Epidemiology of upper limb peripheral nerve injuries in the material collected in the Department of Orthopedics and Traumatology Medical University of Bialystok

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ABSTRACT

Introduction: Common etiologies of acute traumatic peripherial nerve injury include penetrating injury, crush, stretch, and ischemia.
Purpose: This paper reports an epidemiological and clinical study of patients with peripheral nerve injuries who were treated for upper limb trauma, which included nerve injury, surgically treated in the Department of Orthopedics University Hospital in Bialystok, in the years 1997-2007.
Materials and methods: A total of 202 patients with injury to the median, ulnar and radial nerves were involved in the study. Based on the medical history concerning day care and inpatient hospitalization, surgery books data and the analysis of medical histories, the data referring to the nerve trauma were analyzed.
Results: The data allowed a reliable assessment of the population of patients with upper limb nerve injury and methods of treatment, as well as quantitative presentation of the methods of repair and reconstruction of the damaged nerve stem.
Conclusions: In the Department of Orthopedics, Medical University of Bialystok, in the years 1997-2007 delayed nerve injuries were more frequently treated than the immediate ones. Surgical treatment of nerve injuries most frequently used primary suture and cable grafting reconstructions. Secondary epineural suture of the nerve was performed more rarely. Autogenic nerve graft segments were most frequently collected from the ulnar nerve of the lower extremity. The medial antebrachial cutaneous nerve grafting was much seldom performed.
Key words: epidemiology, wounds, injuries, upper extremity, ulnar nerve, median nerve, radial nerve

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INTRODUCTION

In highly developed societies, most daily activities require capable hands. Therefore, upper limb injuries can cause substantial problems for people at all ages. Treatment of these injuries is essential as this motor organ is most frequently affected. The upper limb is a complex anatomical structure. Many structures that significantly determine its function can be found in a relatively small capacity. Due to this specific anatomical structure, the trauma frequently leads to multi-tissue injuries affecting many important structures, including nerves. These injuries constitute one of the most difficult problems of the upper limb surgery and frequently cause disability. Thus, their proper diagnosis and treatment are extremely important.

Many authors agree that primary reconstructions of all injured structures should be undertaken whenever conditions allow [1-5]. Pathological healing of damaged non-reconstructed tissues disturbs significantly the process of healing of the reconstructed components [5-7]. Moreover, the repairs of bones, nerves, skin and ligaments is frequently more difficult, as compared to the non-reconstruction primary procedures and require extensive surgeries [7-10]. Since traumatic injuries to the upper limb peripheral nerves lead to a significant disability of patients, the treatment has to follow the commonly accepted standards. Even if the nerve is precisely sutured (or reconstructed) it will never regain its full function [1,2,5,7,11].

The material collected at the Department of Orthopedics and Traumatology, Medical University of Bialystok, on the treatment of multi-tissue upper limb trauma (including nerves) is extensive. It has been frequently presented at various national and international conferences [12-17]. Data published in the available literature and those presented at conferences have usually referred to the guidelines for the management of patients and surgical techniques applied in various clinical situations [1, 2,4,5, 8,18]. Epidemiology of trauma has been much less discussed. Published data from our clinic on the population of injured patients, their age and gender are scarce [12-17]. Too little attention has been paid to the mechanisms that lead to the peripheral nerve damage, the most common site of injury, the number of performed immediate repairs and reconstructions of damaged nerve stems, and the most common methods of injured nerve management. Therefore the main study objective was the analysis of:

1. The human population with upper limb peripheral nerve trauma.
2. Types of injuries and their incidence rate, leading to nerve dysfunction.
3. Surgical methods of treatment of patients with peripheral nerve trauma.
4. Injuries accompanying injuries to the median, ulnar and radial nerves.
5. Total number of injuries to the respective nerves treated surgically in the Department of Orthopedics in the years 1997-2007.

