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# EPIDEMIOLOLGY OF PERIPHERAL NERVE INJURIES AT FOREARM LEVELIN A TERTIARY CARE HOSPITAL

**Plastic Surgery**

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## ABSTRACT

**Background:** Etiology of traumatic peripheral nerve injury (TPNI) include penetrating injury, crush, traction, ischemia, and less common mechanisms such as thermal, electric shock, radiation & blunt injury[1]. Outcome of the nerve repair is essential as it directly affects the daily life of the patient.

**Aims & Objective:** A follow up study of the epidemiology of traumatic nerve injuries in forearm.

**Methods:** The study was done in Department of Plastic Surgery at Christian Medical College, Ludhiana, Punjab & covered all the nerve injuries from elbow to finger tip. The duration of the study was from 1st May 2011 to 30th April 2017. The study was one year prospective (1st may 2016 to 30th april 2017) & five year retrospective (1st may 2011 to 30th april 2016). All patients above 10 years of age having nerve injury of the forearm were included in the study. Nerve repair where needed was done under microscope. Nerve grafting was attempted in case of nerve loss. Associated vessel, muscle, tendon & bone injury was treated as per routine.

**Statistical Analysis:** Descriptive Analysis was done to express the continuous variables in terms of mean ± standard deviation, and categorical variables were presented as numbers and percentages. For all the analysis P value <0.05 was considered significant.

## KEYWORDS

epidemiology, treatment, nerve, injury, forearm

## INTRODUCTION

Peripheral nerve injuries were first studied systematically during the American Civil War by neurologist S. Weir Mitchell[1]. Many of the advances in knowledge about peripheral nerve injuries have occurred during wartime, from physicians on both sides of the front[1]. In a military setting, most peripheral nerve injuries were due to shrapnel [2]. Etiology of traumatic peripheral nerve injury (TPNI) include penetrating injury, crush, traction, ischemia, and less common mechanisms such as thermal, electric shock, radiation & blunt injury [3] & injuries due to sharp objects [4]. In general, stretch-related injuries are common in civilian nerve trauma, especially in motor vehicle accidents. Lacerations, by glass, knife, fan, saw blade, metal or long bone fractures make up about 30% of serious nerve injuries[1]. Another common injury mechanism is compression, which may involve mechanical deformation as well as ischemia [4].

Unlike other tissues in the body, peripheral nerve regeneration is slow and usually incomplete. Patient experiences can range from physiologic measures, reduction of symptoms and improvement in daily functions [7]. When upper limb motor and sensory function are altered, the patient's return to work may be jeopardized [6,8]. Despite great improvements in treatment, recovery after the repair of peripheral nerve injuries is often disappointing and difficult to predict [9]. Less than half of patients who undergo nerve repair after injury regain good to excellent motor or sensory function and current surgical techniques are similar to those described by Sunderland more than 60 years ago [10].

Our better knowledge about nerve physiology and regeneration far outweighs our surgical abilities to reconstruct damaged nerves and successfully regenerate motor and sensory function. It is technically possible to reconstruct nerves at the fascicular level but not at the level of individual axons. Despite surgical advances, the return of sensory and motor functions is poor in adults and can take upto 7 years [11]. Patients also suffer cold intolerance, pain and paraesthesiae. For both patients and physicians, it is necessary to evaluate the likelihood of recovery based on patients and intervention factors, to enable realistic expectations and appropriate rehabilitation. There is increasing evidence that a number of factors are associated with the motor and sensory recovery after peripheral nerve injuries[6,12]. For example, repair of nerve compression injuries has better outcomes than repair of nerve rupture injuries. Currently, the main factors thought to be associated with outcomes after the repair of peripheral nerve injuries are the age of the patient, mechanism of injury, nerve injured, injury location, defect length, repair time, repair method, operation technique, physiotherapy and repair materials.

