



## Traumatic Nervous Injury of the Upper Limb

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*Epidemiological and clinical aspects of traumatic neurological lesions of the upper limb at Saint Jean de Malta Hospital of Njombe, Cameroon*

### Abstract

Traumatic neurological injuries of the upper limb are common conditions in traumatology and neurosurgery. The disabling nature of these injuries requires urgent diagnosis, medical-surgical therapy and adequate functional rehabilitation techniques, in order to ensure better recovery of function in the medium and long term. The aim our study was to determine the epidemiological and clinical aspects of traumatic neurological injuries of the upper limb and to describe their functional evolutions in rural areas. We conducted a descriptive cross-sectional study (over a period of 5 years and 8 months, from 1st January 2015 to 10th August 2020) at the Saint Jean of Malte Hospital of Njombe (SJM). This preliminary study identified clinical data before and after treatment, from the medical records of patients and with the help of the Chanson and Michon classification modified by Amend we evaluated their evolution. Out of 468 upper limb traumas the prevalence of traumatic neurological injuries was 10.47%. The median age was 19 years with interquartile range of 38 years, the male sex was predominant with 39 males and 10 females. The ratio M/F was 3.9. The main etiological circumstances were; childbirth (36.74%) and road accidents (20.41%). Fractures were the most common associated injury with 51.02%. Lesions of the brachial plexus were the most common with 42.86%, followed by digital collateral nerves damage with 22.45%. Axonal injuries combining neurotmesis (34.69%) and axonotmesis (30.62%) were the most common type of traumatic neurological injury. The post-traumatic functional recovery reassessment time ranged from 2 weeks to 5 years. The clinical evolution of the sensitive and motor functions was good despite a therapy essentially based on rehabilitation techniques. In this context of limited technical facilities, prevention methods remain the best means of reducing the incidence of these neurological lesions.

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### Introduction

Neurological disorders according to the World Health Organization (WHO) are diseases of the central or peripheral nervous system; in other words, they affect the brain, spinal cord, cranial nerves, peripheral nerves, nerve roots, vegetative nervous system, neuromuscular junction and muscles [1]. These neurological lesions are due to various aetiologies including traumatic, degenerative, tumoral and circulatory. Traumatic neurological lesions of the upper limb are considered to be serious injuries and cause major disabilities due to its use in everyday life acts; these lesions are at the origin of paralysis, sensory disturbances and deformities constituting enormous losses to the affected individuals, their families and society [2]. However, less diagnosed peripheral nerve injuries are very often associated with tendon, vascular and bone lesions, making them true emergencies, which may later lead to incomplete

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and random functional recovery [3]. For a very long time, rehabilitation methods were the only means of treatment without any real statistical improvement in prognosis until the introduction of microneuro-surgery in 1960 [4]. From these facts, several studies around the world show us the impact of traumatic neurological lesions on affected people.

### **In the world**

According to several studies, the prevalence of traumatic peripheral nerve damage varies between 2 and 3.3% and even more if associated with plexus damage [5-7]. These lesions are the cause of long periods of hospitalization and consequently heavy financial expenditure. They mainly affect young adults and are very often followed by considerable disability [8]. In the United States in 2006, Jaquet and al. showed that approximately 2/3 of upper limb trauma concerned young adults and 65% of neurological lesions concerned individuals aged between 16 and 40 years in a study of traumatic injuries to the median and ulnar nerves for prognostic and predictive purposes [4]. A retrospective study in the United States in 2010 by Iad and al. on the trend of radial, medial, ulnar and brachial plexus injuries in the United States with the aim of promoting efforts to reduce exposure to risk factors for injury and effective therapy when injury is present, showed that 30 to 40% of radial, ulnar and medial injuries required acute repair by direct suturing of the injured nerve, with males being the most represented with an age range of 18 to 44 years [9].

