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ORIGINAL RESEARCH

Functional limitations of adults with traumatic brachial plexus injury in the first medical appointment: a cross-sectional study

Limitações funcionais de adultos com lesão traumática de plexo braquial no primeiro atendimento ambulatorial: um estudo transversal

Limitaciones funcionales de adultos con lesión traumática del plexo braquial en la primera atención ambulatoria: un estudio transversal

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ABSTRACT | The effective treatment of traumatic brachial plexus injury (BPI) requires studies evaluating its functional outcomes. Nevertheless, these studies are scarce, especially in the Northeastern Brazil. Thus, this cross-sectional study aimed to identify the main physical and functional limitations and the quality of life of patients over 18 years of age diagnosed with traumatic BPI, during their first specialized consultation. Sociodemographic and clinical information were recorded, and the outcomes evaluated were: muscle strength, range of motion (ROM) and pain; functionality and quality of life assessed by the Disabilities of the Arm, Shoulder and Hand (DASH) and World Health Organization Quality of Life (WHOQOL-BREF) questionnaires, respectively. There was a predominance of men (92%) aged 34±10.5 years with total plexus injury (56%) and motorcycle accident etiology (68%). Most of the sample lived far from the capital (52%), had neuropathic pain (87%) and ROM restrictions. The DASH score ranged from 30.8 to 93.3 points and the physical domain was the most affected in the WHOQOL-BREF. This study points out the young, working age profile of patients with traumatic BPI and the predominance of physical and functional deficits, even before the first specialized consultation.

Keywords | Brachial Plexus Neuropathies; Epidemiology; Traffic Accidents; Quality of Life.

RESUMO | Estudos que avaliem desfechos funcionais da lesão traumática de plexo braquial (LTPB) são necessários para um tratamento eficiente. Entretanto, são escassos, assim como estudos epidemiológicos, principalmente na região Nordeste do país. Assim, este estudo transversal objetivou identificar as principais limitações físicas e funcionais e os domínios da qualidade de vida de pacientes maiores de 18 anos com diagnóstico de LTPB, durante a primeira consulta em um ambulatório especializado. Informações sociodemográficas e clínicas foram registradas e os desfechos avaliados foram: força muscular, amplitude de movimento (ADM) e dor; funcionalidade e qualidade de vida avaliadas pelos questionários *Disabilities of the Arm, Shoulder and Hand* (DASH) e *World Health*

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Organization Quality of Life (WHOQOL-bref), respectivamente. Houve predomínio de homens (92%) com idade de 34±10,5 anos com lesão total de plexo (56%) e etiologia por acidente de moto (68%). A maioria da amostra era proveniente do interior do estado de Pernambuco (52%), apresentava dor neuropática (87%) e restrições de ADM. O escore DASH variou de 30,8 a 93,3 pontos, e o domínio físico foi o mais afetado no WHOQOL-bref. Este estudo aponta o perfil jovem em idade produtiva de pacientes com LTPB e o predomínio de déficits físicos e funcionais significativos na primeira consulta especializada.

Descritores | Neuropatias do Plexo Braquial; Epidemiologia; Acidentes de Trânsito; Qualidade de Vida.

RESUMEN | Se necesitan estudios que evalúen los resultados funcionales de la lesión traumática del plexo braquial (LTPB) para un tratamiento eficiente. Sin embargo, son escasos, así como los estudios epidemiológicos, principalmente en la región Nordeste del país. Así, este estudio transversal tuvo el objetivo de identificar las principales limitaciones físicas y funcionales y los dominios de la calidad de vida de pacientes con más de 18 años diagnosticados con LTPB, durante la primera consulta en una clínica ambulatoria especializada. Se registraron informaciones sociodemográficas y clínicas y los resultados evaluados fueron: fuerza muscular, rango de movimiento (ROM) y dolor; funcionalidad y calidad de vida evaluadas a través de los cuestionarios *Disabilities of the Arm, Shoulder and Hand* (DASH) y *World Health Organization Quality of Life* (WHOQOL-bref), respectivamente. Hubo predominio de hombres (el 92%) con edad de 34±10,5 años con lesión total del plexo (el 56%) y etiología por accidente de moto (el 68%). La mayoría de la muestra provino del interior del estado de Pernambuco (el 52%), presentaba dolor neuropático (el 87%) y restricciones de ROM. La puntuación DASH osciló entre 30,8 y 93,3 puntos, y el dominio físico fue el más afectado en el WHOQOL-bref. Este estudio destaca el perfil joven en edad productiva de pacientes con LTPB y el predominio de déficits físicos y funcionales significativos en la primera consulta especializada.