MATERIALS AND METHODS

The study analyzed 202 patients treated surgically in the Department of Orthopedics and Traumatology, Medical University of Bialystok, in the years 1997-2007 due to the upper limb peripheral nerve injury. Data referring to injuries affecting the major nerves of the upper limb, i.e. median, ulnar and radial nerves, were analyzed based on the medical history of day care and inpatient hospitalization, data obtained from surgery books and the analysis of medical histories from the Orthopedic Outpatient Department. Patients who sustained injuries to terminal sensory cutaneous branches of the nerves, e.g. digital nerves (accounting for a considerable percentage of surgically treated patients with peripheral nerve trauma) were excluded from the study.

RESULTS

Among the 202 operated patients, 97(48%) had median nerve damage, in 91(45%) the ulnar nerve was injured and 14(7%) had radial nerve injury. The largest number of injuries were noted in the group of patients aged 31-50 (45%). Those under 30 accounted for 43% of the total number of patients. Nerve traumas were the least frequent in patients over 51(12% of the total number of patients). The under 30 age group included: 39 patients with median nerve injury, 36 with ulnar nerve injury and 11 with radial nerve damage; the 31-50 group of patients consisted of 43 median nerve trauma, 46 with ulnar nerve trauma and 3 with radial nerve injury. The over-51-age group presented 15 patients with median nerve trauma and 9 with ulnar nerve trauma.

Most injuries were reported by men (182 cases, i.e. 90% of the total number of patients). Women accounted for 10% of patients (20 altogether). In the group of study patients, median nerve injuries were present in 90 men and 7 women, the ulnar nerve injuries were found in 81 men and 10 women, whereas the radial nerve was affected in 11 men and 3 women. In the group of women, ulnar nerve injuries were most frequent (50% of all nerve injuries in this group). The median nerve was injured in 35% and radial nerve in 15% of the total number of women. In the analyzed group of men, the number of injuries to the median nerves differed by 4% from that of ulnar nerve injuries (the former accounted for 49% and the latter for 45% of all nerve injuries in this group). Trauma to the radial nerve was uncommon, accounting for 6% of all nerve injuries in the group of men (Table 1).

Table 1. The number of injuries to the peripheral nerves of the upper limb in relation to the age and sex of the patients

Nerve	No of injuries	Age (years)			Sex	
		< 30	31-50	> 51	Women	Men
Median	97	39	43	15	7	90
Ulnar	91	36	46	9	10	81
Radial	14	11	3	0	3	11
Total	202	86	92	24	20	182

In the analyzed group of 202 patients, 53% of all traumas involved nerves of the upper limb and 47% of the left limb. The median nerve injuries were diagnosed in 49 patients with the right upper limb (RUL) injury vs. 48 patients with the left upper limb injury (LUL). The ulnar nerve damage was found in 55 patients with the affected RUL and 36 with LUL, whereas radial nerve injuries were found in 4 PUL and 10 LUL patients. In the analyzed group of patients, 53% of injuries were treated as delayed and 47% as immediate cases. The median nerve injury cases were treated primarily in 51 patients (immediate injuries), whereas in 46 patients the median nerve was reconstructed later as a secondary procedure (delayed injuries). Of the ulnar nerve injuries, primary suture was performed in 42 cases (immediate damage), whereas secondary suture in 49 cases (delayed damage). Of the patients with radial nerve trauma, two had primary nerve suture and in 12 nerve reconstruction was performed (delayed damage). Overall, of all the patients undergoing primary suture, 54% had median nerve injury, 44% experienced ulnar nerve injury and only 2% had radial nerve trauma. In the group of patients who underwent secondary (delayed) nerve repair, 46% of the total number of the study patients had ulnar nerve injury, 43% median nerve injury and 11% - radial nerve trauma.

