunnel release.

Materials and Methods

Using a retrospective search of trauma databases, we identified 71 patients who had a radiologically confirmed acute PLD or PLFD (defined by dislocation of the head of the capitate from the distal surface of the lunate [2]) over a 10-year period at two centers.

We collected the following data from the medical record retrospectively: age, sex, mechanism of injury, type of injury and associated fractures, open or closed dislocations, the development of median nerve symptoms secondary to the injury, and management, including whether carpal tunnel release was performed during surgery. Median nerve symptoms were defined as any numbness, tingling, or diminished sensation in the median nerve distribution.

Radiological Assessment

PLD and PLFD were classified radiologically using standard lateral and posteroanterior views of the wrist at presentation. A

PLD was classified as a purely ligamentous injury with no osseous defect, whereas a PLFD was defined as an injury with both ligamentous and osseous components [2]. PLFD were further sub classified according to the bones involved and precise fracture pattern. Categories included trans-scaphoid, transradial-styloid, trans-capitate, trans-triquetrum, and trans-lunate. Some perilunate injuries occurred in association with small chip fractures of the radial and ulnar styloid, but no carpal fracture, these were classified as PLD [2].

Statistical Methods

Baseline characteristics of study patients were summarized with frequencies and percentages for categorical variables and as mean and standard deviation for continuous variables. Normality of data was checked using Shapiro-Wilk and Kolmogorov-Smirnov tests. The demographic and clinical characteristics of patients were evaluated using bivariate analysis. The significance of categorical variables was assessed using chi-squared tests or two-sided Fisher's exact tests (where less than five cases occurred in a cell). The significance of continuous variables was assessed using the Student's *t* test, or Mann-Whitney *U* (MWU) test for continuous non-parametric data. Significance was set at $p < 0.05$, and two-tailed *p* values were reported throughout.

Table 1 PLDs vs. PLFDs

	PLD <i>n</i> =20	PLFD <i>n</i> =51	<i>P</i> -value
Mean Age (yrs)	37±15	30±7	0.01
	<i>n</i> (%)	<i>n</i> (%)	
Sex			0.31
Male	18 (90)	49 (96)	
Female	2 (10)	2 (4)	
Mechanism of Injury			0.80
Fall from Standing Height	1 (5)	4 (8)	
Fall from more than standing height	6 (30)	10 (20)	
Sport Related	3 (15)	8 (16)	
Bicycle	2 (10)	11 (22)	
Road Traffic Accident	5 (25)	11 (22)	
Assault	0 (0)	2 (4)	
Unknown	3 (15)	5 (10)	
Median Nerve Symptoms			0.37
Yes	11 (55)	22 (43)	
No	9 (45)	29 (57)	
Persistent or Progressive Median Nerve Symptoms			0.32
Resolved after reduction	2 (10)	6 (12)	
Persistent or progressive after reduction, resolved after CTR	3 (15)	5 (10)	
Unclear what happened after reduction resolved after CTR	5 (25)	7 (14)	
Persistent or progressive after CTR	0 (0)	4 (8)	
Resolved unclear exactly when	1 (5)	0 (0)	

PLD perilunate dislocation, PLFD perilunate fracture-dislocation, CTR carpal tunnel release

Results

There were 71 patients in the study cohort and 67 (94 %) were males. Twenty (28 %) patients suffered a PLD and 51 (72 %) a PLFD. Those who sustain a PLD were significantly older than those who sustained a PLFD (Table 1). There were 33 (46.5 %) patients who presented with symptoms consistent of median neuropathy, and 25 (35 %) underwent carpal tunnel decompression. The most common mechanisms of injury was a fall from height and road traffic accidents, followed by bicycle related injuries, sport related injuries, falls from standing height, and assaults.

No demographic or injury factors were associated with symptoms of median neuropathy; and the incidence of median nerve symptoms did not vary significantly between major trauma centres. (Table 2). Of the 20 patients who sustained a PLD, 11 (55 %) had median nerve symptoms, with 22 patients (43 %) symptomatic following a PLFD (Table 2). Of the 33 patients who had median nerve symptoms, 29 (88 %) patient's symptoms resolved either after reduction or surgery, and 4 (12 %) patient's symptoms were persistent or progressive even after surgery (Table 1).

Of the 71 patients in our study 25 (35 %) underwent carpal tunnel decompression. Of the 20 patients that had a PLD 8 (40 %) patients had carpal tunnel release during surgery,

whereas 17 (33 %) patients who had a PLFD underwent carpal tunnel release. Carpal tunnel release surgery during the initial operative management was related to the presence of median nerve symptoms and the trauma center. (Table 3)

Discussion

This study should be interpreted in light of the following limitations. First, we relied on the medical record and did not have objective measures of median nerve symptoms. It is possible that the rate of median nerve dysfunction is underreported. Second, there were no protocols or guidelines for treatment so we are assessing the tendencies of the surgeons in the two centers and may be measuring different biases rather than differences in pathophysiology. Third, unlike other studies [7] we did not measure median nerve function 1 year or greater after injury and cannot comment on outcomes. Fourth, we did not investigate factors that might have affected severity of median nerve dysfunction, such as time until reduction or extreme swelling.

