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Original Research

## Outcomes and Return to Work Following Complex Nerve Lacerations in the Volar Forearm in an Underserved Spanish-Speaking Population



Ryan B. Bucknam, MD, <sup>\*</sup>† John C. Dunn, MD, <sup>†</sup> Isaac Fernandez, MD, <sup>\*</sup> Leon J. Nesti, MD, PhD, <sup>‡</sup> Gilberto A. Gonzalez, MD <sup>\*</sup>

<sup>\*</sup> Department of Orthopaedic Surgery and Rehabilitation, Texas Tech University Health Sciences Center El Paso, El Paso, TX

<sup>†</sup> Department of Orthopaedic Surgery, William Beaumont Army Medical Center, El Paso, TX

<sup>‡</sup> Department of Clinical and Experimental Orthopaedics, Uniformed Services University, Bethesda, MD

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**Purpose:** Lacerations to the ulnar and median nerve in the volar forearm have demonstrated considerable long-term clinical and socioeconomic impacts on patients. The purpose of this study was to evaluate the outcomes of complex volar forearm lacerations involving one or more major peripheral nerves in an economically disadvantaged patient population.

**Methods:** In this study, a retrospective analysis of 61 patients who sustained lacerations to the median nerve, ulnar nerve, or both with volar wrist lacerations was performed. Each patient's preinjury and postinjury occupation, dominant extremity, and demographic variables were evaluated. Sensation recovery, motor recovery, Disabilities of the Arm, Shoulder, and Hand scores, visual analog scale scores, cold intolerance, and return to work were evaluated at 3, 6, and 12 months after the injury.

**Results:** Patients with isolated median nerve injuries demonstrated improved motor recovery compared with patients with isolated ulnar nerve injuries. Patients with combined nerve injuries had worse sensation recovery and motor recovery, and lower rates of return to work than either group of patients with isolated nerve injuries. Manual laborers had worse motor recovery and lower rates of return to work than did patients who were office workers.

**Conclusions:** Patients with combined median and ulnar nerve injuries have worse functional recovery and lower rates of return to work than do patients with isolated median or isolated ulnar nerve injuries at 1 year. Manual laborers demonstrated worse functional recovery and lower rates of return to work compared with office workers at 1 year.

**Type of study/level of evidence:** Therapeutic III.

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Peripheral nerve injuries to the volar forearm and wrist are among the more challenging problems to address in microsurgery and generally portend poor outcomes. Many studies have focused on identifying factors that have an impact on the functional recovery in patients with these injuries. Factors that have been found to predispose a repair to a worse outcome include advanced patient age,<sup>1–13</sup> more proximal injuries,<sup>1,5–8,11,12,14–17</sup> injuries to the ulnar nerve compared with the median nerve,<sup>1–3,5,13,15,17–20</sup>

injuries to multiple nerves,<sup>1,2,7,17,19</sup> and concomitant injuries to tendons and arteries.<sup>1,7,9,10,21</sup> Understanding which factors portend poor outcomes is essential for a surgeon to educate patients better regarding expected prognosis and recovery.

Our hospital serves a relatively economically disadvantaged population with a high number of manual laborers. This is demonstrated by El Paso's lower household income and property value compared with other large American cities in which similar investigations are performed: Boston (42% and 25%, respectively), New York City (73% and 22%, respectively), and San Francisco (68% and 12%, respectively).<sup>22</sup> These considerations are important because economic disparity may serve as a barrier to patient care and these injuries may have a major socioeconomic influence on patients. Upper-extremity injuries have demonstrated a more substantial social and economic impact on patients than other

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**Corresponding author:** Ryan B. Bucknam, MD, Department of Orthopaedic Surgery and Rehabilitation, Texas Tech University Health Sciences Center El Paso, 4801 Alberta Avenue, El Paso, TX 79905.

E-mail address: [Ryan.bucknam@ttuhsc.edu](mailto:Ryan.bucknam@ttuhsc.edu) (R.B. Bucknam).

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traumatic injuries, including head, spinal, abdominal, and thorax injuries, with longer average durations of return to work and thus higher rates of lost wages for the patient.<sup>23</sup>

The purpose of this study was to evaluate the outcomes of complex volar forearm lacerations involving one or more major peripheral nerves in an economically disadvantaged patient population. We hypothesized that patients with combined median and ulnar nerve injuries would have worse functional outcomes compared with those with isolated nerve injuries.

