THERAPY

Surgical treatment of injuries of nervus fibularis

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Abstract

Starting point: **In this retrospective study, we present the results of 40 surgeries of 40 patients that within the period of 15 years, i.e. from 1985 to 1999 were provided the treatment of 40 lesions of n. fibularis, historically treated as problematic in terms of successful healing. The work provides the fundamental lines of their surgery treatment.**
Material and methods: **From the total number of 40, external neurolysis was performed to 20 patients. The remaining 20 patients were provided with reconstruction surgeries of the injured nerves, while 8 surgeries was done by suture of peripheral nerve and 12 surgeries were performed by nerve graft, in cases of complete and persisting neurological deficit and absence of action potential at EMG. The mechanism of lesion included the damages of nerve from elongation, with or without fracture, "sharp" or "blunt" lesions, lesions of shooting, compressions and iatrogenic injuries. If the spontaneous adjustment did not occur within the period of 2—6 months after the lesion, the patients underwent surgery. We performed the analysis of the efficiency of the surgical intervention depending on the following parameters: period of surgery from the lesion, patient's age, nature of lesion, degree of lesion, type of surgery intervention.**
Results: **With 27 of 40 an effective adjustment was achieved preventing the sagging of the foot trace and with 25 of 40 protective sensitivity appeared. After neurolysis with 18 of 20 patients (90 %) we achieved effective degree of adjustment in spite of heavy pre-surgical motor deficit. With 8 patients an "end to end" suture was performed and with 6 (75 %) the degree of adjustment was 3 or higher. 12 patients requested reconstruction surgeries with the help of nerve grafts, the length of grafts varied from 4 to 20 cm. The grafts were shorter than 5 cm with 2 patients, 1 with cut lesion and 1 patient with iatrogenic lesion. With both patients the function was adjusted to the degree M4. With 1 of 4 patients (25 %) with the graft of 6 to 12 cm and with none of 6 with the grafts from 13 to 20 cm the adjustment of the degree 3 or higher was not achieved. In this cases, however, we noticed partial adjustment of trophic and tonus, however at the absence of motor adjustment.**
Conclusion: **The pre-surgical and persurgical examinations are indispensable conditions for obtaining optimal results. It is worth of mentioning that surgical treatment proximal lesins of n. fibularis yielded better results than treatment of more distal lesions in the area of knee.** ***(Tab. 5, Ref. 20.)***
Key words: lower extermity nerve lesions, neurolysis, nerve suture, nerve graft.

Fibular part of n. ischiadicus on the level of thigh has not been excluded from this study. In the knee region, n. fibularis runs obliquely from n. ischiadicus. More distally it is placed behind the caput fibulae and it is covered only by subcutaneous tissue and skin. This anatomical arrangement makes this nerve quite vulnerable (13, 17, 20). Sunderland (17) described also several features that make this nerve more vulnerable, including reduced number of vegetative filaments. Traumatic paralysis of n. fibularis is known especially in athletes, football players, wrestlers, but also as a consequence of traffic injuries. Most authors mention poor prognosis both of spontaneous recovery and of reconstruction surgery (3, 7, 8, 9, 13, 16, 19, 20). Except of direct interruption of the nerve, all injuries are caused by nerve elongation or contusion that may lead to its discontinuation. Such injuries are under clinical and EMG supervision usually for a period of several months with the aim to register even the minimal signs of early regeneration (1, 6, 15). If

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the signs of spontaneous regeneration do not appear in a period of 2 to 6 months, surgical revision and NAP per operationem are used for the decision about eventual reconstruction surgery by "end to end" suturation or by nerve graft. In this retrospective study we report our experience with surgical treatment of 40 patients with lesion of n. fibularis. The aim of this report is to give basic recommendations for treatment of patients with injuries of peripheral nerves of lower extremities.

Patients and methods

40 patients with injuries of n. fibularis were treated on the Department of Neurosurgery, Faculty of Medicine, Comenius University in Bratislava (Slovakia).

These 40 patients included 28 males and 12 females with the average age of 36 years. The average period between the injury and surgical treatment was 6.8 months. Extremely long period (over 12 months) occurred in 9 patients.

The minimum follow-up period was 18 months, however, it exceeded 3 years for the majority of patients. All patients received the first treatment in other hospitals. Per/treatment and post-treatment EMG examination was performed for all patients.

