

CLINICAL STUDY

Our experience with surgical treatment of ischial nerve injuries

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Outline: This report presents the results of 44 surgical interventions performed on 44 patients during a period of 15 years, from 1985 to 1999. The report presents the basic lines of surgical treatment performed on a total number of 50 peripheral nerves of lower extremities — nervus ischiadicus and its rami.

Patient group and methods: In the whole group of 44 patients, external neurolysis was performed in 23 individuals on 26 nerves. Remaining 21 patients were treated by reconstruction surgery that included 24 injured nerves. In this subgroup, suture of peripheral nerve was performed in 8 treatments on 9 nerves and neural graft was performed in 13 treatments of 15 nerves in cases of complete and persisting neurological deficit, and in the absence of action potentials as revealed by EMG. Complete or severe motoric defects and the absence of spontaneous recovery during the period of several months were the indications for the treatment. The analysis of the efficiency of surgical treatment was performed with respect to the following parameters: period between the injury and operation, patient's age, character of injury, type of injured nerve, and type of surgical intervention.

Results: The best results were obtained in external neurolysis which was applied in traumatic lesions of least severity. The effective degree of recovery M3 was observed in 21 patients (91.3 %). With respect to reconstruction surgery, more favourable results were obtained in treatments involving suture (in 6 patients, 75 %) than in nerve grafts used for the treatment of the most severe injuries associated with a loss of nerve tissue. In the latter cases, improvement was observed after a delay, and the extent of recovery did not always meet the expectations. The effective degree of recovery was observed in 4 patients (30.8 %). Good and excellent results were typical for n. tibialis and they were not dependent on the type of surgical intervention, character and location of the injury, period from the injury or patient's age.

Conclusion: Our results demonstrate that late and inappropriate treatment of injured peripheral nerves has severe and disturbing consequences for the patient. If a complete treatment of the injured nerve is not possible by the first contact physician, it should be performed as soon as possible by a specialist trained for microneurosurgical techniques of the treatment of peripheral nerves. (*Tab. 6, Ref. 11.*)

Key words: lower extremity nerve lesions, neurolysis, nerve suture, nerve graft.

Injuries of the nerves of lower extremities are less frequent than those of upper extremities (1). Injuries of n. ischiadicus and its rami represent the largest and the most important part of injuries of lower extremities (2). We emphasize the treatment of patients with these injuries since a majority of surgeons who are not particularly interested in peripheral nerves have had only limited experience with this type of injury over many years of their practice. Accordingly we can find only isolated publications dealing with this problem (1, 2, 3, 4, 5). In this retrospective study we present our experience with surgical treatment of nerve injuries in lower extremities. We provide information on cli-

nical characteristics and treatment of affected patients. The aim of this work is to provide basic recommendations for treatment of patients with injuries of nerves in lower extremities.

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Patients and methods

In the period from 1985 to 1999 we treated 44 patients with injury of n. ischiadicus on the Neurosurgical Clinic, Faculty of Medicine, Comenius University in Bratislava.

Careful and timely treatment of the injured nerve, which is most frequently performed by external neurolysis, constitutes the fundamental condition for reduction of the period required for functional recovery of the nerve after posttraumatic axonotmesis.

23 patients (52.3 %) were treated by external neurolysis of 26 nerves that was indicated due to post-traumatic fibrosis. This fibrosis was caused most frequently by post-traumatic hematoma or contusion which may cause nerve injury by continuing the compression. Neurolysis represents a procedure that leads to nerve reconstruction in such cases. Neurolysis is thus the principal surgical intervention in cases with preserved nerve continuity.

Remaining 21 patients were subjected to 21 reconstruction operations that included 8 reconstructions of 9 nerves by suturation and 13 reconstruction operations of 15 nerves by neural graft.

The total number of 44 patients consisted of 31 males and 13 females at the average age of 37 years. The average period between the injury and surgical treatment was 7.7 months. An extremely long period exceeding 12 months occurred in cases of 12 patients.

A simultaneous injury of two nerves (n. fibularis and n. tibiae) was present in two patients.