## Materials and Methods

### Study design and patient selection

After we obtained institutional review board approval, a single surgeon conducted a retrospective review of the electronic medical record for all cases involving laceration of the median or ulnar nerve at the wrist (Current Procedural Terminology codes 64857, 64859, 25260, 35206, and 37618) at a single level 1 trauma center.

Inclusion criteria were adult patients who sustained an acute, sharp, complete median and/or ulnar nerve injury after a volar wrist or forearm wound between January 2015 and December 2016, received surgery within 48 hours of the injury, and had at least 1 year of documented follow-up. Exclusion criteria included the presence of osseous injuries, notable skin coverage defects requiring free tissue transfer, ipsilateral radial nerve injuries, a previous injury at the same site, or a history of active drug abuse, because this could affect functional outcomes and return to work. A total of 93 patients met inclusion and exclusion criteria; 61 patients were able to complete 1 year of follow-up.

### Surgical technique and recovery

All repairs were performed 6 to 48 hours after the injury was sustained. If indicated, all injured tendons or vessels were repaired at the time of surgery. Nerve repairs consisted of a tension-free epineurial end-to-end coaptation under loupe magnification using 9-0 nylon suture. All repairs were protected with a nerve conduit at the time of repair. The rehabilitation program included a minimum of 4 weeks of complete immobilization and was subsequently dictated by the concomitant tendon injury, focusing on early range of motion.

### Evaluation

Current occupations, recreational activities, and demographic variables were documented before and after surgery. All patients were subsequently evaluated at 3, 6, and 12 months. Evaluation of sensation included a static 2-point discrimination. Evaluation of motor recovery included using grip strength, pinch strength, and the Medical Research Council (MRC) scale.<sup>24</sup> We used a *Quick-Disabilities of the Arm, Shoulder, and Hand (QuickDASH)* score to assess the disability of the affected extremities. A score was generated between 0 and 100 in which 0 corresponded to no disability and 100 to completely disabled.<sup>25</sup> Visual analog scores were obtained and patients' work status was evaluated at each follow-up interval. Cold intolerance was evaluated subjectively. The operating surgeon performed all evaluations in each patient's native language, which was predominately Spanish.

### Statistical analysis

We calculated descriptive statistics using means and SDs for normally distributed data and medians and interquartile range for nonparametric data. Categorical variables were compared using

Pearson chi-square test or Fisher exact test. Continuous variables were analyzed qualitatively for normality using the quantile–quantile plot and quantitatively using the Shapiro–Wilks and Anderson–Darling tests. For nerve injury groups, we compared continuous variables using Welch's analysis of variance with a Tukey post hoc test or Kruskal–Wallis test followed by a pairwise Wilcoxon signed-rank test for post hoc analysis for normally distributed or nonparametric data, respectively. For 2 groups, continuous variables were compared using Welch's *t* test or a Wilcoxon signed-rank test for normally distributed or nonparametric data, respectively. A multiple logistic regression model was fit to identify factors that might be predictive of return to work.

## Results

### Demographics

Of the 61 patients in the study, 27 (44%) had isolated ulnar nerve lacerations, 22 (36%) had isolated median nerve lacerations, and 12 (20%) had combined median and ulnar nerve lacerations. Most (37 of 61 [61%]) had an associated vascular injury, and all patients had associated tendon injuries with an average of 3.6 tendons lacerated. Average age of patients in the study was 30.8 years (range, 18–45 years); half were male and most were manual laborers. The most common mechanism of injury was lacerations from broken glass (39%) (Table 1). In addition, patients with combined nerve injuries had more associated arterial injuries than did those with isolated median nerve injuries ( $n = 12$  of 12 [100%] vs  $n = 10$  of 22 [45%];  $P < .01$ ) or those with isolated ulnar nerve injuries ( $n = 12$  of 12 [100%] vs  $n = 15$  of 27 [56%];  $P < .01$ ) and more associated tendon injuries (Table 1). Combined nerve injuries also demonstrated a shorter interval from time of injury to surgery than isolated median nerve injuries (6 vs 17.5 hours;  $P < .01$ ) or isolated ulnar nerve injuries (6 vs 12 hours;  $P < .01$ ) (Table 1).