External neurolysis was performed at 20 patients (50 %); this treatment was chosen due to developing post-traumatic fibrosis that was caused mostly by post-traumatic haematoma or contusion that caused nerve injury by persisting compression. For such cases, neurolysis is the procedure leading to nerve restoration. Neurolysis is the major surgical treatment for the cases where nerve continuity is still preserved.

Reconstruction surgery was performed in other 20 patients. These included 8 reconstruction treatments involving sutura and 12 reconstruction treatments involving neural grafts. In one case both superficial and subsurface rami were treated by neural graft.

Out of 4 cases of traumatic injury of nervus fibularis in the gluteal muscle region, 2 cases represented iatrogenic lesions and 2 cases traumatic incision injuries. Injuries in the thigh region (10) were usually secondary. One of major causes here were fractures of femur (5). All patients with this injury had a complete or severe lesion of n. fibularis. The most frequent injuries were in the lower third of thigh (24) and crural region (2 patients). With respect to the character of injury, iatrogenic lesions of n. fibularis were dominating in this area (15).

All patients underwent a detailed clinical examination. Pre-treatment EMG examination indicated denervation in all patients subjected subsequently to reconstruction treatment and in 15 patients treated by external neurolysis (75 %). The absence of nerve action potentials even 2—6 months after the injury indicated the presence of neurotmesis with a minimal chance of recovery without a surgical treatment.

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

Operations started always by external neurolysis completed by internal neurolysis when necessary (1 patient). This treatment helped to determine the degree of nerve damage. External neurolysis was the major treatment in 20 cases.

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

Separation and "end to end" suture (8) were less frequent than a suture by means of nerve graft (12).

N. suralis has been used as the autotransplant in all cases. Nerve grafts were deposited loosely between two nerve endings in such a way that depending on the autotransplantate length, an overlap of 5—10 mm between the graft and nerve endings was achieved. 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 per one fascicle.

All patients were subjected to several post-surgical tests to determine the degree of recovery of sensory and motor activity. The actual evaluation of injuries of n. fibularis was based on the classification suggested by Kline et al. (11). Motor recovery was evaluated by a 5-point scale. Recovery scaled in the M3 category was considered as good while M4 and M5 were evaluated as excellent. Results scaled as M1—M2 were considered to be insufficient (Tab. 1).

Analysis of the results of post-operational examinations was performed with respect to general factors affecting the results of operation with respect to:

— time period between the injury and operation,
— patient age,
— character of the injury,
— injury location,
— character of the surgical intervention.

Tab. 1. Grading system for peroneal lesions.

Grade	Criteria
0	no or litle 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 ≥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 ≥Grade 3; EHL ED may have trace function
5	short head of biceps peroneal muscles contract, AT ≥Grade 4; EHL ED contract at least against gravity

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

Results

Of the total number of 40 patients, a complete recovery of the strength and motility as well as of EMG finding was observed in 12 cases (30 %). This number included 11 patients (55 %) treated by external neurolysis and only one patient treated by reconstruction surgery involving suture. A complete recovery of strength, motility and EMG was not observed in any of patients treated by nerve graft. A complete recovery of sensitivity was present in 7 patients

Tab. 2. Dependence of results of surgical treatment on the period between the injury and surgical treatment.

Nerve	Period from injury	Up to 3 months			4 months and more		
	Type of treatment	Neurolysis	Suture	Nerve graft	Neurolysis	Suture	Nerve graft
Fibularis	40	12/12	3/3	4/3	8/6	5/3	8/0

Tab. 3. Dependence of results of surgical treatment on patients' age.

Nerve	Patient age	Up to 20 years			Over 20 years		
	Type of treatment	Neurolysis	Suture	Nerve graft	Neurolysis	Suture	Nerve graft
Fibularis	40	4/3	2/2	4/2	16/15	6/4	8/1

Tab. 4. Dependence of results of surgical treatment on the character of injury.

Nerve	Character of injury	Incisions			Other injuried		
	Type of treatment	Neurolysis	Suture	Nerve graft	Neurolysis	Suture	Nerve graft
Fibularis	40	3/3	3/3	3/2	17/15	5/3	9/1

Tab. 5. Results of surgical treatment of nerves in lower extremities.

Injury type	Pt No	Nerve	Neurolysis Fib	Suture Fib	Nerve graft Fib
Iatro-genic	17	Injection	1/1		
		Plast.surg.coxae			1/1
		Suture	3/3	1/1	
		Other iatr.	6/5	2/1	3/0
Other	23	Incision	2/2	1/1	3/2
		Fracture	5/4	2/1	
		Gunshot	1/1		
		Comp., Cont.	2/2	2/2	5/0
Total			20/18	8/6	12/3

Fib — fibularis, Plast.surg.coxae — plastic surgery of coxae, Comp., Cont. — compressions, contusions

(35 %) treated by external neurolysis, but in none of patients treated by reconstruction surgery.