In our study all the patients who sustained nerve injury in the forearm were evaluated, to study the epidemiology. The patients were evaluated on the basis of age, gender, level of injury, etiology of injury, mechanism of injury, employment status, nerve injured, associated injuries.

### Material & methods

The study was done in Department of Plastic Surgery at Christian Medical College, Ludhiana, Punjab & covered all nerve injuries extending from the elbow to finger tip. The duration of the study was from 1st May 2011 to 30th April 2017 which included five years retrospective(1st may 2011 to 30th April 2016) & 1 year prospective study(1stmay 2016 to 30th April 2017). All patients above 10 years of age having nerve injury of the forearm were included in the study. Clinical examination was the main benchmark for the diagnosis of nerve injury. Investigations were done for diagnosis of nerve injury wherever needed. Prospective group nerve repair was done where needed under magnification. Nerve grafting was attempted in case of nerve loss. Associated vessel, muscle, tendon & bone injury were treated as per routine. Patients were evaluated on the basis of sensory & motor recovery. All the patients were divided into different age groups to evaluate the most common age group affected.

Gender predicition was also done by evaluating the incidence. Ethnicity, whether the patient belonged to urban or rural area was evaluated.Incidence of side of limb involved was determined. Employment status was evaluated, also taken into consideration was the place of injury, whether it was a work place injury or not.

Level of injury was determined, it was divided into three parts proximal 1/3rd, middle 1/3rd & distal 1/3rd. Type of injury was determined & it was divided into crush, blunt & sharp.

Mechanism of injury was divided into self inflicted, trauma, glass cut & assault.

Associated injury to the bone, muscle, tendon & vessel were evaluated. Age wise incidence of different nerve injuries was evaluated

**Observation & results**

A total of 113 patients with nerve injuries in the forearm who underwent nerve repair under the department of plastic surgery at CMC Ludhiana were evaluated. The retrospective group consisted of 83 patients & the prospective group had 30 patients. All the patients who underwent nerve repair, satisfied the inclusion criteria & gave consent for the study were included.

**Table1: Demographic profile of patients(prospectivegroup n=30)**

| Characteristics | |
|---|---|
| **Age (years) Mean±S.D** | 30±10.42 |
| **Gender n (%)** | |
| Male | 28 (93.3) |
| Female | 2 (6.7) |
| **Ethnicity** | |
| Urban | 23 (76.7) |
| Rural | 7 (23.3) |
| **Employment status** | |
| Unemployed | 0 (6.0) |
| Employed | 22 (73.3) |
| Student | 7 (23.3) |
| Housewife | 1 (3.3) |
| **Side limb** | |
| Right | 17 (56.7) |
| Left | 13 (43.3) |

The mean age of the patients in the prospective group was 30±10.42. and 28 out of 30 patients were male (93.3%) The majority of patients evaluated belonged to the urban region, 23 patients (76.7%) belonged to the urban region.

**Table2: Demographic profile of patients(retrospective group n=83)**

| Characteristics | |
|---|---|
| **Age (years) Mean±S.D** | 30±10.47 |
| **Gender n (%)** | |
| Male | 68 (81.9) |
| Female | 15 (18.1) |
| **Ethnicity** | |
| Urban | 58 (69.9) |
| Rural | 25 (30.1) |
| **Employment status** | |
| Unemployed | 5 (6.0) |
| Employed | 46 (55.4) |
| Student | 21 (25.3) |
| Housewife | 11 (13.3) |
| **Side limb** | |
| Right | 52 (62.7) |
| Left | 31 (37.3) |

In the retrospective group mean age was 30±10.47years & 68 out of 83 patients were male (81.9%), 58 patients (69.9 %) belonged to the urban region.