In the analyzed material most nerve injuries were due to cuts (72% of the total number), fewer were caused by lacerations (27%). Bone fracture caused nerve damage only in one case, which required primary surgical treatment (cut, 1%). Of all the study patients with cuts, 39 sustained trauma to the median nerve, 28 to the ulnar nerve and only in one case the radial nerve was affected. Laceration was the cause of injury to the median nerve in 12 patients, of the ulnar nerve in 14 and none had radial nerve injury. In one case bone fracture led to trauma that required primary suture of the radial nerve as an immediate injury. Over a half (58%) of the cuts affected the median nerve, 41% the ulnar nerve and only 1% the radial nerve. Due to lacerations, 54% of patients had ulnar nerve damage, 46% experienced median nerve damage and none had radial nerve injury. Only one radial nerve damage was caused by bone fracture (Table 2).

Table 2. The number of immediate and delayed repairs depending on the type of nerve, mechanism of immediate nerve injury and the site of injury

Nerve	Limb		Repair		Nerve injury			Site of injury			
	Right upper limb	Left upper limb	Immediate	Past	Cut wound	Laceration	Due to bone fracture	Wrist	Forearm	Ulnar joint region	Arm
Median	49	48	51	46	39	12	0	48	46	3	0
Ulnar	55	36	42	49	28	14	0	34	55	1	1
Radial	4	10	2	12	1	0	1	0	4	5	5
Total	108	94	95	107	68	26	1	82	105	9	6

Among all nerve injuries, the forearm was the most frequently affected site (52%), followed by the wrist (41%), the elbow (4%) and the arm (3%). At the wrist there were 48 injuries to the median nerve and 34 to the ulnar nerve. The forearm showed 46 injuries to the median nerve, 55 to the ulnar nerve and 4 to the radial nerve. At the level of the elbow, 3 median, 1 ulnar and 5 radial nerve injury cases were noted. Of all the wrist injuries, 59% referred to the median nerve and 41% to the ulnar one. Among all the forearm injuries, 52% affected the ulnar nerve, 44% the median nerve and 4% the radial nerve. At the elbow, radial nerve injury was the most common (56%), followed by median nerve damage (33%) and ulnar nerve damage (11%). Injuries affecting the arm involved mainly the radial nerve (83%). The ulnar nerve damage accounted for 17% of all the injuries.

In 46% of all the cases only one nerve was injured, in 24% - nerve injury was accompanied by damage to flexor or extensor tendons, in 10% also other nerves (two or three altogether) were injured, together with tendons and arteries (one or two). In 9% of the cases only the second nerve was injured, and also 9% of the victims had one nerve, tendons

and arteries injured. In 2% of the cases, patients underwent limb amputation and replantation, whereas bone fracture was noted only in one case (not presented as the percentage value).

Among the cases of only one nerve injury, 35 involved median nerve, 43 ulnar nerve, 12 radial nerve; damage to tendons accompanied 32 median nerve and 17 ulnar nerve injuries. The cases in which also the second nerve or both were injured involved trauma to the median nerve (8), ulnar nerve (9) and radial nerve (1). When also other structures were affected (one or two nerves, flexor or/and extensor tendons, one or two arteries), trauma was found in 13 median nerves and 8 ulnar nerves. The injury affecting one nerve, tendons and arteries involved 5 median nerves and 13 ulnar nerves. After limb amputation and transplantation, nerve reconstruction was performed in 4 cases of the median nerve and in one case of the ulnar nerve. Immediate reconstruction of the nerve accompanied by bone fracture was performed only in one case.

The involvement of one nerve was noted in 48% of the total number of ulnar nerve injuries, in 39% of the median nerve damage and in 13% of the radial nerve injury. Damage to tendons was more common in the median nerve injury (65% of cases) as compared to the ulnar nerve (35%). The ulnar nerve damage accounted for 50%, median nerve injury for 44%, and radial nerve injury for 6% of the traumas accompanied by another nerve injury. As many as 62% of these injuries affected the median nerve, 38% - the ulnar nerve. Ulnar nerve injuries accounted for 72% and median nerve injuries for 28% of this type of trauma.