Furthermore, a case-control study in Germany in 2018 by Torge and al. on nerve damage in severe trauma of the upper extremities of the DGU trauma registers, with the aim of assessing the prevalence, mechanisms, injury severity and progression characteristics of upper extremity nerve damage, revealed that the prevalence of nerve damage in upper extremity trauma victims was 3.3%, the male sex was the most represented at 78.6% versus 73.2% with a mean age of 40.6 years. Motorcycle accidents were the leading cause of peripheral nerve injury (32.5%). Associated injuries in decreasing order were: fractures of the humerus (37.2%) or ulnar (20.3%), vascular lacerations (arterial 10.9%; venous 2.4%) and soft tissue (21.3%). There was also a longer hospital stay in patients with nerve lesions of 30.6 days with the need for rehabilitation sessions in 36% of cases compared with 24.2 days in controls, despite similar lesion severity [10].

Finally, another retrospective study in China in 2019, by Li and al. on traumatic brachial plexus injuries in multiple service centers in Guangxi, whose objectives were to study the epidemiology, clinical management and evolutionary

results of brachial plexus injuries, showed that the male sex was the most represented with a mean age of 29.04 years. The most common etiology was MVAs (64.71%), especially motorcycle accidents. Closed lesions were found in 88.24%, 83.53% of the patients had associated lesions, the most frequent of which were fractures at 76.24% [11].

### **In Africa**

Here a few studies on traumatic neurological injuries of the upper limb reveal that accidents are the primary etiology of traumatic neurological injuries, with significant morbidity. A study in Morocco, in 2017, by Ezzahra and al. on the epidemiological profile of traumatic peripheral nerve injuries of the upper limb at the University of Cadi Ayyad Marrakech, with the objectives of analyzing epidemiological, etiological, therapeutic and prognosis of patients who have been treated for an upper limb peripheral nerve injury and evaluation of the results in comparison with the data in the literature shows a predominance of young age (mean age 29.3 years) and male sex (90.83%). The right side was the most frequently affected (51.19%), aggression was the most frequent cause (51.92%), knife blade was the most frequently found traumatic agent (48.07%). Wrist wounds were the most frequent (37.97%), associated injuries were tendinous in 76.92% of cases and vascular in 36.53%. Ulnar nerve damage was predominant (26.31%), followed by the median nerve (22.8%) and the sensory branch of the radial nerve (21.05%) [12].

### **In Cameroon**

In Cameroon we note an increase in the rate of handicapped persons from 1.5% in 2010 to 5.4% in 2011 where motor deficiency affecting members represented 1.6% of the population with a predominance in rural areas [13]. In 2010, Ibrahim and al. revealed that hand trauma is associated with 2.6% of traumatic ulnar nerve injuries in a study on the management of severe hand trauma at the Douala General Hospital [14]. In 2014, Motah and al. in a preliminary study on the surgical treatment of post-traumatic brachial plexus paralysis at the Douala General Hospital, showed that road accidents accounted for 81.5% of the causes of trauma, all of which were men with an average age of 33 years [15]. These conditions still pose a problem of diagnosis and treatment in some countries, hence the lack of a real consensus.

The aim of this study was to evaluate the peripheral nervous system: to describe the epidemiological aspects, to determine the frequency, the etiological mechanisms, the anatomoclinical characteristics of the affected nerves and the evolution of traumatic neurological lesions of the upper limbs in rural areas at the Saint Jean de Malte Hospital in

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Njombe, in order to improve the management of the most vulnerable groups in Cameroon.

## Methodology

Type of study: We conducted a cross-sectional descriptive study.

Study site: Saint Jean de Malte Hospital in Njombe. It is a district hospital with a surgical department with a General Surgeon and Orthopedic-Traumatologist and a rehabilitation department with a specialist in kinesiology therapy and rehabilitation.

Duration of the study: It lasted for 10 months (from November 15, 2019 to August 10, 2020) in strict compliance with the pandemic barrier measures at COVID 19. It was conducted from January 1, 2015 to August 10, 2020, i.e. over a retrospective period of 5 years and a prospective period of 8 months.