Palabras clave | Neuropatías del Plexo Braquial; Epidemiología; Accidentes de Tráfico; Calidad de Vida.

INTRODUCTION

Traumatic brachial plexus injuries (BPI) are severe and limiting nerve injuries that affect the upper limb, whose repercussions also affect functional, emotional, and social aspects of the individual[1-3]. Young, healthy, and economically active men are the most affected by this type of injury, mainly due to traffic accidents involving motorcycles[4-6].

The clinical picture is variable and may have total or partial involvement of the limb, whose severity and prognosis are associated with individualized factors, such as location, mechanism, and type of lesion[7,8]. The reduction in quality of life and incapacity for work resulting from traumatic BPI have a serious socioeconomic impact on patients and society, since recovery can require surgeries and years of rehabilitation to achieve satisfactory functional results, often below expectations[9,10].

In this context, in recent years, functional, emotional, and quality of life aspects have been incorporated as important factors in the evaluation of patients who suffered traumatic BPI[1,3,11,12]. Most studies use these parameters only to evaluate the patient's recovery after surgical intervention; however, these losses already interfere in the lives of individuals from the moment of injury and should become part of the routine evaluation[10].

In addition, long delays in surgical or conservative treatment may compromise the recovery of these patients. Studies show worse scores of functionality and quality of life in patients who started treatment or surgical intervention more than six months late[1,3,10]. This is a very worrying data, considering the Brazilian reality in which there are long time intervals between trauma and the first consultation, as well as between the first consultation and surgery[5,6,13,14].

Considering the delay in diagnosis and specialized care in the public health service and the relevance of an efficient initial management for a better prognosis, this study aimed to describe the main physical and functional limitations and the domains of quality of life of individuals who suffered traumatic BPI, comparing the results according to the level of the lesion at the time of their first specialized consultation. In addition, this will be the first study to present sociodemographic and clinical information on this type of injury in Northeastern Brazil.

METHODOLOGY

Design and location

This is a cross-sectional study carried out at the Peripheral Nerve Neurosurgery Outpatient Clinic of

the Hospital da Restauração in Recife, Pernambuco, from November 2018 to November 2019. This hospital is a reference in the state for cases of traffic accidents and emergency care for multiple traumas and neurosurgery.

Population and sample criteria

Individuals over 18 years of age, of both sexes, who started specialized care at the referred outpatient clinic and received the clinical diagnosis of traumatic BPI (ICD-10 S14.3 Brachial plexus trauma) during the study period were included. The sample was defined by convenience. Patients already submitted to surgical intervention were excluded.

Data collection and ethical aspects

This study is in accordance with Resolution No. 466, of December 12, 2012, of the National Health Council. Data collection and evaluations were performed at the outpatient clinic; each patient was evaluated at a single time and there was no follow-up of the sample. All evaluations were performed by two previously trained researchers.

A standardized form was used to record sociodemographic information and aspects related to the lesion. Primary outcomes, functionality, and quality of life were analyzed using the Disabilities of the Arm, Shoulder and Hand (DASH)[15] and World Health Organization Quality of Life (WHOQOL-BREF)[16]questionnaires. Pain intensity was measured by the Numerical Pain Scale (NDS)[17] and the presence of neuropathic pain was identified by Douleur neuropathique 4 questions (DN4)[18].

The physical evaluation included (1) passive range of motion (ROM) and (2) degree of muscle strength of the affected upper limb, the results of which were compared with the non-affected limb. Passive ROM was assessed with a goniometer and classified as limited or normal from the goniometry reference values[19]. For shoulder flexion and abduction movements, we consider a ROM below 90° as a limited movement. Muscle strength was assessed using the Medical Research Council (MRC) muscle strength manual[20]. The patient remained seated with his feet supported during the shoulder and elbow evaluation, and kept his forearm resting on a table, leaving his hand free to evaluate wrist movements. Shoulder flexion movement was assessed in the supine posture to minimize offsets. Muscle strength limitation was considered a degree of strength less than three by the MRC[3] scale.

Patients who did not have a sufficient degree of understanding to be able to complete the questionnaires performed only the physical evaluation, but were not excluded from the research. The sample was divided into two groups according to the level of the lesion—partial and total.