Reconstructions of the median nerve referred to 80%, whereas of the ulnar nerve to 20% of all reconstructions done. In 48% of cases the treatment involved primary suture, 27% of patients had nerve reconstruction by autogenic graft (cable), in 19% of cases secondary suture was performed and in 6% nerve neurolysis was done. After nerve damage, primary suture was performed in 52 patients with median nerve trauma, 42 with ulnar nerve injury and in 3 patients with radial nerve damage. Secondary suture was done in 16 patients with median nerve damage, in 20 with ulnar nerve damage and in 2 with radial nerve injury. Nerve neurolysis was performed in 3 cases of median nerve injury, in 3 patients with ulnar nerve injury and in 7 with radial nerve injury. Primary suture was performed in 54% of median nerve injury cases, in 43% of ulnar nerve injury cases and in 3% of the radial ones. Secondary suture was performed in 53% of the ulnar, 42% of the median and 5% of the radial nerve injury cases. Cable grafts were conducted in 48% of the median and ulnar and 4% of the radial nerve injury cases. Nerve neurolysis was done in 54% of patients after trauma to the radial nerve, in 23% after median nerve injury and in 23% after ulnar nerve damage.

In 85% of cases, nerve graft was collected from the sural nerve, in 9% from the medial nerve and in 6% of the patients the pedicle graft of the ulnar nerve was performed. The sural nerve was used for the reconstruction of 22 median nerves, 22 ulnar nerves and 2 radial nerves. The pedicle graft of the ulnar nerve was used to reconstruct 3 median nerves, whereas the medial antebrachial nerve was used in one reconstruction of the median nerve and in 4 reconstructions of the ulnar nerve. The sural nerve was used to reconstruct the median nerve in 48% of cases and in the same proportion for the ulnar nerve (48%). In 4 cases the sural nerve was used for secondary reconstruction of the radial nerve. The cutaneous medial nerve of the forearm was used for the reconstruction of the ulnar nerve in 80% of cases, and of the median nerve in 20% of cases (Table 3).

Table 3. Types of anatomical structure damage, method of nerve treatment and site of nerve graft collection

Nerve	**Anatomical structure damage**							**Treatment**				**Graft collection**		
	Only 1	N+Tendon	N+N	N+N+Tendons+ Arteries	N+Tendons + Arteries	Amputation + Replantatio	Bone fractures	Primary suture	Secondary suture	Autogenic graft	Neurolysis	Surnal nerve	Pedicle graft of the ulnar nerve	Medial nerve of the forearm
Median	35	32	8	13	5	4	0	52	16	26	3	22	3	1
Ulnar	43	17	9	8	13	1	0	42	20	26	3	22	0	4
Radial	12	0	1	0	0	0	1	3	2	2	7	2	0	0
Total	90	49	18	21	18	5	1	97	38	54	13	46	3	5

DISCUSSION

In the current study, the clinical material concerning patients with upper limb nerve injuries treated surgically in the Department of Orthopedics in the years 1997-2007 was analyzed retrospectively based on medical histories of day care and in-patient hospitalization, surgery books and medical documentation from the outpatient clinic.

The material involved 202 patients with injuries to the median, ulnar and radial nerves. Most

patients sustained injury to the median nerve (97 patients) or ulnar nerve (91 patients). Patients with the radial nerve damage were in minority (14 patients). The large number of surgical procedures performed to treat injuries to the nerves that are crucial for the functioning of the upper limb can be explained by the agricultural character of the Podlasie region and by inadequate protection of machines causing severe damage to the upper limbs. The considerably smaller number of radial nerve injuries as compared to the ulnar and median nerves can be associated with the more proximal course of the radial nerve stem. This nerve branches terminally already in one third of the proximal forearm, whereas the ulnar and median nerves divide ultimately at the wrist and in one-third of the proximal segment of the arm. At the level of the wrist run the terminal mobile radial nerve (posterior interosseous nerve) and its terminal sensory branches, which are not functionally important for the nerves of the hand.

