

INTRODUCTION

In the United States, up to 3% of all patients admitted to a Level 1 trauma center suffer from significant peripheral nerve injuries (PNI) caused by trauma.¹ Some are minor and treated conservatively, while others are more significant and may benefit from surgical intervention. A meta-analysis study showed that only 51.6% of PNIs achieve satisfactory motor recovery, and only 42.6% experience satisfactory sensory recovery.² Since many PNIs affect the upper extremity,¹ it may be difficult to perform daily tasks – especially if it is one’s dominant hand.

Electrodiagnostic testing (EDX) such as electromyography (EMG) and nerve conduction studies are an extension of the patient’s clinical examination to determine the severity of the injury. These results have implications for prognosis and need for surgical intervention. EDX done initially may suggest or detect axonal loss but follow up studies done in conjunction with a repeat clinical examination months later can help determine the degree of nerve regeneration. Strength can recover after PNIs for up to two years after onset.³ The purpose of this study is to analyze the clinical and electrodiagnostic factors contributing to outcomes of patients with peripheral nerve injuries following trauma and help understand why some patients have better outcomes over time.

METHODS

This was a single-center, retrospective study of patients seen in the same physiatry-directed electrodiagnostic laboratory. Patients aged 18-90 diagnosed with traumatic PNI between 1/1/2010 and 8/1/2020 were included. We analyzed each individual chart in EPIC, identifying factors that affect outcome such as demographic information, injury characteristics, interventions, EDX results, and more. Two outcome measures were included. The first was chronic or resolved pain, indicated by if they continued using pain medications past their last follow up. The second was clinical improvement, graded using the Modified British Medical Research Council for manual muscle testing (MMT), with score improvement of 1 indicating slight improvement, and score improvement of 2 or more indicating significant improvement. Statistics were calculated for all variables, and Fisher’s exact test was used for categorical data due to the small sample size, with a p-value <0.05 considered statistically significant.

DATA/RESULTS

The study population consisted of 30 patients (Table 1), with an average age of 46.1±15.6 years old. Thirty-six percent of patients were female, and the majority (64%) male, consistent with the literature that traumatic PNI’s are more prevalent in males. The most common comorbidity was hypertension, followed by mental conditions (depression, anxiety, PTSD). Seventy three percent of patients were working, but had to stop due to their injury, with only half of them returning to their job (some were lost to follow-up). The most common mechanisms of injury, types of lesions, and locations of injuries are seen in Figure 1. Eighty-six percent of patients did occupational therapy, physical therapy, or both for their injuries. Seven out of 30 patients had nerve repair surgery. Sixty percent of patients took gabapentin, 73% took some type of narcotic (oxycodone, Percocet, hydrocodone, tramadol), 20% took amitriptyline, and 53% took over-the-counter medications (acetaminophen and NSAIDs). Half of the patients had slight improvement in MMT, and the other half had significant improvement. One-third of the patients had ongoing pain and continued to take medications, while two-thirds had their pain resolved over the course of recovery.