### Nerves involved

Patients with isolated median nerve injuries had better sensation recovery based on 2-point discrimination than did those with isolated ulnar injuries (average, 6 vs 7.1 mm;  $P < .01$ ) and those with combined nerve injuries (6 vs 7.4 mm;  $P < .01$ ) 12 months after surgery. Isolated median nerve injuries had slightly better motor recovery based on the MRC scale than did isolated ulnar nerve injuries (average, 67.6 vs 65;  $P < .01$ ) and better recovery than did combined nerve injuries (average, 67.6 vs 42.5;  $P < .01$ ) at the 6-month follow-up. Combined nerve injuries demonstrated worse motor recovery than did the isolated nerve groups at 6 and 12 months. Patients with the most disability according to the DASH score at both 6 months (64.4 vs 49.8 and 49.4;  $P < .01$ ) and 12 months (37.9 vs 29.1 and 31;  $P < .01$ ) were those with combined nerve injuries. Patients with combined nerve injuries returned to work at a lower rate than those with isolated median nerves injuries ( $n = 4$  of 12 [33%] vs  $n = 19$  of 22 [86%];  $P < .01$ ) and isolated ulnar nerve injuries ( $n = 4$  of 12 [33%] vs  $n = 21$  of 27 [78%];  $P = .01$ ) at 6 months (Table 2).

### Manual laborers versus office jobs

Manual laborers returned to work at a lower rate than office workers experienced at the 6-month follow-up ( $n = 30$  of 47 [64%] vs  $n = 14$  of 14 [100%];  $P < .01$ ). Those with office jobs also had superior motor recovery than manual laborers based on grip strength (115 vs 100 lb;  $P = .01$ ) and pinch strength (17.5 vs 15 lb;  $P = .03$ ) 1 year after surgery, in addition to better DASH scores (27 vs

**Table 1**  
Patient Demographic Characteristics Stratified According to Nerve Injury Group

Characteristics	Median Nerve (n = 22)	Ulnar Nerve (n = 27)	Combined Nerve Injury (n = 12)	P Value
Age, y (median [interquartile range])	35.5 (27.5–40.8) <sup>a</sup>	29.0 (24.0–36.0)	23.0 (20.0–31.0) <sup>a</sup>	.04*
Gender				
Male	14	8	7	.26
Female	8	19	5	
Mechanism of injury				
Broken glass	2 <sup>a,b</sup>	15 <sup>b</sup>	7 <sup>a</sup>	< .01*
Motor vehicle Accident	2 <sup>a,b</sup>	2 <sup>b</sup>	2 <sup>a</sup>	
Work accident	6 <sup>a,b</sup>	3 <sup>b</sup>	1 <sup>a</sup>	
Suicide attempt	12 <sup>a,b</sup>	7 <sup>b</sup>	2 <sup>a</sup>	
Occupation				
Office	7	7	0	.08
Manual labor	15	20	12	
Workers' compensation				
Yes	4	5	2	.99
No	18	22	10	
Time to surgery, h (median [interquartile range])	17.5 (13.0–21.5) <sup>a</sup>	12.0 (8.0–21.5) <sup>b</sup>	6.0 (4.0–7.0) <sup>a,b</sup>	< .01*
Associated vascular injuries	10 <sup>a</sup>	15 <sup>b</sup>	12 <sup>a,b</sup>	< .01*
Tendons lacerated	Flexor carpi radialis, flexor pollicis longus, palmaris longus	Flexor carpi ulnaris, flexor digitorum profundus, flexor digitorum superficialis	Flexor carpi ulnaris, flexor digitorum profundus, flexor digitorum superficialis, flexor carpi radialis, flexor pollicis longus, palmaris longus	
Injury and hand dominance				
Dominant hand	17 <sup>a</sup>	24 <sup>b</sup>	4 <sup>a,b</sup>	< .01*
Nondominant hand	5	3	8	

\* Significant at  $\alpha = .05$ .<sup>a,b</sup> Superscript letters indicate significant differences between corresponding groups for the given variable on post hoc analysis.**Table 2**  
Functional Outcomes Scores and Complications