Injury to the sensory branch of the radial nerve at the wrist can lead ”only” to a painful neuroma, just like cutting of the posterior interosseous nerve at the wrist will cause local hyperesthesia on touching. It is not the same with the ulnar and median nerves. The former divides ultimately into the sensory branch and the motor branch at the level of the pisiform bone. Injury to the ulnar nerve at that site threatens with considerable invalidity of a patient caused by denervation of the majority of internal muscles of the hand (lumbricals and interosseous muscles of the hand). Injury to the median nerve at the wrist or at the base of the metacarpus can damage the motor branch of this nerve and consequently cause denervation of the thenar eminence with the resulting improper position of the thumb in relation to the remaining fingers. Trauma to the median nerve at the wrist with cutting of the nerve stem leads to the loss of superficial sensation in the palmar aspect of the hand.

The number of patients with peripheral nerve injury was comparable to the number of patients reported from other centers that specialize in upper limb surgery. Baczkowski [7] analyzed the clinical material from Department of Orthopedics, Medical Academy of Gdansk (years 1966-1987). Within that period (20 years), orthopedic surgeons in Gdansk repaired 465 injuries to upper limb peripheral nerves. However, in that number Baczkowski included minor injuries to fine digital cutaneous nerves, which increased the total number of surgical procedures.

In the own clinical material, nerve injuries were most common in young and middle-aged people (age groups 31-50 years and up to 30). This is a typical distribution of upper limb injuries, which mostly affect the working population. Not surprisingly, nerve injuries were ninefold more common in the male population. Traumas to the upper limbs with accompanying injuries of deeply lying nerves are more frequent in the industrial regions in male physical workers than in women.

The analysis of the clinical material showed that women more frequently sustained injuries to the ulnar nerve (in 50% of the study material), and then to the median nerve (35%). The situation was different in the group of men, where the median nerve injuries were the most common (49%), followed by the ulnar nerve damage (45%).

Median nerve injuries affected the right and left upper limb with the same frequency (49 and 48 cases, respectively). The ulnar nerve injuries were more common in the right upper limb (55 cases), as compared to the left upper limb (36 cases). The radial nerve was by far more frequently damaged in the left (10 patients) than in the right upper limb. Considering the fact that the study material did not include any information whether the patients were right- or left-handed, it is difficult to draw any conclusions here.

The higher incidence of ulnar nerve injuries in the right upper limb can be explained by the fact that the majority of patients are right-handed, so when they work, the ulnar edge of the upper limb (most frequently affected) is nearest to the operating machine. Also other authors who analyzed various upper limb injuries observed more frequent damage to the hands and wrist from the ulnar side [1,2,6-8].

The analysis of the own clinical material showed that delayed injuries to the upper limb nerves were more frequent than the immediate injuries (107 nerve reconstructions vs. 95, respectively). In the Department of Orthopedics and Traumatology orthopedic surgeons treat both immediate and delayed peripheral nerves injuries, also those managed previously in other surgical centers. Proper ultimate nerve management requires the use of microsurgical techniques which condition satisfactory regeneration of damaged nerves. Since microsurgical procedures are not performed in any of the general surgery centers in our region, the stumps of the cut nerve are brought together by a surgeon and ultimate nerve reconstruction is scheduled in the Department of Orthopedics. Hence, the high percentage of secondary procedures, exceeding that of primary nerve repairs in the Department of Orthopedics. It should be emphasized that the secondary management of the nerve 2-4 weeks after the sustained trauma is consistent with the generally accepted international standards in peripheral nerve surgery. After 2-3 weeks following peripheral nerve injury, the epineural sheath to the stumps thickens and thus injured nerve stem suture is technically easier and more satisfactory [19-22]. If the primary nerve injury was of laceration or contusion nature it is difficult to predict on the day of the injury which part of nerve will undergo scarring. In a patient subjected to secondary reconstructive procedure, the crushed part has already developed scarring and thus it is easier to

determine the level of stump resection to the limit of normal neural bundles.