Data treatment and analysis

Data were tabulated in Microsoft Excel 2013 software and analyzed in SPSS version 20.0. Descriptive statistics were presented in absolute and relative frequency, mean and standard deviation. For the comparison between the total and partial lesion groups, the Student's t-test was used for the analysis of parametric data and the Mann-Whitney test for non-parametric data. Spearman's correlation was used to compare continuous variables. A p-value≤0.05 was considered significant.

RESULTS

During the 12-month period, approximately 88 adult patients with traumatic BPI were seen at the outpatient clinic; of these, 30 were potentially eligible and were approached for screening. The final sample consisted of 25 patients (two women), with a 34±10.5 years mean age (ranging from 19 to 55 years). The dominant limb was the most affected (66.7%), and 14 (56%) patients had total brachial plexus injury. Except for one patient, all of them worked before the trauma (95.8%), with the majority being the main provider in the family (62.5%), and only two (8.3%) continued working after the injury. Table 1 shows the characteristics of the study sample.

Table 1. Characterization of the sample of 25 patients with traumatic brachial plexus injury. Hospital da Restauração, Pernambuco, Brazil; 2018—2019

Parameter	N	%
Sex		
Male	23	92.0
Female	2	8.0
Age group (years)		
18–25	7	28.0
26–35	6	24.0
36–45	9	36.0
46–55	3	12.0
Education Level		
Illiterate	4	16.0
Elementary School	5	20.0
Middle School	5	20.0
High School	6	24.0
Higher Education	3	12.0

(continues)

Table 1. Continuation

Parameter	N	%
Family Income (in minimum wage); n=23/25*		
<1	6	24.0
1	9	36.0
1 to 3	6	24.0
4 or more	2	8.0
Origin		
Metropolitan Area of Recife	9	36.0
State countryside	13	52.0
Other states	3	12.0

n=number of participants; *two participants refused to answer.

The main etiology of trauma was motorcycle accident (68%), followed by firearm injury (12%) and fall (12%), and automobile accident (8%). However, comparing between the groups, motorcycle accident was the cause of almost all total plexus injuries (92.9%), with the exception of one patient. The time between the occurrence of the injury and the care by the specialist physician ranged from seven to 393 days (79.7±83.3 days mean). Fifteen patients (60%) were not undergoing physical therapy. Of the 11 patients with partial injury, six (54.5%) had greater involvement of the upper trunk, two (18.2%) of the middle and lower trunks, one patient (9.1%) upper and middle trunks, one (9.1%) lower trunk alone and the other infraclavicular lesion (9.1%).

Table 2 shows the results of the physical evaluation of the patients according to the level of total and partial injury. More than 60% (8/13) of patients with total injury had passive ROM limitation in the external rotation movement of the shoulder and 46.2% (6/13) in the shoulder abduction and elbow flexion movements.

In relation to patients with partial injury, more than half (54.5%) presented passive ROM limitation in the movements of external rotation of the shoulder and wrist flexion. Elbow flexor and shoulder external rotator muscles were weak in 9/11 and 8/11 individuals, respectively, followed by the shoulder flexor muscles which were also weak in more than 60% of this population (Table 2).

Table 2. Limitations of range of motion and muscle strength of 24/25 patients with traumatic brachial plexus injury according to the level of the injury. Hospital da Restauração, Pernambuco, Brazil; 2018—2019