Outcomes	6 Mo			12 Mo		
	Median Nerve (n = 22)	Ulnar Nerve (n = 27)	Combined Nerve Injury (n = 12)	Median Nerve (n = 22)	Ulnar Nerve (n = 27)	Combined Nerve Injury (n = 12)
Return to work						
Yes	19 (86%) <sup>a</sup>	21 (78%) <sup>b</sup>	4 (33%) <sup>a,b</sup>	21 (95%)	24 (89%)	9 (75%)
No	3 (14%) <sup>a</sup>	6 (22%) <sup>b</sup>	8 (67%) <sup>a,b</sup>	1 (5%)	3 (11%)	3 (25%)
	$P < .01^*$			$P = .21$		
Visual analog scale score (median [interquartile range])	2.5 (2.0–3.0) <sup>a</sup>	4.0 (3.0–5.5) <sup>a</sup>	3.5 (3.0–4.5)	1.0 (1.0–2.0) <sup>b</sup>	2.0 (1.5–3.0) <sup>b</sup>	2.0 (1.8–3.3)
	$P < .01^*$			$P = .02^*$		
QuickDASH score (mean [SD])	49.8 (3.8) <sup>b</sup>	49.4 (4.2) <sup>b</sup>	64.4 (2.9) <sup>a,b</sup>	29.1 (5.0) <sup>a</sup>	31.0 (5.6) <sup>b</sup>	37.9 (2.8) <sup>a,b</sup>
	$P < .01^*$			$P < .01^*$		
Grip strength, lb (median [interquartile range])	67.5 (51.3–75.0) <sup>a</sup>	65.0 (45.0–77.5)	42.5 (40.0–56.3) <sup>a</sup>	100.0 (75.0–108.8) <sup>a</sup>	105.0 (67.5–115.0) <sup>b</sup>	67.5 (63.8–83.8) <sup>a,b</sup>
	$P < .01^*$			$P = .01^*$		
Pinch strength, lb (median [interquartile range])	9.5 (8.3–12.0) <sup>a</sup>	11.0 (8.0–12.5) <sup>b</sup>	6.50 (5.8–8.0) <sup>a,b</sup>	16.5 (11.0–18.0) <sup>a</sup>	16.0 (10.0–17.0)	10.5 (9.0–14.3) <sup>a</sup>
	$P < .01^*$			$P = .02^*$		
Medical Research Council sensation (patients)	2+ (1+ to 3)	2 (1 to 3)	1 (1)	3+ (3 to 4)	3 (2+ to 4)	2+ (2 to 3)
Medical Research Council motor rating						
3	2 <sup>a,b</sup>	25 <sup>b,c</sup>	0 <sup>a,c</sup>	2 <sup>a</sup>	6	5 <sup>a</sup>
4	20 <sup>a,b</sup>	2 <sup>b,c</sup>	12 <sup>a,c</sup>	4 <sup>a</sup>	8	5 <sup>a</sup>
4+				16 <sup>a</sup>	13	2 <sup>a</sup>
5						
	$P < .01^*$			$P = .03^*$		
2-Point discrimination rating, mm						
6				22 <sup>a,b</sup>	0 <sup>a</sup>	0 <sup>b</sup>
7				0 <sup>a,b</sup>	26 <sup>a</sup>	9 <sup>b</sup>
8.5	22	27	12	0 <sup>a,b</sup>	1 <sup>a</sup>	3 <sup>b</sup>
				$P < .01^*$		
Cold sensitivity						
Yes	1	3	3	1	1	3
No	21	24	9	21	26	9
	$P = .21$			$P = .10$		

\* Significant at  $\alpha = .05$ .<sup>a,b,c</sup> Superscript letters indicate significant differences between corresponding groups for the given variable in a given time frame on post hoc analysis.