Study population: All patients who had an upper limb trauma during our study period at Saint Jean de Malte Hospital in Njombe.

Inclusion criteria: Patients with traumatic neurological injury of the shoulder, arm, forearm, wrist and hand.

Exclusion criteria: Patients with moderate to severe head trauma, deceased patients, incomplete records.

Sampling: It was voluntary, consecutive and exhaustive in the upper limb trauma patient population.

Sample: We had estimated a minimum sample size of 42 using proportions from a study in Turkey in 2009 [5].

## Administrative procedures

This study was conducted after obtaining the various administrative authorizations, the ethical clearance of the institutional committee of ethics and research of the University of the Mountains; as well as the authorization of the director of the HSJM of Njombe.

### Criteria for the evaluation of results

To evaluate functional recovery, we adopted the criteria proposed by Chanson and Michon, which take into account motor, sensory and functional recovery, and Seddon's classification taking into account sensory recovery. Each nerve is assigned three scores, each ranging from 0 to 4. This scoring method allowed us to classify the results into six categories: Excellent, very good, good, average, poor, failure.

i. Excellent : 444

ii. Very good: 433 and above.

iii. - Good : 322 and above.

iv. - Average : Below 322 and above 211.

v. - Poor : Below 211 and above 100.

vi. - Failure: Below 100.

## Type of Nerve Damage

For closed nerve lesions, were considered as neurapraxia all lesions with very good to excellent recovery results over a maximum duration of 3 months. The axonotmesis represented all nerve lesions with partial functional recovery over a period of at least 3 months. Apart from any intraoperative diagnosis, neurotmesis was evoked in any patient showing no sign of functional recovery over a period of at least 3 months.

## Data Collection

The data were collected from patient records, hospital registries of the surgery, pediatrics, physiotherapy and from patients. Each patient was assigned a file for all this information as well as a code number for data entry and statistical analysis.

## Statistical Analysis

Data were entered and analyzed using Epi info 7.2.3 software and tables and graphs were created using Microsoft Office Excel and Word 2013 software.

## Ethical Considerations

We have obtained ethical clearance from the institutional ethics and research committee of the University of the Mountains; our informed consent forms signed by patients and the authorization of the director of the HSJM of Njombe and the University of the Mountains. Information on each participant was filed, assigned a code number and kept anonymous.

## Results

### Study population

We retained 63 records of patients with neurological lesions from the 468 records of upper limb trauma patients at the SJMH during our study period. Ultimately, 14 patients were excluded (12 for incomplete records and 2 for refusal to participate) and only 49 patients (42 retrospective and 7 prospective cases) could be contacted and reassessed.

### Socio-demographic aspects of the population

Out of 468 patients with upper limb trauma, we included 49 with neurological lesions, i.e. a frequency of

Table 1: Socio-demographic characteristics of the population.

Characteristics	child	Adult	Total
Number	22 (44,90%)	27 (55,10%)	49 (100,00%)
Médian/ mean	<1;EI:	38±14	
age (year)	1		
Most represented age group	[0- 5]	[25- 30]	
Gender (M/F)	15/7	24/3	39/10
Dominant limb			
Left	0 (0%)	2 (6,67%)	2 (6,67%)
Right	3	25	28
	(10,00%)	(83,33%)	(93,33%)
Marital status			
Single	0 (0%)	11	11
		(40,74%)	(40,74%)
Married	0 (0%)	16 (59,26%)	16 (59,26%)

10.47%. (N: 468) (Table 1). We could not affirm the laterality of the children before the age of 4 years, i.e. 19 cases in our series. Apart from the 19 cases of infants, the most frequent occupation was that of labourers (agricultural workers) with 10 cases, i.e. 20.41%.

### Clinical aspects

We have not found any cases with underlying chronic pathologies. Toxic habits (smoking, alcoholism) were reported in 19 patients (3 cases of smoking or 6.12% and 16 cases of alcoholism or 32.65% of our population).