Best results were observed for neurolysis where the utility grade M3 and better was achieved in 18 patients (90 %). This result was observed in 6 patients treated by reconstruction surgery with sutura (75 %) and only in 3 patients treated by surgery involving nerve grafts (25 %).

When the surgical treatment was performed within the 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 %) subjected to reconstruction surgery involving nerve graft. Increasing the time elapsing from the injury caused aggravation of the results particularly in the case of reconstruction operations (Tab. 2).

Values are expressed as number of surgically treated nerves/number of cases with functional recovery of the grade M3 and better.

With respect to patient age, the best results were observed in patients younger than 20 years (Tab. 3).

Clean wounds (incisions, penetrating wounds) provided much more favourable conditions for the successful treatment than other more complex injuries, e.g. contusions. The success rate for the first mentioned type of wounds was 100 % for neurolysis and suturation and 66.7 % for nerve grafts (2 patients) (Tab. 4).

Regarding reconstruction operations by nerve grafts, best results were observed in cases when nerve grafts did not exceed the length of 5 cm (2 patients). For nerve graft length over 12 cm we did not register the "utility grade" in any one case.

It is necessary to emphasize the relatively high number of iatrogenic lesions — 17 patients (42.3 %) (Tab. 5).

The time of appearance of the first symptoms of restored inervation relied on analysed factors and it varied from several days in the cases of neurolysis to 14 months to 2 years in the cases of reconstruction operations of n. fibularis (in isolated cases also up to 3.5 years). The presence of positive nerve action potentials is always an undeniable evidence for the regeneration of damaged nerve. A promising motor recovery was observed in the majority of these patients. Out of 20 patients subjected to neurolysis as the major surgical intervention, both internal and external neurolysis were performed in one patient subject to persisting severe pains that did not respond to pharmaceutical treatment. Retreat of obstructions was observed thereafter.

Discussion

Surgery of the nervus fibularis and its rami is a direct and often time-consuming procedure that is aimed at solving the problem of defects in motility caused by lesions in this nerve. Operations in the region of knee were performed because of extensive lesions of nervus fibularis after luxation fractures of knee joint. Injuries of n. fibularis may be generated also as a consequence of fractures in fibular head or neck (caput or collum fibularis) or they may be associated with dislocation in the knee joint. Elongation may then result in such a lesion. Patients with injuries in the region of fibular neck represented the largest group of lesions of n. fibularis. Sport-related injuries were another frequent cause of lesions (9), all patients with this type of injury had damaged soft tissues of knee associated with stretching or rupture of ligaments. Early diagnosis of lesions of n. fibularis associated with knee injuries is very important. Surgeon performing the first examination must be aware of various mechanisms that may lead to lesions of n. fibularis.

Incision wounds should be fixed immediately, shotgun wounds within three months after the injury, "blunt" injuries within 2 to 6 months. The case of iatrogenic injuries should be evaluated accor-

ding to their character. External neurolysis is used for treatment of the least severe traumatic changes, however, reconstruction operations involving neural grafts are employed in the cases of the most severe nerve lesions, often associated with loss of neural tissue. Deliberation and reconstruction surgery offers good conditions for restoration of motor and sensory functions.

Surgical resolution of neural lesions in continuity with preoperational NAP record is becoming important during first few months after the injury. Treatment of neuroma in continuity includes neurolysis or resection and reconstitution operations. This technique may be complicated by loss of residual conductance through axons that were intact before surgical neurolysis or reconstruction surgery.

20 deliberation and 20 recostruction operations (inclusive 12 cases by means of autografts) were performed in 40 patients. Preoperational EMG revealed denervation in all cases of reconstruction and in 15 cases (75 %) of deliberation surgery. The results of performed surgical treatments of n. fibularis and its rami were objectivized by classification of Kline et al. (11). Only improvement classified as M3 or better are of functional value for the patient and the recovery of sensory functions is relatively less important.

Best results were observed for neurolysis (success rate 90 %). Less favorable results were obtained for reconstruction operation by sutura of peripheral nerves — 75 % success rate.

Similar to previous reports (4, 14), the worst results were reached in reconstruction operations by neural graft — only 25 % success rate.