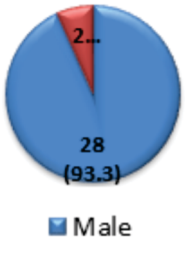



**Figure1: Gender distribution in patients(prospective group n=30)**

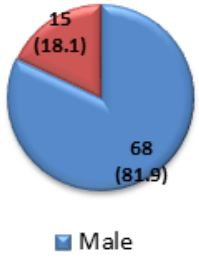



**Figure2: Gender distribution in patients(retrospective group n=83**

In our study it was observed that the right upper limb was more commonly affected as compared to the left upper limb. In the prospective group 17 out of 30 patients (56.7%) had right upper limb injury. In the retrospective group 52 out of 83 patients (62.7%) had right upper limb involvement.

Age distribution of the patients showed that majority of the patients belonged to the age group of 20-29 years in both the prospective & retrospective group. There was a decreasing trend seen in the number of patients with increasing age.

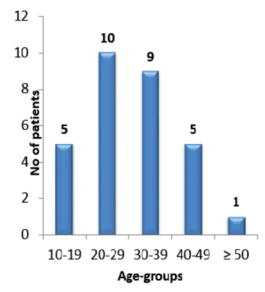



**Figure3: Distribution of age in patients(prospective group n= 30)**

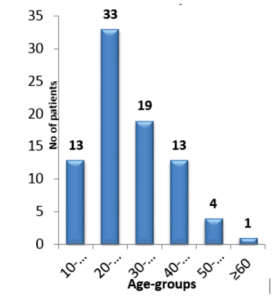



**Figure 4: Distribution of age in patients(retrospective group n=83)**

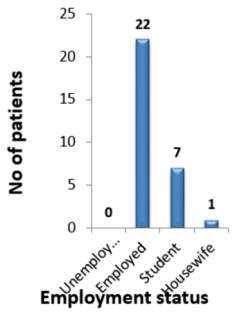



**Figure5: Employment status of patients at the time of injury(prospective group n=30**

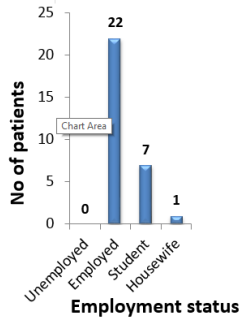



**Figure 6: Employment status of patients at the time of follow up(prospective group n=30)**

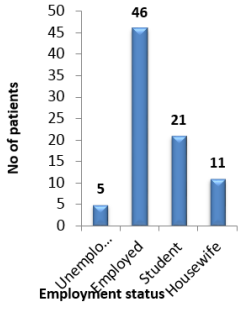



**Figure 7: Employment status of patients at the time of injury(retrospective group n=83)**

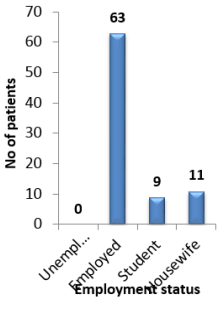



**Figure 8: Employment status of patients at the time of follow up(retrospective group n=83)**

**Table 3: Level and type of injury in patients(prospective group n=30)**

| | Frequency | Percentage |
|---|---|---|
| **Level of Injury** | | |
| Distal 1/3rd | 16 | 53.3 |
| Middle 1/3rd | 10 | 33.3 |
| Proximal 1/3rd | 4 | 13.3 |
| **Type of Injury** | | |
| Crush | 5 | 16.7 |
| Blunt | 4 | 13.3 |
| Sharp | 21 | 70.0 |

**Table 4: Level and type of injury in patients(retrospective group n=83)**

| | Frequency | Percentage |
|---|---|---|
| **Level of Injury** | | |
| Distal 1/3rd | 48 | 57.8 |
| Middle 1/3rd | 27 | 32.5 |
| Proximal 1/3rd | 8 | 9.6 |
| **Type of Injury** | | |
| Crush | 8 | 9.6 |
| Blunt | 13 | 15.7 |
| Sharp | 62 | 74.7 |

As observed in the study the most common region for injury in both the prospective & retrospective group was the distal 1/3rd of forearm, followed by the middle 1/3rd & lastly proximal 1/3rd. The most common type of injury observed was sharp injuries 70 % in prospective group & 74.7% in retrospective group. Followed by blunt & crush injuries.