**Table 3**  
Functional Outcomes Scores and Complications Based on Workers' Compensation Status

Outcomes	6 Mo		12 Mo	
	Office Job (n = 14)	Manual Laborer (n = 47)	Office Job (n = 14)	Manual Laborer (n = 47)
Return to work				
Yes	14 (100%)	30 (64%)	14 (100%)	40 (85%)
No	0	17 (36%)	0	7 (15%)
	<i>P</i> = .01*		<i>P</i> = .19	
Visual analog scale scores (median [interquartile range])	3.0 (2.0–3.8)	3.0 (3.0–5.0)	1.5 (1.0–2.0)	2.0 (1.0–3.0)
	<i>P</i> = .04*		<i>P</i> = .06	
QuickDASH score (median [interquartile range])	48.0 (48.0–48.0)	52.0 (50.0–58.0)	27.0 (26.0–29.5)	34.0 (30.0–37.0)
	<i>P</i> < .01*		<i>P</i> < .01*	
Grip strength, lb (median [interquartile range])	77.5 (52.8–80.0)	60.0 (40.0–70.0)	115.0 (75.0–118.8)	100 (65.0–105.0)
	<i>P</i> = .02*		<i>P</i> = .01*	
Pinch strength, lb (median [interquartile range])	11.0 (8.0–12.0)	9.0 (7.0–12.0)	17.5 (10.3–19.0)	15.0 (10.0–17.0)
	<i>P</i> = .20		<i>P</i> = .03*	
Medical Research Council sensation rating				
1	0	12		
2	7	15		
2.5	7	20	0	12
3			7	15
3.5			7	20
	<i>P</i> = .08		<i>P</i> = .08	
Medical Research Council motor rating				
3	6	21		
4	8	26	0	13
4+			1	16
5			13	18
	<i>P</i> = 1.00		<i>P</i> < .01*	
2-Point discrimination, mm				
6			7	20
7			7	23
8.5	11	47	0	4
			<i>P</i> = .72	
Cold sensitivity				
Yes	0	7	0	5
No	14	40	14	42
	<i>P</i> = .189		<i>P</i> = .58	

\* Significant at  $\alpha = .05$ .

34; *P* < .01). There were no differences in sensation recovery or visual analog scores at 12 months (Table 3). Manual laborers also had worse initial injuries with more injured concomitant structures (5.7 vs 4.5) and were more likely to have a combined nerve injury (n = 12 of 47 [26%] vs n = 0 of 14 [0%]) than were office workers.

*Dominant versus nondominant extremities*

Injuries to the dominant extremity demonstrated better grip strength (100 vs 70 lb; *P* < .01) and pinch strength (16 vs 10 lb; *P* < .01) at 1 year; however, there was no clinically significant difference in MRC motor scores. The difference in sensation recovery with 2-point discrimination was not clinically notable at 1 year (6.6 vs 6.8 mm; *P* = .01). There were no differences in return to work or DASH scores between dominant and nondominant extremity injuries (Table 4).

**Discussion**

In this study of functional outcomes and the ability to return to work after repair of complex volar wrist lacerations in a low socioeconomic population, we identified 3 key points. First, isolated ulnar nerve injuries had worse sensation recovery and slightly slower motor recovery than isolated median nerve injuries. Second, combined nerve injuries had worse strength, motor, and sensation

recovery in addition to lower rates of return to work than did isolated nerve injuries. Third, manual laborers had worse motor recovery and lower return to work than did office workers. Despite socioeconomic barriers, the patient population fared comparably to similar cohorts of complex wrist lacerations involving the ulnar and median nerves.<sup>1,3,19</sup>

Although there was a statistically significant difference in motor recovery for isolated median and isolated ulnar nerve injuries based on the MRC scale, the difference was small and likely did not contribute to clinical outcomes. Better motor recovery, however, has been supported in patients with isolated median nerve injuries compared with isolated ulnar nerve injuries in multiple other studies (Table 5). We found markedly better sensation recovery for patients with isolated median nerve injuries compared with isolated ulnar nerve injuries. Data vary in similar studies pertaining to the recovery of sensation (Table 5). There is also less consensus regarding the rates of return to work between isolated ulnar and isolated median nerve injuries (Table 5). Outcomes of ulnar nerve repairs are often worse compared with median nerve repairs because the ulnar nerve has a larger motor component than the median nerve and the ulnar nerve is essential for precise coordination of hand locomotion.<sup>3,13</sup> Without this coordinated contraction, hand function is limited and return to work may be delayed.<sup>15</sup> Innervation of the ulnar nerve to the intrinsic muscles of the hand is also more distal than innervation of the median nerve to the more