Joint movement (goniometry reference values)	Total lesion n=13* (%)				Partial lesion n=11 (%)			
	Passive range of motion		Muscle strength		Passive range of motion		Muscle strength	
	normal	limited	<3	>3	normal	limited	<3	>3
Shoulder								
Flexion (≥90°)**	10 (76.9)	3 (23.1)	13 (100)	0 (0)	8 (72.7)	3 (27.3)	7 (63.6)	4 (36.4)
Hyperextension (≥45°)	11 (84.6)	2 (15.4)	13 (100)	0 (0)	8 (72.7)	3 (27.3)	1 (9.1)	10 (90.9)
Abduction (≥90°)**	7 (53.8)	6 (46.2)	12 (92.3)	1 (7.7)	7 (63.6)	4 (36.4)	5 (45.5)	6 (54.5)
Internal Rotation (≥90°)	10 (76.9)	3 (23.1)	12 (92.3)	1 (7.7)	10 (90.9)	1 (9.1)	2 (18.2)	9 (81.8)
External Rotation (≥90°)	5 (38.5)	8 (61.5)	12 (92.3)	1 (7.7)	5 (45.5)	6 (54.5)	8 (72.7)	3 (27.3)
Elbow								
Flexion (≥145°)	8 (61.5)	5 (38.5)	13 (100)	0 (0)	9 (81.8)	2 (18.2)	9 (81.8)	2 (18.2)
Extension (≥145°)	13 (100)	0 (0)	13 (100)	0 (0)	10 (90.9)	1 (9.1)	3 (27.3)	8 (72.7)
Pronation (≥90°)	13 (100)	0 (0)	12 (92.3)	1 (7.7)	13 (100)	0 (0)	1 (9.1)	10 (90.9)
Supination (≥90°)	12 (92.3)	1 (7.7)	13 (100)	0 (0)	8 (72.7)	3 (27.3)	3 (27.3)	8 (72.7)
Wrist								
Flexion (≥90°)**	7 (53.8)	6 (46.2)	12 (92.3)	1 (7.7)	5 (45.5)	6 (54.5)	1 (9.1)	10 (90.9)
Extension (≥70°)	10 (76.9)	3 (23.1)	13 (100)	0 (0)	6 (54.5)	5 (45.5)	2 (18.2)	9 (81.8)
Radial deviation (≥20°)	9 (69.2)	4 (30.8)	12 (92.3)	1 (7.7)	7 (63.6)	4 (36.4)	2 (18.2)	9 (81.8)
Ulnar deviation (≥45°)	8 (61.5)	5 (38.5)	12 (92.3)	1 (7.7)	6 (54.5)	5 (45.5)	3 (27.3)	8 (72.7)

*One patient could not be evaluated; **For shoulder flexion and abduction movements, we considered ROM below 90° as a limited movement.

Regarding pain assessment, the intensity ranged from 0 to 10 in both groups, with 4.8±4.1 and 5.2±2.9 mean values for patients with partial and total injuries, respectively. In total, 20 patients (87.0%) had neuropathic pain, 8/10 patients with partial injury and 12/13 with total injury.

The function score ranged from 30.8 to 93.3, with a 63.2±15.7 points mean. Figure 1 shows the comparison of DASH results according to the level of the injury, demonstrating that the groups were similar to each other.

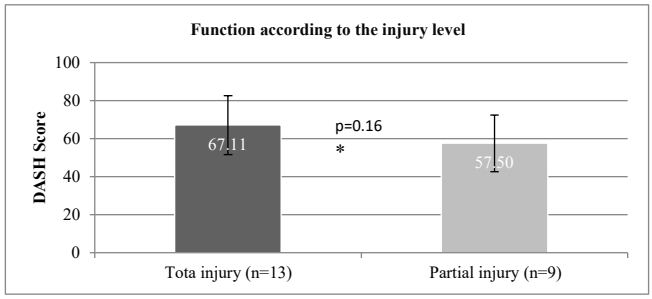

Figure 1 — Comparison of DASH score of 22/25 patients with traumatic brachial plexus injury. Hospital da Restauração, Pernambuco, Brazil; 2018—2019

Three patients could not answer the questionnaire; *t-test.

Regarding the assessment of quality of life, the physical domain (PD) was the most affected, with a 10.0±2.1 mean. There was no difference in any of the WHOQOL-bref domains in the comparison between the partial and total injurt groups (Figure 2).

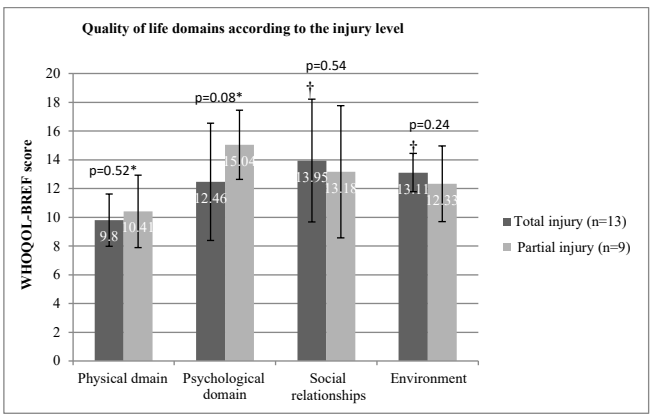

Figure 2 — Comparison of WHOQOL-BREF scores of 22/25 patients with traumatic brachial plexus injury. Hospital da Restauração, Pernambuco, Brazil; 2018—2019

Three patients could not answer the questionnaire; *t-test; † Mann Whitney.