### Traumatic circumstances and agents

Childbirth was the most frequent etiological circumstance in our series with 18 cases or 36.74%. In children, childbirth was the most common etiological circumstance with 18 cases (81.82%), followed by cases of domestic accidents due to carelessness with 3 cases (13.64%), then the least frequent MVA with only one case (4.55%). In adults, MVAs were the most frequent injury circumstances, with 9 cases out of 27 (33.33%) (Table 2).

### Symptoms and Signs

Motor deficit was the most common sign at reevaluation with 28 cases or 84.85%.

Figure 1

### Associated lesions

More than half of the patients had associated lesions with a predominance of bone lesions with 51.02% and skin lesions with 46.94%, followed by musculo-tendinous lesions

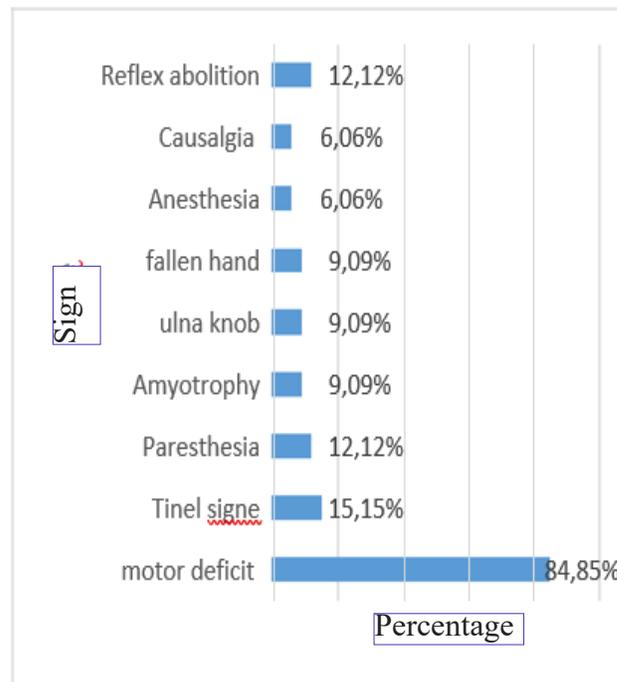


Figure 1: Patient signs and symptoms.

Table 2: Circumstances and traumatic agents.

Characteristics	Child	Adult	Total
Effectives (%)			
Delivery	18 (81,82)	0 (0)	18 (36,74)
AVP	1 (4,55)	9 (33,33)	10 (20,41)
Agression	0 (0)	5 (18,52)	5 (10,20)
Accident at work	0 (0)	5	5
Domestic accident	3 (13,64)	4 (14,81)	7 (14,29)
Iatrogenic accident	0 (0)	4 (14,81)	4 (8,16)
Blunt objects	1 (4,55)	12	13
<b>Blade (razor/ machine)</b>	2 (9,09)	4 (14,81)	6 (12,25)
Knife	1 (4,55)	3 (11,11)	4 (8,16)
Glass	0 (0)	2 (7,41)	2 (4,08)
Surgery and care	0 (0)	4 (14,81)	4 (8,16)
Bite	0 (0)	2 (7,41)	2 (4,08)

with 36.73%. Large and medium-gauge vascular lesions accounted for 14.28%.

### Nerve lesions

Isolated lesions of the brachial plexus were the most common, followed by digital collateral lesions (Table 3). The most frequent simultaneous nerve damage was to the median and radial nerves. It was observed in 4 cases, i.e. 8.16%.

Table 3: Isolated and simultaneous nerve damage.

Nerve	Child	Adult	Total	Prevalence
Brachial plexus	19 (86,36)	2 (8,70)	21 (42,86)	4,49
Radial	0 (0)	6 (26,09)	6(12,24)	1,28
Ulnar	0 (0)	6 (26,09)	6(12,24)	1,28
Median	0 (0)	1 (4,35)	1(2,04)	0,21
Digital collateral	3 (13,64)	8 (34,78)	11 (22,45)	2,35
M+R	0 (0)	2 (50%)	2(4,08)	0,43
M+U+R	0 (0)	2 (50%)	2(4,08)	0,43

Table 4: Types of nerve lesions according to Seddon and Birch Thomas.