**Table 4**  
Functional Outcomes Scores and Complications Based on Injured Extremity

Outcomes	6 Mo		12 Mo	
	Dominant Hand (n = 45)	Nondominant Hand (n = 16)	Dominant Hand (n = 45)	Nondominant Hand (n = 16)
Return to work				
Yes	33 (73%)	11 (69%)	38 (84%)	16 (100%)
No	12 (27%)	5 (31%)	7 (16%)	0
	<i>P</i> = .75		<i>P</i> = .17	
Visual analog scale scores (median [interquartile range])	3.0 (2.0–5.0)	3.0 (2.8–3.3)	2.0 (1.0–3.0)	2.0 (1.0–2.0)
	<i>P</i> = .14		<i>P</i> = .45	
QuickDASH score (mean [SD] or median [interquartile range])	50.0 (48.0–52.0)	58.0 (50.0–62.5)	30.9 (5.9)	33.8 (5.4)
	<i>P</i> < .01*		<i>P</i> = .09	
Grip strength, lb (median [interquartile range])	65.0 (55.0–75.0)	45.0 (40.0–55.3)	100.0 (75.0–115.0)	70.0 (65.0–82.5)
	<i>P</i> < .01*		<i>P</i> < .01*	
Pinch strength, lb (median [interquartile range])	10.0 (8.0–12.0)	7.5 (5.8–8.0)	16.0 (12.0–18.0)	10.0 (9.0–12.5)
	<i>P</i> < .01*		<i>P</i> < .01*	
Medical Research Council sensation rating				
1	4	8		
2	17	15		
2.5	24	3	4	8
3			17	15
3.5			24	3
	<i>P</i> < .01*		<i>P</i> < .01*	
Medical Research Council motor rating				
3	24	3		
4	21	13	10	3
4+			12	5
5			23	8
	<i>P</i> = .02*		<i>P</i> = 1.00	
2-Point discrimination, mm				
6			24	3
7			17	13
8.5	45	16	4	0
			<i>P</i> = .01*	
Cold sensitivity				
Yes	7	0	5	0
No	38	16	40	16
	<i>P</i> = .17		<i>P</i> = .31	

\* Significant at  $\alpha = .05$ .

proximal flexor muscles.<sup>1</sup> The resulting greater distance from the site of the injury to the site of motor innervation likely contributes to lower motor recovery and a delay in return to work in ulnar nerve repair patients. Finally, patients with isolated median nerve injuries can often recruit ulnar innervated or dual innervated muscles to aid in thumb opposition, whereas those with ulnar nerve injuries have less opportunity for motor compensation from an uninjured nerve.<sup>15,21</sup>

In addition, our results parallel those of similar cohorts in that patients with combined median and ulnar nerve lacerations demonstrated worse motor and sensation recovery and a lower rate of return to work compared with isolated median or ulnar nerve injuries (Table 5). Our finding that patients with combined nerve injuries had a higher number of associated vascular injuries and tendon injuries was also demonstrated in multiple other studies.<sup>17,21,26,27</sup> This likely contributed to worse outcomes for combined nerve injuries, because worse recovery was demonstrated in patients with more associated tendon lacerations<sup>1,9,10,21</sup> and more associated arterial lacerations.<sup>1,7</sup> Lower rates of return to work for patients with combined nerve lacerations mainly results from the worse motor and sensation recoveries, because patients with worse motor and sensation recovery demonstrated lower rates of return to work.<sup>1,17,19</sup> Our finding of a shorter time to surgery for combined nerve injuries compared with isolated nerve injuries likely did not affect the outcomes because all surgeries

were performed within 48 hours of the injury. Interval to surgery was found to influence outcomes, but only after a delay of 3 to 12 months after the injury.<sup>1,5,12</sup>