There was no correlation between physical assessment results and functional outcomes (DASH and WHOQOL-BREF), as well as the time between injury and the first visit and whether the affected limb was the dominant limb.

DISCUSSION

This study allowed for the identification of socioeconomic and demographic characteristics, as well as main physical limitations and functional deficits of patients diagnosed with traumatic BPI, treated consecutively over a period of one year, in a reference outpatient clinic for peripheral nerve injuries in a public health service in Pernambuco.

Socioeconomic and demographic aspects

The sample consisted mostly of men (92%), in line with the world[4] and Brazilian literature[2,5,6,14]. The patients' mean age confirms the young profile of the population affected; nonetheless, when analyzing frequency by age group, there was a prevalence of adults older than 30, which differs from epidemiological studies conducted in Minas Gerais[5], the Federal District[13], São Paulo[6], and Rio de Janeiro[21].

As for the level of education, most patients had completed high school. On the other hand, a considerable number of adults completed only Elementary School or were illiterate (16%), corroborating the profile of those affected by motorcycle accidents in Pernambuco[22]. Oliveira and collaborators[5] found 48.9% of their sample with a profile similar to ours and point to a relationship between this result and the predominance of professions involving manual activities, such as general services and agriculture. Data on the education level of patients with traumatic BPI are scarce in the literature, although they are important to provide information such as prognosis and treatment options in an adequate way and compatible with the educational level of the affected individuals, as well as to outline prevention strategies.

More than half of the patients came from the countryside of the state, a fact also observed in a reference outpatient setting in Minas Gerais[5]. This may be related to the very nature of the hospital—a reference in trauma in the state—, but it also denotes a failure to decentralize the public health service and the lack of specialized services in smaller cities[5]. In another study, conducted in Goiás[2], most patients came from the capital, but the sample consisted only of patients who underwent surgery.

Approximately 95% of the sample worked before suffering the injury, mainly with manual occupations similar to that found in other studies[2,5,12]; and 60% had a family income of one minimum wage or less, compatible with the activities identified and with the profile of motorcycle accidents in the state[22]. Most were the provider of their residence and almost all did not work after the trauma, demonstrating a socioeconomic loss for the patient and their families, a relevant fact when considering the difficulty of reintegration into the labor market of those whose occupations require physical effort[2].

Motorcycle accidents accounted for 68% of traumas, a percentile very similar to that found in the world literature[4] and in national studies[2,5,21]. Higher rates,

73% and 79%, were found in studies carried out in São Paulo[6,14] which, according to the *2019 Motorcycles and Mopeds Report*[23], is the Brazilian state that leads the ranking of motorcycle accidents and compensation paid. The Northeast is the region with the most victims compensated by the Mandatory Insurance for the Protection of Victims of Traffic Accidents (DPVAT), and Pernambuco is the seventh Brazilian state with the highest number of disability payments and the ninth considering medical expenses.

The problem of motorcycle accidents is even more evident when we observe that this was the cause of more than 90% of cases of total injury (13/14), the most serious of the plexus, in this research. In 2018, 70% of motorcycle accidents resulted in some type of disability for drivers, in which 78% were men and the most affected age group was 18 to 34 years[23].

The time between the occurrence of trauma and specialized medical care varied greatly, most (76%) arrived at the outpatient clinic up to 90 days after the accident and no significant relationship was found between time and functionality and quality of life in this first care. Despite this, in this period, many patients already showed important ROM limitations and 60% were not undergoing physical therapy, which is essential in the rehabilitation process, regardless of whether the choice was for conservative or surgical treatment[24]. This reinforces that the sooner the patient is referred to the specialized service, the faster they will be informed and directed to appropriate treatment, which can minimize limitations.

More than half of the sample suffered total or complete plexus injury, this percentile ranged from 33% to 64.6% in the literature[2,4,6,13]. Among the partial lesions, there was a predominance of involvement in the upper trunk, in line with the literature[4,6,14].

Physical limitations

The physical aspects evaluated, passive ROM and muscle strength, revealed important deficits not only as a consequence of the injury, but also of the disuse and lack of rehabilitation of the affected limb in both groups. Most individuals already had some limitation in the passive ROM of external rotation of the shoulder, and approximately half of the sample in the movements of shoulder abduction and wrist flexion, which indicates that only the period between the injury and the first specialized consultation was enough to cause muscle shortening and joint limitations.