Severity of injury	Type	N	%
	Neurotmesis (total section)	17	34,69
Major injury (Axonal injury)	Axonotmesis (partial section)	15	30,62

### Type of nerve injury

In this series, the major nerve lesions grouping together neurotmesis and axonotmesis lesions, i.e. 32 patients, represented 65.31% of the cases (Table 4). The average length of hospitalization was less than 3 days in patients with benign lesions. Special grounds (sick, advanced age, complications) and/or cases that received general anesthesia were up to 15 days.

### Therapeutic aspects

1. Pharmacological means: All were treated with Tier 1 and/or Tier 2 analgesics (paracetamol + tramadol), non-steroidal anti-inflammatory drugs and vitamin B therapy.

Table 5: Global evolution of impaired functions.

Résultat	Variable	N	%
	Excellent	4	12,12
Useful	Very good	1	3,03
	Good	12	36,36
	<b>Average</b>	<b>11</b>	<b>33,33</b>
Less useful	Poor	3	9,09
	Failure	2	6,06
Total		33	100,0
			0

2. Means of immobilization: The immobilization of the injured and/or operated limb was done by sling, splint or simple plaster cast in order to prevent secondary displacement, tension and promote healing in the surgical area for an average of 3 to 6 weeks.

3. Rehabilitation: In this series, 27 patients underwent a sensitivomotor re-education of 10 sessions of an average duration of 2 hours followed by self-rehabilitation at home.

4. Clinical neurological evolution: We re-evaluated the patients after a post-traumatic period ranging from 2 weeks to 58 months (Table 5). We were able to evaluate the results in 32 patients with isolated lesions and one with an associated lesion. The evolutions were considered good (useful) in 28 cases (84.85%).

### Discussion

The prevalence of traumatic neurological lesions of the upper limb in this series was 10.47% this could be explained by the inclusion of neurapraxia in our study. This result deviates from the 5% estimated by Noble and al [7]. This difference could be explained by the method of data collection which was based on electromyography results allowing to distinguish the evolution of severe nerve lesions (axonotmesis and neurotmesis) and to exclude benign lesions (neurapraxia). The most represented age group was 0-5 years with a prevalence of 38.78% followed by the 25-30 years age group, i.e. 12.24%. The general median age was 19 years with an interquartile range of 38 years, which can be explained by the frequency of under 5 year olds in this population. While it varied between 29 years in the study of Ezzahra [12] and Jacquet and al [4] and 40 years in the study of Li and al [11] and Huckhagel and al [10]. This difference in age could be explained by the inclusion of obstetric nerve damage in our series. The male sex was the most common in this series with 79.60%. This male predominance is found in many studies ranging from 71% Eser and al [5], to 100% in the study by Motah and al [15], which may be explained by the risky nature of certain occupations and activities practiced mainly by men.

The left side was the most injured at 57.14%. This can be explained by the high frequency of patients injured following domestic accidents of imprudence with the non-dominant limb very often victim of negligence during the accidents. This result is in line with that found in the study by Noble and al[7] where the left side was affected at 54.5% and is close to the 50% found digitally in the study by Mcallister and al[8]. This similarity of results could be explained by the importance of the rate of nerve damage due to road and domestic accidents in our series compared

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to these different studies.

Apart from the context of childbirth in newborns, MVAs (20.41%) represented the first circumstance of nerve damage in our study. This could be explained by the rate of alcohol consumption in this study, the hostile environment with bad roads, the lack of organisation of the emergency and road safety services. This circumstance is also found in the studies of Eser and al [5] with 26.9% and Huckhagel and al [10] with 68.9%. The MVA was the only other cause of plexus damage in our study, which is in line with the numerous studies in the literature [9-11,15]. In addition to obstetrical maneuvers (36.73%) in newborns, blunt objects (26.54%) represent the most common causal agents found in our series. This follows the trend found according to etiologic agent in the series of Huckhagel and al [10], where blunt objects represented the first etiology with 85.3%.