FIGURE 1. Injury Characteristics

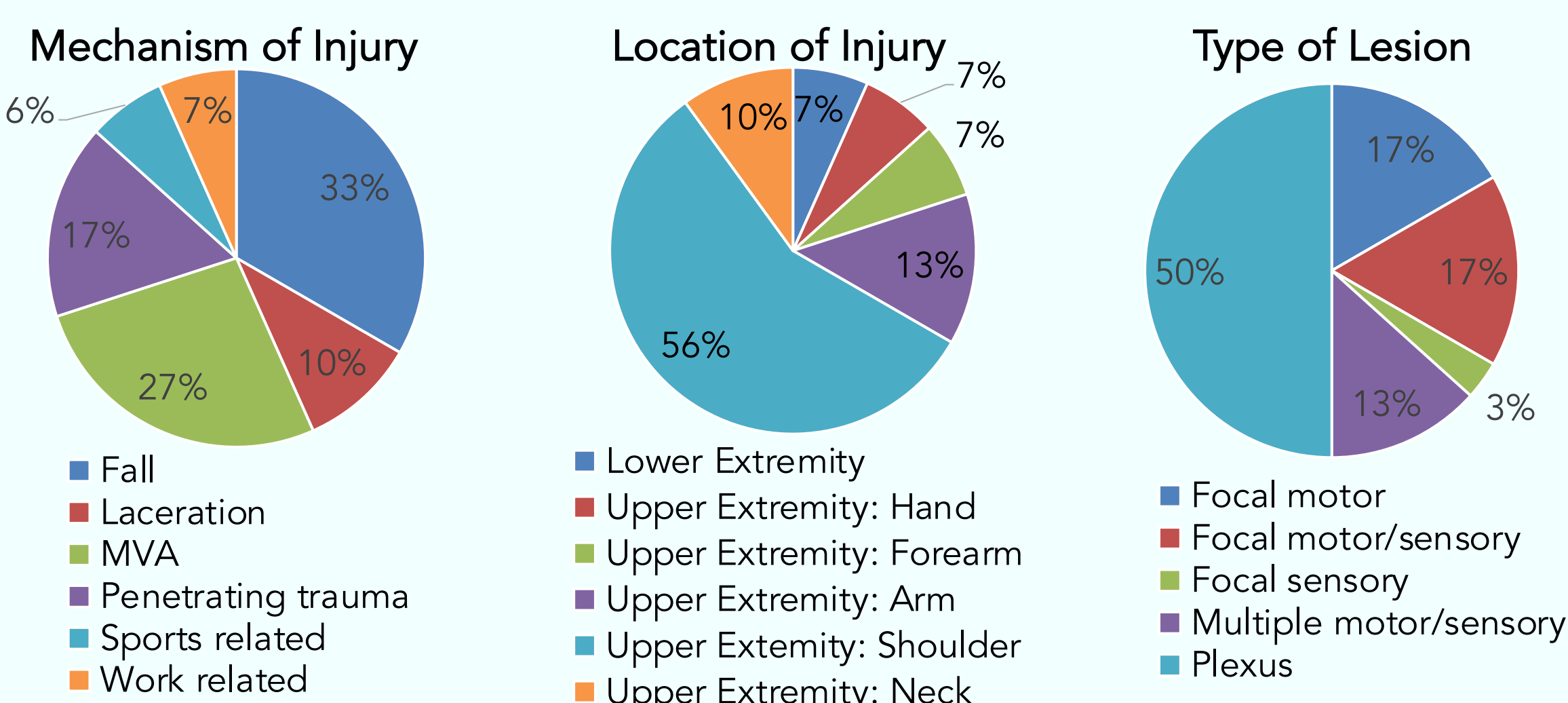


FIGURE 2. Mechanism of Injury, January 2019-December 2019 Trauma Registry, UMass Memorial Medical Center