Limb inactivity and lack of passive mobilization are aggravating factors that are related to the absence of adequate physiotherapeutic guidance and the prolonged use of sling-type orthoses. Orthoses are recommended to improve limb positioning and relieve pain, especially in cases of shoulder subluxation, providing greater safety and comfort to the patient[25,26]. However, preference should be given to models that provide support to the glenohumeral joint without restricting other joint movements of the elbow and wrist, when possible, and the patient should be advised about the length of stay with the limb immobilized.

Regarding the muscle strength of patients with partial injury, most were not able to flex the elbow, nor flex and externally rotate the shoulder against gravity, essential movements to perform most daily activities with the upper limb. Despite this, there was no significant correlation between the physical aspects evaluated and the functional results in both groups.

Another limiting factor of movement to be considered is the presence of pain. Some patients did not move the limb to avoid feeling pain, which generates a vicious cycle of rest, muscle atrophy, contractures and, consequently, more pain. In general, the pain reported by patients was of moderate intensity, a fact also observed in the initial evaluation of another study[2], and did not influence the DASH and WHOQOL-BREF scores, as well as the presence of neuropathic pain. However, in the long term, pain intensity may be an important predictor of disability for these patients[27]. Studies[10,27] have shown that patients with traumatic BPI have more pain and disability than patients with other peripheral nerve injuries. In addition, pain was also a significant predictor of work disability and physical health[10].

Individuals with traumatic BPI may experience disabling neuropathic pain[8] that tends to be chronic, with stronger cognitive modulation than nociceptive, and this is associated with impaired quality of life, but still poorly evaluated in this population[28]. Neuropathic pain was present in more than 80% of the sample, according to the DN4 questionnaire, and in 71% of another Brazilian study[13]. This high prevalence demonstrates that not only the intensity, but the characteristics of pain should also be investigated[8], and in this context, neuropathic pain needs to be emphasized both in the clinic and in future research[10,28].

Function and quality of life

In general, the study population had low upper limb function. The highest DASH scores indicating worse upper

limb disability were found in patients with total injury; however, these results were not statistically significant. Even in the long term, after surgery, the location of the lesion does not seem to interfere with the functional results of the patient[3]. There were also no differences regarding limb dominance and time of injury. However, studies indicate that the DASH score was worse in patients who took more than six months to undergo surgery[1,3].

Unlike the findings in the literature, this study aimed to evaluate the domains of quality of life of individuals already in the first specialized consultation and demonstrated that, at that time, there were no differences according to the level, time of injury, and whether the affected limb was the dominant one.

The worst scores according to the WHOQOL-BREF were in the physical and psychological domains. In a study with patients undergoing surgical intervention, the psychological domain was the most affected and statistically lower than in the normal population, together with the physical and environmental domains; factors such as age, injury to the dominant member, DASH score, emotional connection with the family, and family income influenced the quality of life[29]. Another study, which also used this assessment tool, demonstrated that 55% of the sample often presented some degree of moodiness, anxiety and depression[30].

These results reinforce that over time, the quality of life of individuals who have undergone traumatic BPI tends to continue to be impaired even after surgical treatment, and psychological and emotional aspects need to be taken into account since the beginning, along with the physical ones, since they are the most affected. Related factors already pointed out in the literature may be valuable to identify patients prone to low quality of life scores and explore these demands according to the initial evaluation, referring them appropriately for treatment with a psychologist, for example.

This study had some limitations. As it is a cross-sectional study, the results express the moment of evaluation. Injuries and associated trauma were not noted. Due to the profile of this population, some patients with low education were unable to respond to the assessment of functionality and quality of life because they did not present sufficient cognitive level for the compression of these questionnaires. However, this is a pioneering study in the Northeast region that demonstrates the importance of performing physical therapy from the beginning of the treatment of patients with traumatic BPI, presenting relevant contributions so that there is a more effective approach in preventing traffic accidents and improving the population's access to specialized health services.

CONCLUSION

From this study, it was possible to conclude that traumatic BPI decreases the functionality and quality of life of adult individuals affected regardless of the level of nerve impairment and the time of injury. The physical limitations of these patients can be aggravated by complications secondary to trauma, which in turn can be minimized with early and appropriate initial management. We reinforce the importance of including functional and quality of life aspects in the preoperative evaluation, as it enables the planning of a personalized and comprehensive treatment.

It is also noteworthy that the great social and economic impact on the lives of individuals and their families requires greater attention from the government to this type of injury, which must range from trauma awareness and prevention to adequate, systematized and multidisciplinary treatment for these patients.

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