In our analysis, manual laborers were less likely to return to work and had reduced motor recovery compared with office workers. However, our finding of an 85% return to work at 1 year was higher than the findings of many other studies. Jaquet et al<sup>17</sup> found a lower rate of return to work, but also a longer time until return to work at 34.4 weeks for blue-collar workers, compared with 24.2 weeks for white-collar workers. Bruyns et al<sup>19</sup> found expectations of white-collar workers to return to work to be 4.3 times higher than that of blue-collar workers. We also noted a difference in QuickDASH scores between office workers and manual laborers. However, this difference was likely not clinically important because it was smaller than the minimal clinically important difference.<sup>28</sup> The discrepancy in education levels between manual laborers and office workers may have a role in the difference in outcomes, because patients with higher levels of education have demonstrated improved sensation and motor recovery<sup>7</sup> in addition to better return to work.<sup>7,10,19,23</sup> This was attributed to increased compliance to postoperative therapy,<sup>7</sup> less post-injury psychological stress,<sup>29</sup> and lower levels of physical demand at their place of occupation.<sup>7,19</sup> The higher rate of concomitant injuries in manual laborers and higher rate of combined nerve injuries that we found in the current study also likely had a considerable impact on outcomes.

**Table 5**  
Study Findings and Comparison With Other Literature<sup>†</sup>

Study	Patients, n	Nerves	Age, years	Follow-Up, years	Outcomes
Flynn and Flynn, <sup>18</sup> 1962	80	M (40) U (40)	28.75 (15–55)	(1–12)	Sensation: no difference between U (20%) and M (20%) Motor: M > U (60% fair to excellent recovery vs 30%)
Jaquet et al, <sup>17</sup> 2001	220	M (105) U (72) MU (43)	31.4 (5–73)	1.48 (0.1–14.4)	Sensation: no significant difference between U (59% recovery), M (62%), MU (55%)—MU with worse recovery than U or M Motor: no difference between U (85% recovery), M (84%), MU (69%)—with worse recovery than U or M* RTW: 76% by 17.7 mo; worse with manual laborers and proximal injuries. No difference between M (75%), U (81%), or MU (71%) TOW: no significant difference between M (30.7 wk) and U (24.2 wk), MU (44.8 wk)
Ruijs et al, <sup>5</sup> 2005	623	M (253) U (232) MU (138)	30.5 (18–58)		Sensation: no significant difference between M (44%), U (41%), or MU (41%) Motor: M (61%) better recovery than U (45%), no difference between isolated and MU (54%) recovery RTW: highest for M (80%), then U (59%), lowest for MU (24%) by 1 y
Bruyns et al, <sup>19</sup> 2003	81	M (30) U (34) MU (17)	28.4 (2–69)		TOW: no significant difference between M (30.7 wk) and U (24.2 wk), MU (44.8 wk)
Vordemvenne et al, <sup>3</sup> 2007	71	M (35) U (28) PM (8)			Sensation: no significant difference between U (20% recovery) and M (40%) Motor: M (57% recovery) > U (25%)* DASH: M, 3.85 ± 24.34 (M) [0–81.67]; U, 13.44 ± 12.47 (U) [0–32.5] Rosen score: M, 2.2 (0.93–2.93) (median)*; U, 1.92 (0.77–2.53) (ulnar)*
Kilinc et al, <sup>35</sup> 2009	39 (40 nerves)	M (20) U (7) MU (13)	28 (12–45)	1.9 (1–4.5)	Sensation: U (71% recovery); M (50%); MU (15%)* Motor: no statistical difference between M (71% recovery) or U (71%); MU (38.5%)
Galanakos et al, <sup>1</sup> 2011	73	M (25) U (27) MU (21)	31 (14–62)	3 (2–6)	Sensation: Improvement between M (96% recovery), U (96.3%), MU (71.4%) Motor: final motor subscores were significantly higher in M > U; U and in M > MU Discomfort: no difference for U, M, or MU for cold intolerance or hyperesthesia Rosen score: M, 2.71 [0.79–2.99]; U 2.63 [0.63–3]; MU, 2.03 [0.49–2.76] Regression analysis identified type of nerve injury as most important determinant of total score RTW: MU (52.3%), vs M (96%) or U (96.3%) No significant difference between blue-collar (79.7%) and white-collar workers (100%); multiple logistic regression analysis identified total Rosen score, age, and type of injured nerve as independent predictors of RTW TOW: MU (mean 9.7 wk), M (7.8 wk), U (8.1 wk); no significant difference between blue-collar (8.52 mo) and white-collar (8.39 mo) workers
Galanakos et al, <sup>2</sup> 2012	73	M (25) U (27) MU (21)	31 (14–62)	3 (2–6)	Sensation: Regression model identified negative predictive factors for recovery of sensation: male gender, older age, and combined nerve injuries Motor: According to the regression model, MU as a factor will lower Medical Research Council score by 2.8 points DASH: Number of structures and arteries involved, location, and type of nerve injured influence function outcome. Only the number of structures and arteries involved were significant predictors.
Hundepool et al, <sup>7</sup> 2015	61	M (28) U (27) MU (6)		1	Sensation: M (100%), U (100%), and MU (0%) at 12 mo; no significant difference between manual laborers (50%) and office workers (43%) at 1 y Motor: M, U, and UM, 100% recovery at 1 year; U, M had significantly higher proportion of patients with a rating of 5 than those in MU; office workers were 100% and manual laborers were 100% at 12 months RTW: no significant difference between M (95%), U (89%), and MU (75%) at 1 y; no significant difference for office workers (100%) or manual laborers (85%) at 1 y DASH: M, 29.1 ± 5.0 [18–36]; U, 31.0 ± 5.6 [18–45]; MU, 37.9 ± 2.8 [34–42] Sensation: M, 51% (254 of 500); U, 48% (209 of 433); MU, 43% (97 of 227) Motor: M, 68% (308 of 455); U, 53% (189 of 406); MU, 59% (121 of 206) RTW: M, 81% (147 of 182); U, 80% (128 of 160); MU, 59% (54 of 93) TOW: M, 20.3 wk; U, 17.1 wk; MU, 25.4 wk DASH: M, 25.9 [0–81.67]; U, 22.1 [0–45]; MU, 37.9 [34–42] Rosen score: M, 2.41 [0.79–2.99]; U, 2.26 [0.63–3]; MU, 2.03 [0.49–2.76]
Current findings	61	M (22) U (27) MU (12)	31 (18–45)	1	
Aggregate	1,383	M (588) U (518) MU (277)	30.4 (2–78)	1.82 (0.1–14.4)	