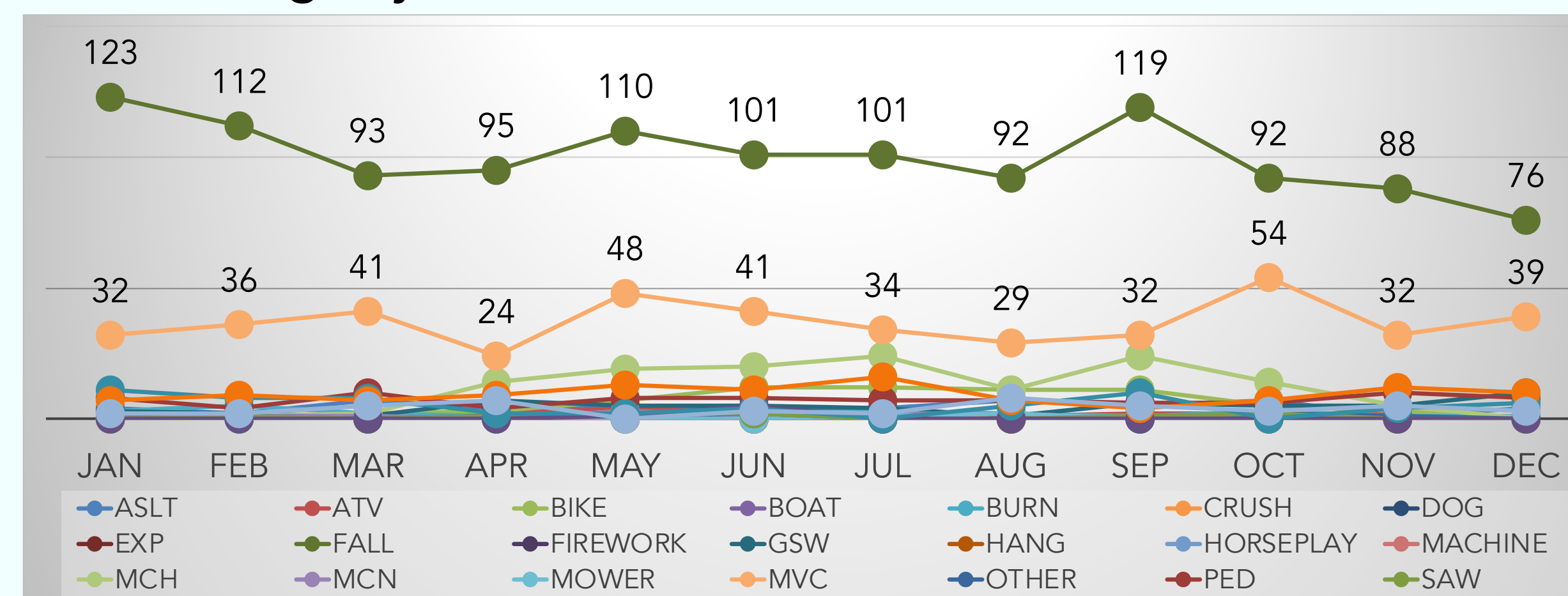


TABLE 1. Factors and Clinical Outcomes

Variables	Total n=30	Slight Improvement n=15	Significant Improvement n=15	p-value	Ongoing Pain n=10	Pain Resolved n=20	p-value
Gender				0.13			1.00
Male	19	12	7		6	13	
Female	11	3	8		4	7	
Age at Trauma				0.06			0.54
20-29	8	6	2		3	5	
30-39	1	1	0		1	0	
40-49	3	2	1		0	3	
50-59	11	2	9		3	8	
60-70	7	4	3		3	4	
Smoking Status				0.79			0.30
Yes	10	4	6		5	5	
No	15	8	7		3	12	
Former Smoker	5	3	2		2	3	
Nerve Repair Surgery				1.00			0.03
Yes	7	3	4		5	2	
No	23	12	11		5	18	
Mechanism of Injury				0.19			1.00
Fall	10	4	6		3	7	
Motor Vehicle Accident	8	3	0		3	5	
Penetrating Trauma	5	2	4		2	3	
Laceration	3	3	2		1	2	
Work Related	2	2	0		0	2	
Sports Related	2	1	1		1	1	
Type of Lesion				0.68			0.33
Focal motor	5	3	2		0	5	
Focal motor/sensory	5	2	3		3	2	
Focal sensory	1	1	0		0	1	
Multiple motor/sensory	4	3	1		1	3	
Plexus	15	6	9		6	9	
Associated Injuries							
Fracture	21	9	12	0.43	7	14	1.00
Muscle/Tendon	2	2	0	0.48	1	1	1.00
Vascular	6	2	4	0.65	4	2	0.14
Therapy Type				0.46			0.79
Physical Therapy	6	2	4		1	5	
Occupational Therapy	7	4	3		2	4	
Both	12	5	7		4	8	
None	5	4	1		2	3	
Follow Up Time (months)				0.70			0.12
0-5	11	7	4		2	9	
6-11	7	2	3		1	6	
12-17	5	4	3		2	3	
18-24	1	0	1		1	0	
>24	6	2	4		4	2	
EMG Prognosis				0.07			0.77
Good	16	5	11		6	10	
Fair	6	5	1		1	5	
Guarded	8	5	3		3	5	

DISCUSSION

There is little medical consensus on how to optimally treat a peripheral nerve injury, with many options available. We found that all of our patients had clinical improvement over time. Those without operative management still had spontaneous recovery of their nerves, with no statistically significant differences in their clinical outcome (p=1.00). Axons can predictably grow down the intact endoneurial tubes, with about 1mm/day of regeneration, making those muscles in close proximity to the lesion more likely to recover. There was a significant association between type of lesion and surgery versus non-operative treatment (p=0.002), indicating that some lesions may require surgery while others don’t. Interestingly, there was also a significant association between non-operative treatment and pain being resolved over time (p=0.03).

Falls were the most common mechanism of PNI (33%), which is consistent with the trauma data for all UMass trauma patients in 2019 (Figure 2). All but two patients (93.3%) had upper extremity injuries, with 46.4% on their dominant side, limiting their functional use and affecting their activities of daily living, such as driving, personal hygiene, dressing, and preparing food.

EDX studies were done within the first three months after injury in 63% of patients, and within the first year in 83% of patients. The prognosis based on these studies guided treatment options and also provided patients with realistic expectations of recovery. Those with repeat EMGs also had positive changes suggesting reinnervation- resolution of fibrillations and positive sharp waves and evidence of polyphasics. Repeat EMGs serve as an integral tool to help assess improvement over time, helping both the patient and the physician. It would have been interesting to see repeat EMG data for all of the patients throughout the progression of their recovery.

LIMITATIONS AND FUTURE WORK

The principal challenge in this study was the small sample size. If more trauma patients were studied, and with more time to conduct the research, there may be more significant results. Another challenge was the inconsistency between providers; the same muscles were not always measured for MMT and the results were not recorded in the same way. All physicians did not include sensory exam scores either, which could have been added as a clinical outcome for this study. Another limitation of this study was that some patients were lost to follow-up, and all the patients were seen for varying periods of time. Some patients may see no need to perform a follow-up EDX if they feel they are improving clinically, while others had limited insurance coverage, insurance that denied EDX testing, prohibitively expensive co-pays, or changes in employment that led to loss of insurance coverage. Therefore, a large sample size, prospective study with more standardization in MMT, multiple EDXs performed at the same time interval after injury, and longer follow-up time would provide better results on what factors contribute to better outcomes in traumatic nerve injury.

REFERENCES

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