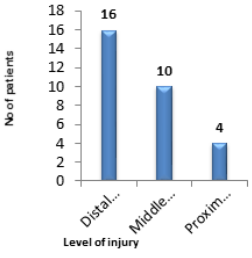



**Figure 9: Level of injury in patients(prospective group n=30)**

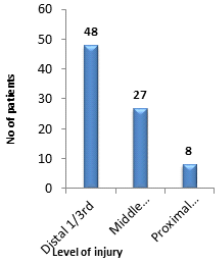



**Figure 10: Level of injury in patients(retrospective group n=83)**

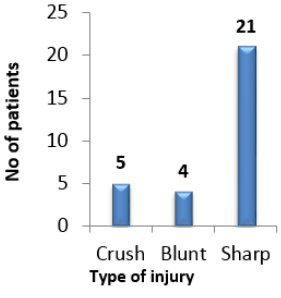



**Figure 11: Type of injury in patients(prospective group n=30)**

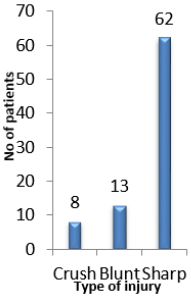



**Figure 12: Type of injury in patients(retrospective group n=83)**

**Table 5: Mechanism of injury in patients(prospective group n=30)**

| Mechanism of injury | Frequency | Percentage |
|---|---|---|
| Self | 2 | 6.7 |
| Trauma | 9 | 30.0 |
| Glass cut | 13 | 43.3 |
| Assault | 6 | 20.0 |

**Table 6: Mechanism of injury in patients(retrospective group n=83)**

| Mechanism of injury | Frequency | Percentage |
|---|---|---|
| Self | 11 | 13.3 |
| Trauma | 21 | 25.3 |
| Glass cut | 34 | 41.0 |
| Assault | 17 | 20.5 |

The most common mechanism of injury in both the prospective & retrospective group was accidental glass cut injury 43.3% (prospective group) & 41 % (retrospective group) Second mechanism was trauma which included road traffic accidents, mechanical trauma etc. Other mechanisms were assault & self inflicted injuries.

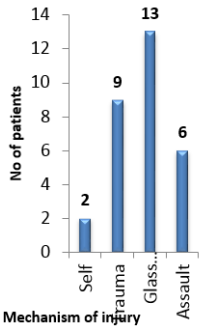



**Figure 13: Mechanism of injury in patients (prospective group n=30**

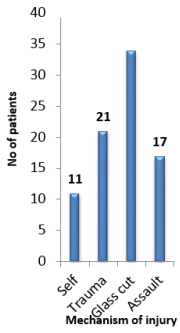



**Figure 14: Mechanism of injury in patients(retrospective group n=83)**

**Table 7: Associated injury (prospective group n=30)**

| Associated Injury | Yes n (%) | No n (%) |
|---|---|---|
| Bone | 2 (6.7) | 28 (93.3) |
| Muscle | 14 (46.7) | 16 (53.3) |
| Tendon | 30 (100.0) | 0 (0) |
| Vessel | 26 (86.7) | 4 (13.3) |

**Table 8: Associated injuries (retrospective group n=83)**

| Associated Injury | Yes n (%) | No n (%) |
|---|---|---|
| Bone | 8 (9.6) | 75 (90.4) |
| Muscle | 32 (38.6) | 51 (61.4) |
| Tendon | 79 (95.2) | 4 (4.8) |
| Vessel | 57 (68.7) | 26 (31.3) |

As observed tendon injury was the most common associated injury in both prospective (100%) & retrospective (95.2%) group. Muscle injury was seen in 46.7% patients in the prospective group & 38.6 % patients in the retrospective group. Vessel injury was noted in 86.7% patients in the prospective group & 68.7 % patients in the retrospective group. Bone injury was the least common associated injury in our study seen in 6.7% patients in prospective group & 9.6% patients in the retrospective group.