Table 2 Median nerve symptoms

	No n=38	Yes n=33	P-value
Mean Age (yrs)			0.61
	31±8	32±13	
	n (%)	n (%)	
Sex			0.62
Male	35 (92)	32 (97)	
Female	3 (8)	1 (3)	
PLD or PLFD			0.43
pld	9 (24)	11 (33)	
plfd	29 (76)	22 (67)	
Closed or Open dislocation			0.99
Closed	36 (95)	31 (94)	
Open	2 (5)	2 (6)	
Mechanism of Injury			0.60
Fall from Standing Height	2 (5)	3 (9)	
Fall from more than standing height	8 (21)	8 (24)	
Sport Related	6 (16)	5 (15)	
Bicycle	6 (16)	7 (21)	
Road Traffic Accident	8 (21)	8 (24)	
Assault	1 (3)	1 (3)	
Unspecified	7 (18)	1 (3)	
Boston or Edinburgh			0.23
Boston	12 (32)	15 (45)	
Edinburgh	26 (68)	18 (55)	

PLD perilunate dislocation, PLFD perilunate fracture-dislocation

Table 3 Carpal tunnel release during surgery

	No n=46	Yes n=25	P-value
Mean Age (yrs)			0.62
	36±10	37±12	
	n (%)	n (%)	
Sex			0.52
Male	44 (96)	23 (92)	
Female	2 (4)	2 (8)	
PLD or PLFD			0.60
pld	12 (26)	8 (32)	
plfd	34 (74)	17 (68)	
Closed or Open dislocation			0.52
Closed	44 (96)	23 (92)	
Open	2 (4)	2 (8)	
Mechanism of Injury			0.72
Fall from Standing Height	4 (9)	1 (4)	
Fall from more than standing height	9 (20)	7 (28)	
Sport Related	6 (13)	5 (20)	
Cycle	9 (20)	4 (16)	
Road Traffic Accident	10 (22)	6 (24)	
Assault	1 (2)	1 (4)	
Unspecified	7 (15)	1 (4)	
Median Nerve Symptoms			<0.01
Yes	9 (20)	23 (92)	
No	37 (80)	2 (8)	
Boston or Edinburgh			0.02
Boston	13 (28)	14 (56)	
Edinburgh	33 (72)	11 (44)	

PLD perilunate dislocation, PLFD perilunate fracture-dislocation

The only significant difference between PLD and PLFD was a younger age with PLFD. It is not clear whether this is due to a difference in pathomechanics (either energy or direction of force) [8,9]. Both groups were relatively young, so bone quality is an unlikely influence.

No demographic or injury factors were associated with symptoms of median neuropathy. Median neuropathy in the context of perilunate injuries can be caused by direct compression exerted by the lunate (particularly in the dislocated position) and by elevated pressure within the carpal tunnel due to a mixture of edema and bleeding. Given that no factors were associated with median neuropathy, it is important to be equally vigilant in all patients presenting with a perilunate injury.

Carpal tunnel release surgery during the initial operative management was related to the presence of median neuropathy and the trauma center. In the presence of median nerve symptoms patients were more likely to undergo carpal tunnel release during surgery. When symptoms of median neuropathy are present, some specialists advocate carpal tunnel release surgery [10]. The threshold for prophylactic release of the median nerve varies. In the authors opinion prophylactic release is based on the observation of progressive median nerve dysfunction after correction of deformity or operative treatment. Patients were less likely to have carpal tunnel release during surgery in one of our two centres but we have not been able to identify any significant factors as to why this is the case.

In conclusion, nearly half of all PLD/PLFD have associated acute median neuropathy and we found no factors that were predictive of which patients will develop it. All patients with PLD/PLFD merit careful evaluation and vigilance for acute median neuropathy.

Compliance with Ethical Standards

Conflict of Interest Statement No author has any conflict of interest directly related to the work under consideration for publication.

Relevant Financial activities outside the submitted work DR has a consultancy with Wright Medical and Skeletal Dynamics. He also gives expert testimony in malpractice and personal injury lawsuits. His institution has grants pending with Biomet and Skeletal Dynamics. He is paid to give lectures by AO North America, AO International and multiple universities. He receives royalties from Wright Medical, Skeletal Dynamics, Medartis, and Biomet. He has stock in Illuminos. He is Parliamentarian for

Hand, Deputy Editor of The Journal of Hand Surgery, Deputy Editor of The Journal of Orthopaedic Trauma, Associate Editor of The Journal of Shoulder and Elbow Surgery and Deputy Editor of Clinical Orthopaedics and Related Research.

Statement of Human and Animal Rights All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Ethical Review Committee Statement The authors declare that the appropriate ethical reviews have occurred and we enclose documentation proving this.

Location of work The work was performed both at The Royal Infirmary of Edinburgh and Massachusetts General Hospital.

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