Out of four cases of injury of n. ischiadicus in the area of gluteal muscle, 2 cases were iatrogenic and two cases were traumatic incisions. Injuries of nerves in the thigh region (total of 14) were usually derived ones. Most common causes included fractures of femur (7) and gunshot wounds (3). Fractures of femur resulted often in various degrees of injury of both nerves (n. fibularis and n. tibialis). All patients with this type of injury had a complete or severe lesion of n. fibularis and only a partial lesion of n. tibialis.

The most frequent injuries were observed in the lower third of thigh (24 patients) and in crural area (2 patients). With respect to the character of injury, iatrogenic damage of n. fibularis were prevailing in this region (15).

We conclude that injuries of n. fibularis were highly prevalent (39) (i.e. 78 %).

All patients were subjected to detailed clinical examination. Pre-treatment EMG examination indicated denervation in all patients subjected to reconstruction treatment and 15 of them were treated by external neurolysis. The absence of nerve action potentials that persisted even 2—3 months after the injury indicated the presence of neurotmesis with a minimal chance to recover without surgical treatment.

Follow-up post-treatment EMG was performed in all patients. The follow-up monitoring period was 1 year at minimum, the majority of patients (43) (i.e. 97.7 %) were monitored for 3 and more years.

All patients received primary care in other hospitals, iatro-

genic injuries, incisions or gunshot wounds were treated within first few days after the injury.

The definite indication for operation was total or severe motor deficit in the absence of spontaneous recovery within several months (2—3). Intense pain not responding to medicinal therapy was the indication for surgical treatment also in cases of partial loss of function (2 patients).

Operations started always by external neurolysis (complemented by internal neurolysis where needed) that was used to determine the degree of nerve damage. External neurolysis was the major treatment in 23 cases.

Reconstruction operations were performed by microtechnique. Nerves were treated by suture in cases where neural suturation was possible without tension after mobilisation of the nerve or extremity.

Separation and „end-to-end“ sutures (9) were less frequent than sutures by means of neural graft (15).

In all such cases, n. suralis was used as the autotransplant. Neural grafts were deposited loosely between two nerve endings in such a way that an overlap of 5 to 10 mm (depending on the length of the graft) between the graft and nerve endings was achieved. The number of grafts varied between 2 and 4. Fascicles or fascicle groups were connected by sewing material of the value „8.0“; 2—3 stitches were usually used.

All patients were subjected to several post-treatment tests with the aim to determine the degree of recovery of sensory and motor activities. The actual evaluation was based on the classification suggested by Kline D.G et al. (1981). Motor recovery was evaluated by a 5-point scale. Improvement scaled M3 was considered as being good while M4 and M5 were evaluated as being excellent. Results scaled as M1—M2 were considered to be insufficient (Tab. 1, 2).

The analysis of results of post-operational examinations of patients was performed in confrontation with general factors affecting the results of operations with respect to:

Tab. 1. Grading system for tibial lesions.

Grade	Criteria
0	no gastrocnemius-soleus function, no inversion, no toe flexion, little or no sensation on the plantar surface of the foot
1	trace gastrocnemius but no other tibial muscle function; trace to poor plantar sensation
2	gastrocnemius contracts against gravity only; plantar surface sensation usually \leq Grade 2
3	gastrocnemius-soleus contracts against gravity some force; trace better inversion; plantar sensation \geq Grade 3
4	gastrocnemius contracts against moderate resistance, inversion \geq Grade 3, either a trace or no toe flexion; sensation \geq Grade 4
5	gastrocnemius has full function, inversion \geq Grade 4, toe flexion present; plantar sensation \geq Grade 4

Tab. 2. Grading system for peroneal lesions.

