Common Peroneal Nerve Palsy in the Recent Literature: Is it Worth to Reconstruct the Nerve?

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Introduction

The affection of the common peroneal nerve (CPN) is the most common nerve palsy of the lower limb, probably due to its superficial location lateral to the surgical neck of the fibula. Functional outcome after reconstruction of this nerve is classically described as disappointing when compared with other frequently injured nerves. We analyzed seven recently published articles, to determine if this bad prognosis is still the rule, and if there is any way to obtain better results in this pathology.

1) MANAGEMENT AND OUTCOMES IN 318 OPERATIVE COMMON PERONEAL NERVE LESIONS AT THE LOUISIANA STATE UNIVERSITY HEALTH SCIENCES CENTER

Kim D, Murovic J, Tiel RL, Kline D.
Neurosurgery 54:1421-1429, 2004.

Information

The authors of this paper have designed and performed a retrospective study to compare the outcome of 318 surgical common peroneal nerve lesions at knee-level, managed at the Louisiana State University Health Sciences Center between 1967 and 1999 (32-year period). The largest proportion of these injures were associated with blunt trauma to the knee. Ligamentous and meniscus injuries associated with instability and dislocation of the knee joint accounted for 141 of 318 (44%) of the operated CPN injuries. The same type of injury when associated with a tibial or fibular fracture or dislocation accounted for another 7% (22 of 318); that is, more than 50% of the injuries are related to closed trauma to the knee, the other six types of injuries were tumor (13%), lacerations (12%), entrapments (9%), compressions (7%), iatrogenic injuries (4%), and gunshot wounds (4%).

In this group of patients, after performing neurolysis, 107 (88%) of 121 knee-level common peroneal nerve lesions with positive intraoperative nerve action potentials, recovered useful function. Nineteen patients underwent end-to-end suture repair, and 16 (84%) of these achieved good recovery by 24 months. Graft repair was performed in 138 peroneal nerve injuries.

Thirty-six patients (26%) had grafts less than 6 cm long, of which 27 (75%) achieved Grade 3 or greater peroneal nerve function. Twenty-four (38%) of 64 patients with 6- to 12-cm grafts, and only 6 (16%) of 38 patients with 13- to 24-cm grafts, attained good peroneal nerve function. Longer grafts correlated with more severe injuries and thus poorer outcomes. Forty patients with intrinsic CPN tumors underwent surgery (16 intraneural ganglion cysts; 10 schwannomas, 6 neurofibromas, 2 osteochondromas, 2 neurogenic sarcomas; 2 focal hypertrophic neuropathies, 1 desmoid tumor; and 1 glomus tumor); tumors were resected with preservation of preoperative clinical function.

Analysis

This series is the biggest published till present about peroneal nerve injury. In concordance with the rest of the literature, blunt trauma to the knee predominates as the cause of the palsy in this retrospective study. The relatively good results the authors obtained after nerve grafting with grafts between 6 to 12 cm long (38% good outcomes) contrast with other findings in the literature that noted moderate results only with grafts minor as 5 to 8 cm in length.

Longer grafts, as expected, correlated with bad results. Unfortunately, the authors did not tabulate or analyzed neither the delay from trauma to surgery, nor discriminate the results of reconstruction of each technique (neuroraphy, neurolysis and short, middle and long grafts) according to the etiology of the injury. This information would be very interesting in the context of such a big series. The authors recommend in their conclusions a different timing for the surgical intervention according to the mechanism of injury: immediate for sharp lacerations, 2 or 4 weeks delay in blunt lacerations, 3 months for gunshot wounds if there is no spontaneous recovery and elective surgery for tumors and compressive lesions. The authors did not recommend an specific surgical timing for blunt trauma at the knee, which constitutes the vast majority of peroneal nerve injuries. Finally, and according to the rest of their work, the authors used nerve action potentials (NAP´s) as an important tool at the moment of surgery to determine the extent and prognosis of the lesion.

2) SURGICAL TREATMENT OF TRAUMATIC PERONEAL NERVE LESIONS

Seidel JA, Koenig R, Antoniadis G, Richter HP, Kretschmer T.
Neurosurgery 62:664–673, 2008.

Information

In this paper, Seidel et al. presented retrospectively their experience in the treatment of 48 patients with traumatic peroneal nerve injury, with a follow-up period of at least 18 months

Two groups were identified: one showed a lesion in continuity that recquired: (1) an external neurolysis, in which 73% (eight out of 11) showed a good functional outcome (MRC grade >4, no need of ankle brace) or (2): an internal or interfascicular neurolysis group, where 71% (five out of seven) exhibited a similar outcome.