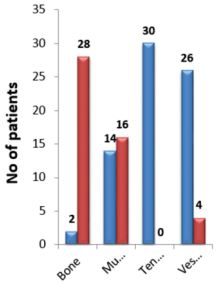



**Figure 15: Associated injuries(prospective group n=30)**

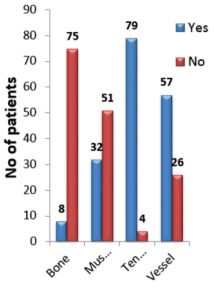



**Figure 16: Associated injuries(retrospective group n=83)**

**Table 9: Distribution of nerve injuries among patients of different age-groups(prospective group n=30)**

| Age-groups | Radial | Ulnar | Median | Median and Ulnar | Radial, Median and Ulnar |
|---|---|---|---|---|---|
| | n (%) | n (%) | n (%) | n (%) | n (%) |
| 10-19 | 0 | 2 | 1 | 2 | 0 |
| 20-29 | 1 | 1 | 4 | 4 | 0 |
| 30-39 | 0 | 2 | 4 | 3 | 0 |
| 40-49 | 0 | 4 | 1 | 0 | 0 |
| ≥ 50 | 0 | 0 | 0 | 1 | 0 |
| **Total** | 1 | 9 | 10 | 10 | 0 |
| **p-value** | 1.00 | 0.053 | 0.832 | 0.350 | |

**Figure 17: Distribution of nerve injuries among patients of different age-groups(prospective group n=30)**

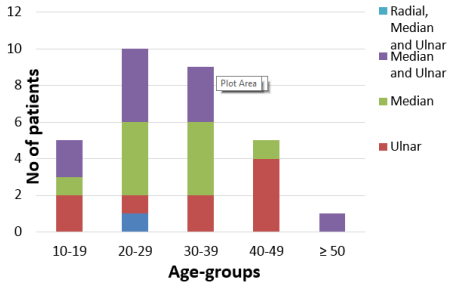
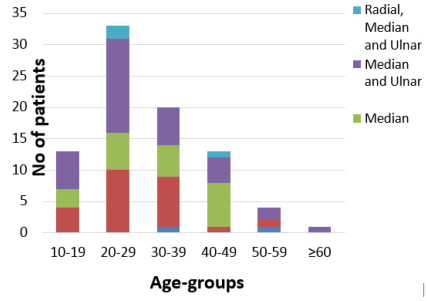



**Table 10: Distribution of nerve injuries among patients of different age-groups(retrospective group n=83)**

| Age-groups | Radial | Ulnar | Median | Median and Ulnar | Radial, Median and Ulnar |
|---|---|---|---|---|---|
| | n (%) | n (%) | n (%) | n (%) | n (%) |
| 10-19 | 0 | 4 | 3 | 6 | 0 |
| 20-29 | 0 | 10 | 6 | 15 | 2 |
| 30-39 | 1 | 8 | 5 | 6 | 0 |
| 40-49 | 0 | 1 | 7 | 4 | 1 |
| 50-59 | 1 | 1 | 0 | 2 | 0 |
| ≥60 | 0 | 0 | 0 | 1 | 0 |
| Total | 2 | 24 | 21 | 34 | 3 |
| p-value | 0.079 | 0.387 | 0.176 | 0.701 | 0.713 |

**Figure18: Distribution of nerve injuries among patients of different age-groups retrospective group n=83**




## Discussion

The study was conducted at Christian Medical College, Ludhiana by the Department of Plastic Surgery. There were a total of 113 patients who were evaluated for the nerve injuries in the forearm. These patients were divided into two groups prospective which included 30 patients of which 28(93.3%) were male patients & retrospective group included 83 patients of which 68 (81.9%) were male patients, denoting that more accidents are happening at work places & calls for appropriate precaution steps. Rasulić L et al[13] (2015) conducted a study which included 104 patients of which males were 84;( 80.8%) and 20 (19.2%) were females**.** Puzović V[14] (2015)et al studied the nerve injuries in forearm which included total 99 patients, male 81 (81.8%), while 18 (18.2%) were females,