Grade	Criteria
0	no or little function in short head of biceps, no peroneal function, no AT, no EHL or ED function
1	short head of biceps contracts, peroneal-innervated motor function
2	short head of biceps contracts, peroneal muscles contract against gravity or better; no trace of AT, no other distal motor function
3	short head of biceps contracts, peroneal muscles \geq Grade 3; AT contracts against gravity, but function of EHL ED for toes is usually absent
4	short head of biceps peroneal muscles contract, as does AT, which is \geq Grade 3; EHL ED may have trace function
5	short head of biceps peroneal muscles contract, AT \geq Grade 4; EHL ED contract at least against gravity

AT = anterior tibialis; ED = extensor digitorum; EHL = extensor hallucis longus

Tab. 3. Dependence of the outcome of surgical treatment on the time of operation since injury.

Nerve	Period from the injury	Up to 3 months			4 months and more		
		Type of treatment	Neuro-lysis	Suture	Nerve graft	Neuro-lysis	Suture
		Number of nerves					
Tibialis	11	2/2	-	2/2	4/4	2/2	1/1
Fibularis	39	12/12	2/2	4/3	8/6	5/3	8/0
Total	50	14/14	2/2	6/5	12/10	7/5	9/1

- time period of time between injury and operation,
- age of the patient,
- character of injury,
- type of injured nerve,
- character of surgical intervention.

Results

In the group of 44 patients, in 16 cases (36.4 %), the treatment resulted in complete restoration of strength, motility and EMG findings. 13 patients were treated by external neurolysis and 3 patients by reconstruction operations involving suture.

None of cases involving neural graft surgery resulted in complete recovery of strength, motility and EMG. A complete restoration of sensitivity was observed in 10 patients treated by exter-

Tab. 4. Dependence of the outcome of surgical treatment on patient's age.

Nerve	Patient's the injury	Up to 20 years			Over 20 years		
		Type of treatment	Neuro-lysis	Suture	Nerve graft	Neuro-lysis	Suture
		Number of nerves					
Tibialis	11	1/1	-	1/1	5/5	2/2	2/2
Fibularis	39	4/3	1/1	4/2	16/15	6/4	8/1
Total	50	5/4	1/1	5/3	21/20	8/6	10/3

nal neurolysis (43.5 %) and only in one patient (11.1 %) treated by reconstruction surgery involving suture.

Best results were observed in 21 patients (91.3 %) treated by neurolysis where recovery of functional grade M3 or better was achieved. Such positive results were observed in 6 patients subjected to reconstruction surgery involving suture (75 %) and only in 4 patients after operation involving neural grafts (30.8 %). When the treatment was performed within first three months after the injury, good and excellent results were achieved in all cases of neurolysis and neural suture and in 3 patients (75 %) that were subjected to reconstruction surgery involving neural graft (Tab. 3). An increase in time elapsing from injury caused aggravation of results particularly for reconstruction operations.

The results are expressed as a number of cases of nerves treated by surgery/number of cases with functional adjustment M3, or better.

With respect to the age, the best results were observed in patients aged below 20 years (Tab. 4).

Clean wounds (incisions, penetrating wounds) provided much more favourable conditions for the recovery than other more complicated injuries (e.g. contusions and lacerations). The success rate for the first mentioned type of wounds was 100 % for neurolysis and suturation and 66.7 % for neural grafts (3 patients) (Tab. 5).

One of most important factors affecting the outcome of regeneration process was the nature (character, type) of injured nerve. Functional recovery of n. tibialis was observed in all treated cases, irrespective of the type of operation.

In reconstruction operations by nerve grafts, best results were observed for nerve grafts shorter than 5 cm (2 patients). In cases with graft length over 5 cm we registered functional recovery in one case — n. tibialis.

It is necessary to emphasize the relatively high number of iatrogenic lesions — 18 patients (40.9 %) that represented one half of all treated lesions of n. fibularis (Tab. 6).

The time of appearance of the first symptoms of re-innervation relied on analysed factors and varied from several days in case of neurolyses to 14 months for reconstruction operations of n. tibialis and up to 2 years for reconstruction operations of n.

Tab. 5. Dependence of the outcome of surgical treatment on the character of injury.