The analysis of the median nerve to ulnar nerve repair ratio in immediate and delayed injuries showed no distinct differences. However, in the case of the radial nerve, delayed reconstructions predominated over the primary management. This fact can be explained by the most common mechanism and site of injury to this nerve (1/3 of the proximal forearm, or high injuries in humerus fractures). When lacerations of the radial nerves occur at 1/3 of the proximal forearm it is difficult to find the radial nerve stumps and thus the proportion of primary repairs is low. If this is the case, in the Department of Orthopedics, the stumps divided into proximal nerve bundles are implanted in the denervated muscle bellies. These procedures are called direct neuromuscular neurotization [12-14, 16,17]. In the case of radial nerve injury at the level of the arm (e.g. simple fracture of the humerus) there are no primary indications for early surgical treatment. Assuming that the majority of such injuries are the cases of neuropraxia, with a good prognosis for the nerve function, proper therapeutic management involves patient's observation in outpatient conditions and securing "the falling upper limb" with orthosis. In most cases, the nerve function returns to normal spontaneously 3-6 months after the trauma occurred.

In the study material, nerve injuries caused by cutting were predominant (72% of cases). Lacerations led to upper limb nerve injuries in 27% of cases. In the mechanism of the cut, the median nerve was more frequently injured (58 %) than the ulnar nerve (41%). Patients who sustained self-inflicted injuries increased the incidence rate of median nerve damage due to cutting. In such cases, the cut in the middle of the palmar surface of the wrist cuts the median nerve. The ulnar nerve hidden under the ulnar flexor of the wrist is more difficult to injure. Lacerations most frequently affected the ulnar nerve (54%), followed by the median nerve (46%). This injury frequency ratio can be explained by a close distance of the ulnar edge of the hand to the operating machine.

The analysis of the site of the most common nerve injuries showed that the ulnar and median nerves were frequently injured at the wrist and forearm. However, radial nerve injuries were predominant in the region of the ulnar articulation. These injuries accounted for 56% of all nerve injuries in this body region and exceeded the overall number of traumas to the ulnar and median nerves (44%). This can be explained by anatomical relations. The radial nerve, winding around the radius, lies relatively superficially, on the outer surface of the ulna, and therefore it is more at risk of injury than the median and ulnar nerves situated deeper in tissues and on the medial surface of the ulna.

At the level of the arm, the frequency rate of radial nerve injuries was even higher (83%), whereas the median and ulnar nerve injuries altogether were noted in 17% of cases. Nerve injury was frequently accompanied by damage to other structures: tendons, arteries or another nerve. The analysis of the study material showed that tendon injury most frequently occurred when the median nerve was damaged. As revealed by surgery protocols, this was most frequently the palmaris longus muscle tendon, which is short in diameter and lies just at the median nerve stem, close to the skin, on the palmar wrist surface. If the nerve injury was accompanied by tendon and artery damage, most frequently the ulnar nerve was affected. The analysis of the study material showed almost three times more frequent injury to the ulnar nerve than to the median nerve. Simultaneous damage to 3 structures at the wrist is rarely described in literature. The significance of that type of injury was emphasized by Puckett and Meyers in 1985, who defined it as *spaghetti wrist* [24].

Radical amputations of the upper limbs at the level of the forearm, the wrist and the metacarpus cause rupture of all the anatomical structures, i.e. bones, tendons, muscles and nerves. Such patients are as a rule excluded from the assessment of peripheral nerve regeneration due to exceptional nerve repair conditions. According to our study material, radical amputations of the upper limb involved reconstruction of the median nerve 4 times more frequently than of the ulnar nerve. This fact is absolutely clear when we consider the significance of the median nerve for hand sensation. Interestingly, in the Department of Orthopedics and Traumatology, there were no patients who underwent ulnar nerve replantation without median nerve suturing. Therefore, it can be assumed that in 25% of replantation cases, the two nerves were repaired at the same time.