It was observed in our study that the right upper limb was more commonly affected as compared to the left upper limb. In the prospective group 17 out of 30 patients (56.7%) had right upper limb injury. In the retrospective group 52 out of 83 patients (62.7%) had right upper limb involvement. Mcallister et al[15] (1996) had similar incidence on both sides. Probably due to the fact that more people are right hand dominant.

The majority of the patients in our study suffered injury to the distal 1/3rd of the forearm 53.3 % in the prospective & 57.8 % in the retrospective group. Puzović V[14] et al (2015)studied the nerve injuries in forearm, which showed similar results with majority of the injuries occurring in the distal forearm (75.6%).

The most common cause for nerve injury found in our study was sharp injury mostly caused by accidental glass cut injury 43% in the prospective & 41 % in the retrospective group. Rasulic L et al[13] (2015)reported that Injury by a sharp object was the most frequent etiologic factor and it occurred in (59.6%) patients, while traffic accident and gunshot injuries were the least common etiologic factor of forearm nerve injury, occurring in (6.7%) and (5.8%) cases, respectively. Saadat S[16] et al(2011) found that the most common cause for nerve injury was direct laceration from a sharp object (61%) followed by road traffic crashes (22%) .

In our study the associated injury to the bone, muscle, tendon & vessel in the prospective group was 6.7%, 46.7%, 100% & 86.7% respectively & in the retrospective group 9.6%, 38.6%, 95.2% & 68.7% respectively. Puzović V,[14]et al (2015)reported 22 % vascular injuries, 33 % muscle and tendon injuries and 20% bone fractures**.** Rasulić L et al (2015)[13] reported associated injuries of muscles and tendons, bones and blood vessels occurred in 20 (19.2%), 16 (15.4%) and 15 (14.4%) patients, respectively. This indicates that the severity of injury is not high to cause disruption of all structures.

Our study showed a mean age of 30±10.42 in the prospective group & 30±10.47 in the retrospective group, Saadat et al [16] (2011) noted that the mean age of the patients with PNI of forearm was 28.6±14.45 years. Mcallister et al[15] (1996)found that the most common age group of injury was 16 -20 years. 57.1% of patients were in the age group of 16-35 years.

The patient's age seems to play an important role for sensory recovery after performed repair as proposed in 1990 by Glickman and Mackinnon [17] and confirmed by our statistical meta-analysis. It was noted, after nerve repair younger patients seem to have a better sensory recovery outcome.

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In our study most common cause/ mechanism of injury was sharp/ transection injuries, 70 % in the prospective group & 74.7% in the retrospective group. Puzović V [14]et al(2015) documented two injury mechanisms, transection in 85 patients and traction and contusion in 14 of the patients, out of the total 99 patients. Rasulić L[13] et al (2015) also had a similar finding with transection as the dominant mechanism of injury and it occurred in 84.6% of cases.

Secer et al[17] (2008)studied 455 patients with gunshot or shrapnel injuries to the ulnar nerve and found that the rate of good to excellent results was < 32%. Crush injuries cause a relatively extensive area of tissue damage, resulting in poor outcomes after the repair of nerve injuries.

In our study the most common injured nerve in prospective group was median nerve & in the retrospective group was ulnar nerve. Saadat S[16] et al (2011)found that the ulnar nerve was the most commonly injured nerve. Rasulić L et al[13](2015)found that out of 104 cases, Ulnar nerve injury predominated with 70 cases, followed by median nerve with 54 (51.9%) cases and radial nerve with only 5 cases.

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