Nerve Injury character	Incision			Other injuries			
	Type of treatment	Neurolysis	Suture	Nerve graft	Neurolysis	Suture	Nerve graft
	Number of nerves						
Tibialis	11	2/2	-	1/1	4/4	2/2	2/2
Fibularis	39	3/3	2/2	3/2	17/15	5/3	9/1
Total	50	5/5	2/2	4/3	21/19	7/5	11/3

tibialis. The presence of positive nerve action potentials is always an undeniable evidence for regeneration of the damaged nerve. A fair motor recovery was observed in the majority of these patients. From 23 patients subjected to neurolysis as the major surgical intervention, internal neurolysis was performed in two patients due to persisting severe pains that did not respond to medical treatment. A retreat of difficulties was observed in both cases.

Discussion

Surgery of the nerves of lower extremities is a direct often time-consuming method that is aimed at solving the problem of motor defects caused by peripheral nerve lesions. Deliberation and reconstruction operations provide good conditions for the recovery of motor and sensory functions.

23 deliberation and 21 reconstruction operations were performed in 44 patients. These surgical interventions included 13 operations by autotransplant with n. suralis used as autograft in all cases.

Pre-treatment EMG examinations revealed denervation in all cases of reconstruction operations and in 15 cases (65.2 %) of deliberation operations. The objectivisation of results of operations performed on n. ischiadicus and its rami was based on the classification of Kline D.G. et al. (1998). The best results were observed for neurolysis — more than 90 % success rate. Average results were achieved for reconstruction operations by suture of peripheral nerve — 77.8 % success rate. The poorest results were observed for reconstruction by nerve grafts with mere 40 % success rate.

Post-treatment examinations were performed in all patients. In some cases, objective examination as well as subjective evaluation by patient revealed an improvement, however, EMG examination did not show any change when compared to previous examination. The recovery of motor and sensory functions was dependent on the period of time from injury to operation, on patient age, on the type of injured nerve and last but not least, on the character of reconstruction intervention. We observed functional recovery in all cases of n. tibialis treatment. The first signs

Tab. 6. Results of surgical treatment of nerves in lower extremi-

Type of injury	Number of patients	Nerve	Number of nerves	Neurolysis		Suture		Neural graft	
				Tib.	Fib.	Tib.	Fib.	Tib.	Fib.
Iatrogenic	18	Injection	2/2	1/1	1/1				
		Pl. s.coxae	2/2				1/1	1/1	
		Bind. sut.	4/4		3/3	1/1			
Other	26	Other ia.	12/7	6/5	2/1	1/1	3/0		
		Incision	8/7	1/1	2/2	1/1	1/1	3/2	
		Fracture	8/6		5/4	1/1	2/1		
		Gunshot	3/3	1/1	1/1	1/1			
		Cmp.Cnt.	11/6	3/3	2/2		1/1		5/0
Total			50/37	6/6	20/18	2/2	7/5	3/3	12/3

Tib. = tibialis; Fib. = fibularis; Pl.s.coxae = plastic surgery of coxae; Bind.sut. = binding of a nerve into a suture; Cmp., Cnt. = compression, contusion

of recovery were observed in some cases of deliberation operations already after several days. Subject to various factors, such symptoms could appear in 14—16 months for n. tibialis treatment, and in 2 years for n. fibularis treatment. Full recovery of sensory functions was not observed in any of treated patients older than 40 years. All these cases revealed only protective sensitivity.

Iatrogenic injuries were present in 18 cases (40.9 %). Early surgical treatment showed a 66.7 % success rate (12 patients) in this case. The best results were observed in patients younger than 20 years that were treated within 3 months since the injury, in the cases of incised wounds and for injuries of n. tibialis irrespective of the character of operation. Similar results were reported by other authors for operations of peripheral nerves in lower extremities (3, 6, 7). In agreement with our results, a significantly inferior outcome of operations of n. fibularis were reported also by other groups (1, 6, 8, 9, 10).

Surgical interventions on peripheral nerves of lower extremities showed significantly inferior results when compared with operations of peripheral nerves on upper extremities. Early surgical revisions associated with neurolysis or reconstruction operation, if necessary, is an extremely important factor in indicated cases. It affects the outcome of operation and thus the prospects of the patient for his everyday life.

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