In 48% of cases the treatment involved primary suture, 27% of patients had nerve reconstruction by autogenic graft (cable), in 19% of cases secondary suture was performed and in 6% nerve neurolysis was done. Depending on the time of nerve management, the surgical treatment of the peripheral nerve injury involves three techniques: primary suture, secondary suture (up to 3 weeks after injury) and free autogenic cutaneous nerve grafting [15]. Primary suture was the most common (48%) vs. secondary suture (19%). In total, the primary suture was applied in 67% of the reconstructed nerves. Injured nerves were reconstructed using cable grafts in 27% of cases. In the study group of patients, primary suture was more frequently applied to treat the median nerve, whereas secondary suture for the ulnar nerve. Secondary suture in the median and ulnar nerves should be used with caution. According to the analysis of the material from other hand surgery centers, not all microsurgeons

frequently use the secondary nerve suture technique [1-5,25]. Obviously, it ensures better conditions for the resection of damaged and scarred nerve stump endings. However, if the nerve loss exceeds 2 cm, then free autogenic nerve grafting should be performed to eliminate excessive tension on the suture line and create better conditions for the regeneration of nerve bundles [26,27]. In the Department of Orthopedics, orthopedic surgeons resecting scar tissue of the proximal stump and distal nerve (neuroma, glioma) sometimes used palmar-flexed wrist position to apply the lowest possible tension to the suture. Not always the functional results are satisfactory in these cases, since removing plaster of Paris that keeps the wrist in palmar-flexed position (after 3 weeks) must lead to excessive tension on the suture line, which the regenerating axons have already passed by. This is not indifferent for the nerve fibers [5-8,23,28]. The treatment of choice in the case of nerve loss exceeding 2-3 cm involves the use of free autogenic nerve grafts [15, 17,26,27,29,30]. In the material of our clinic, free autogenic grafts were applied in 48% of median and 48% of ulnar nerve injuries. Autogenic nerve graft segments are usually ”collected” from the sular nerve of the lower limb. The sular nerve cut into fragments joins damaged nerve stumps like a phone cable (hence the name”cable grafts”). Such grafts are purposely 15% longer than the nerve loss, thus decreasing tension on the suture line between grafts and damaged nerve stumps: proximal and distal. The greater length of the grafts is also associated with their postoperative retraction [26-28]. Cable grafts were most frequently obtained from the sular nerve (85%), and markedly more seldom from the medial cutaneous antebrachial nerve (9%). The medial cutaneous antebrachial nerve was 4 times more frequently used to reconstruct ulnar nerve damage than the sular nerve. It should be assumed that the loss of the ulnar nerve was not so extensive as that of the median nerve. The medial cutaneous antebrachial nerve is fourfold thinner than the sular nerve.

The analysis of medical documentation of patients with upper limb peripheral nerve injuries subjected to nerve reconstruction in the years 1997-2007 revealed no significant tendencies in the number of surgical procedures. Differences between various types and severity of nerve damage are sometimes possible to determine only after a few-weeks of clinical follow-up. Most authors agree that primary reconstructions of all damaged structures should be undertaken whenever medical conditions permit [2-4,7,15,20].

CONCLUSIONS

The results of the analysis of the study population of patients with upper limb nerve injuries allowed for the following conclusions:

1. In the Department of Orthopedics, Medical University of Bialystok, in the years 1997-2007 delayed nerve injuries were more frequently treated than the immediate ones.
2. Surgical treatment of nerve injuries most frequently used primary suture and cable grafting reconstructions. Secondary epineural suture of the nerve was performed more rarely.
3. Autogenic nerve graft segments were most frequently collected from the sulnar nerve of the lower extremity. The medial antebrachial cutaneous nerve grafting was much seldom performed.

Conflicts of interest

The authors declare that there are no conflicts of interest of this paper.

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