M, median nerve injury; MU, combined median and ulnar injury; RTW, return to work; TOW, time off work; U, ulnar nerve injury.

\* Statistically significant difference.

† Sensory recovery was defined as ≥ S3+ at last follow-up; motor recovery was defined as a Medical Research Council score of ≥ 4 at last follow up. Ranges are presented in brackets.



Our analysis was completed at a hospital serving an economically disadvantaged and predominantly Spanish-speaking population. Socioeconomic disparities were demonstrated as a barrier to proper care in oncologic,<sup>30</sup> general,<sup>31</sup> orthopedic,<sup>32</sup> pediatric,<sup>33</sup> and spine surgery.<sup>34</sup> The current relatively socioeconomically disadvantaged, primarily Spanish-speaking population fared no worse than comparable cohorts from major academic centers (Table 5). We attribute this to an easily accessible clinic with Spanish-speaking staff and physicians.

There were certain limitations to this analysis, such as its retrospective nature, which relied on accurate data input. Second, it is possible that Spanish-speaking patients, despite seeing a Spanish-speaking surgeon, might not have been completely comfortable answering subjective questions about their outcome and function. In addition, we did not adjust grip strength to extremity dominance, which might have influenced motor recovery when comparing dominant versus nondominant extremity injuries. The impact of more concomitant injuries on combined nerve injuries may have affected outcomes as well. Because of socioeconomic pressures, patients might have returned to work earlier than patients who enjoyed a higher degree of labor support. Finally, roughly one-third of patients were lost to follow-up. It is common for patients to be injured in Mexico, have surgery at our facility, and then return to Mexico indefinitely.

Despite these limitations, we present a relatively large cohort of complex peripheral nerve injuries after volar wrist lacerations and conclude that despite socioeconomic barriers, the current patient population fared comparably to similar cohorts of complex wrist lacerations. When treating patients in underserved populations, it is especially important to consider the immense socioeconomic burden these injuries can have on patients. Understanding the factors that portend a better or worse outcome allows the surgeon to educate patients better regarding expectations and planning, thus facilitating a more rapid return to work or a necessary change in occupation. In addition, we recommend minimizing potential barriers to patient care such as language. In doing so, patients from an underserved socioeconomic region may expect outcomes similar to those of the general population.

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