In some cases, objective examination as well as subjective evaluation by the patient revealed an improvement, however, the EMG examination did not show any change when compared to previous examination. The recovery of motor and sensory functions was dependent on the time period from the injury to operation, on patient age, on the location of injury as well as on the character of reconstruction intervention. For deliberation operations, the first signs of re-inervation were observed already after several days. Dependent on various factors, they could appear during 14—16 months or even up to 2 years. 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 17 cases (42.5 %). We consider this number to be high, however, an early surgical treatment resulted in high rate of recovery in these cases (12 patients — 70.6 %). The best results were observed for patients younger than 20 years, for the cases of incised wounds and for operations performed within 3 months from the injury. Similar results were reported by other authors (2, 5, 12, 18).

Similar to other lesions of peripheral nerves, early surgical revision and thorough pre-surgical and persurgical examinations are indispensable conditions for obtaining optimal results. It is worth of mentioning that surgical treatment proximal lesions of n. fibularis yielded better results than treatment of more distal lesions in the area of knee.

References

1. Berry H., Richardson P.M.: Common peroneal nerve palsy: a clinical and electrophysiological review. J Neurol Neurosurg Psychiatry 1976; 39: 1162—1171.

2. Bourrel P.: Transplantation du jambier postérieur sur le jambier antérier et du fléchisseur commun des orteils sur l'extenseur du gros orteil et lextenseur commun des orteils dans les paralysies s.p.e. A propos de 27 observations. Ann Chir 1967; 21: 1451—1460.

3. Clawson D.K., Seddon H.J.: The results of repair of the sciatic nerve. J Bone Joint Surg (Brit) 1960; 42: 205—113.

4. Delaria G., Manupassa J., Saporiti E., Taglaoretti I.: Surgical treatment of lesions of the sciatic nerve. J Orthop Traumatol 1983; 9, 451—459.

5. Gentili F., Hudson A.R., Midha R.: Peripheral nerve injuries: types, causes and grading. P. 3105—3114. In: Wilkins R.H., Rengachary S.S. (Eds.): Neurosurgery. New York, McGraw Hill 1997.

6. Haymaker W., Woodhall B.: Peripheral nerve injuries: Principles of diagnosis. Philadelphia, W.B. Saunders Co., 1953.

7. Highet W.B., Holmes W.: Traction injuries to the lateral popliteal and traction injuries to peripheral nerves after suture. Brit J Surg 1943; 30: 212—215.

8. Johnson E.W.: Nerve injuries in fractures to the lower extremity. Minn Med 1969; 52: 627—633.

9. Kim D.H., Kline D.G.: Management and results of peroneal nerve lesions. Neurosurgery 1998; 27: 183—106.

10. Kline D.G., Hudson A.R.: Nerve injuries. Operative results for Major Nerve Entrapments, and Tumors. Philadelphia, W.B. Saunders 1995; 289—344.

11. Kline D.G., Kim D., Midha R., Harsh C., Tiel R.: Management and results of sciatic nerve injuries: a 24-year experience. J Neurosurg 1998; 89: 13—23.

12. Kredba J., Stejskal L.: Studie pozdních pooperačních výsledků peroneálního nervu. Voj Zdrav Listy 1979; 48 (4): 143—147.

13. Seddon H.J. (Ed.): Lesions of individual nerves: Lower limb in Surgical disorders of the Peripheral Nerves. Baltimore, Williams & Wilkins 1972, 505—579.

14. Sedel L., Nizard R.S.: Nerve grafting for traction injuries of the common peroneal nerve a report of 17 cases. J Bone Surg (Brit) 1993; 75: 772—774.

15. Singh N., Behse F., Buchtal F.: Electrophysiological study of peroneal pausy. J Neurol Neurosurg Psychiatry 1974; 37: 1202—1213. **1974.**

16. Stejskal L., Metelka M.: Úrazové poškození nervus ischiadicus. Rozhl Chir 1974; 53: 793—802.

17. Sunderland S.: Nerves and Nerve Lesions. Edinburgh, Churchill Livingstone 1978.

18. Vastamaki M.: Decompression for peroneal nerve entrapment. Acta Orthop Scand 1986; 57: 551—554.

19. Wilkinson C., Birch R.: Repair of the common peroneal nerve. J Bone Surg (Brit) 1995; 77: 501—503.

20. Zvěřina E., Stejskal L.: Poranení periférnych nervu. Praha, Avicenum 1979, 303 p.

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