In the study by Ezzahra [12] and Jaquet and al [4], knife wounds were found in 48.07% and glass wounds in 62% respectively. While overall nerve damage following lacerations accounted for only 13.64% in our series. This could be explained by the low rate of aggression (10.2%) in our study. The determination of this causal agent is important, as it clarified the nature of the lesions, which are most often multiple and diverse, sometimes posing difficult therapeutic problems with a significant impact on the functional prognosis of patients. In this study, lesions of the brachial plexus were the most frequent with 42.86%, which could be explained by the frequency of SJMH reference cases and home deliveries in rural areas. Simultaneous medio-radial and medial-radial nerve lesions were rare, accounting for 8.16% of cases. These findings reflect the frequency and severity of these injuries. This seriousness is more marked in cases of combined lesions, which result in a true functional amputation of the hand. In this series, nerve injuries with axonal

involvement (axonotmesis and/or neurotmesis) represented 65.31%, which could be explained by the frequency of traumatic amputation accidents, MVAs and domestic accidents. Our results are consistent with the study by Eser and al [5], where total and/or partial sections were clearly predominant over other types of injuries with approximately 66.67%. The rate of arterial lesions encountered in this series was 14.28%, in contrast to 36.53% in the Ezzahra series [12], this difference may be due to the low rate of laceration wounds in our study. On the other hand, there were 25 cases of bone fracture, i.e. (51.02%) in our series, these results follow those found in the series of Huckhagel and al [10], where humerus and radius fractures accounted for 37.2% and 28.5% respectively,

in contrast to that of Ezzahra [12], where there were no cases of associated bone lesions. This difference is due to the traumatic amputation rates and the large number of MVAs identified in our work. This shows that despite the high rate of axonal degeneration including neurotmesis (34.69%) and axonotmesis (30.62%), only one patient, i.e. 3.03%, was treated by nerve surgery. This shows that these nerve lesions are essentially managed by medical treatment and rehabilitation methods in our context compared to the 96.1% of nerve repair in the Ezzahra study[12]. This difference can be explained by the limits of the technical platform in rural areas. In this study, the duration of reevaluation and/or surgical exploration varied from 2 weeks to 58 months, which for the majority of patients was different from the 6 months proposed in the literature by Lad and al[9], thus decreasing the chances of functional recovery of our patients. In our series, we obtained 84.85% of patients with good functional recovery compared to 92.3% in a publication by Ezzahra[12] about 52 patients with postoperative peripheral nerve damage of the upper limb. This significant difference can be attributed to the lack of surgical management of nerve damage in this study.

### Limitations of this Study

We were able to obtain these results despite some limitations, namely:

- A. The difficulty to contact some patients.
- B. The technical platform limited by: The absence of electromyogram (EMG) examination and advanced binocular microscope to enrich our diagnoses, still remains a handicap given their non-availability within this hospital structure.

### Conclusion

Our results show that these traumatic neurological lesions have a high prevalence of 10.47% in the traumatized upper limb, occurring mostly in young subjects with a clear male predominance, being mostly agricultural workers. The major traumatic circumstances were childbirth and road accidents. Injuries to the brachial plexus (36.74%) were the most frequent, followed by injuries to the digital collateral nerves (22.45%). Axonal damage was more frequent compared to conduction block nerve damage. The therapy used was essentially medical, orthopedic and rehabilitation, despite the predominance of axonal damage. The evolution of functions was statistically good and could be significantly improved if the microsurgery centers were decentralized. Finally, we can say that traumatic neurological lesions of the upper limb are very frequent in rural areas and cause major disability; hence the need for emergency follow-up of these

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nerve lesions to ensure optimal management and therefore better results of functional recovery.

### Compliance with Ethical Standards

Conflict of Interest: The authors declare that they have no conflicts of interest.

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