The second group of patients had no regenerative potentials when tested intraoperatively (negative NAP´s) and accordingly underwent sural nerve graft repairs. This group achieved a global rate of only 28% with good functional recovery (MRC grade >4 for ankle dorsiflexion). Patients that required a graft shorter than 6 cm achieved a functionally useful outcome in 44% of cases (four out of nine) compared with 11% (one out of nine) when the graft length was greater than or equal to 6 cm. In some patients failing to recover foot lift, tendon transfers were undertaken.

Analysis

This report is a reminder of the relatively poor prognosis of common peroneal nerve injury compared with injuries of other peripheral nerves such as radial and tibial nerves. External and internal neurolysis is known to have better results than nerve repair using nerve grafts. Graft lengths of less than 6 cm have a better outcome than graft lengths of more than 6 cm.

3) MISSILE-CAUSED COMPLETE LESIONS OF THE PERONEAL NERVE AND PERONEAL DIVISION OF THE SCIATIC NERVE: RESULTS OF 157 REPAIRS

Roganovic Z
Neurosurgery 57:1201-1212, 2005

Information

In this paper, the author reports his vast experience gained at the Belgrade Military Medical Academy during ´90s war in former Yugoslavia. During a 3-year period, the author treated 702 patients with peroneal nerve injury; prospectively collected data of this patient population has been analyzed to determine the factors that influence outcome. Of these, 157 patients with complete missile-caused lesions of the peroneal nerve or peroneal division were treated surgically, 95 having complete discontinuity of the nerve and 66 having lesions in continuity, all requiring trimming of both stumps to healthy tissue and repair. The patients were operated between 1 to 11.6 months, 150 underwent graft repair and 7 end-to-end coaptation. 23.6% had a high-level injury (above the middle of the thigh), 57.3% intermediate-level injury (middle of the thigh to popliteal crease), and 19.1% low-level injury (distal to the popliteal crease).
4 of the 24 (16%) patients who had high-level injury achieved M3 motor recovery, 28 (31%) with intermediate-level lesions achieved M3 or better recovery and 57% of the 30 patients with low-level lesions achieved M3 or better function.

Seventy-two patients (45.9%) had missile bone fracture in the repair region, 32 (20.4%) had main artery damage, and 39 (24.8%) had considerable soft tissue damage. Grafts were 2.2 to 15 cm in length (average 5.2 cm). Of the grafted patients, 47 (31.3%) required a graft smaller than 4 cm, 18 (12%) required a graft larger than 8 cm, and 85 (56.7%) required a graft between 4 and 8 cm long. A successful outcome was achieved in 57.4% of patients with a nerve graft shorter than 4 cm, in 22.4% of patients with graft lengths 4 to 8 cm, and in 0%

of patients with a graft >8 cm. The probability of a successful outcome was significantly lower if nerve defect was >5 cm.

Analysis

This is to date the most important series of missile-caused peroneal nerve injury during wartime. The author made a great job cautiously analyzing his statistics, and valid conclusions can therefore be extracted: proximal (gluteal) injuries have a worst prognosis, as well as surgical delay longer than 7 months, and injuries requiring grafts longer than 8 cm.

Conversely, surgical delay shorter than 3 months, grafts shorter than 4 cm, and distal lesions of the branches of the common peroneal at the tight evidence a good functional result for foot flexion.

It is important to point out that this series of patients had significant comorbidities, including bone fracture, artery lesion and tissue defect. This reflects the high energy impact and the type of missile employed during war. In this series, patients with one or none comorbidities experienced 36.7% of good outcome, comparing with 13.5% of those with two and an astonishing 0% of patients with bone fractures, arterial damage and tissue defects all together. Civilian missile injuries are generally linked to smaller projectiles and to less comorbidity. Careful application of these results should be discussed with a peroneal nerve injured patient caused by a missile wound asking for information if the lesion was not related to a war environment.

4) ZONE OF TRACTION INJURY OF THE COMMON PERONEAL NERVE

Prasad Ar, Steck JK, Lee Dellon A.
Ann Plast Surg 2007;59: 302–306

Information

The hypothesis tested is that the failure of functional motor recovery after common peroneal nerve traction injury is because the zone of injury extends beyond the visible region of peroneal nerve in continuity injury and into the muscle entry zone of the motor nerve terminations. The authors took profit of the opportunity to analyze this distal zone of lesion in a severe traction injury of the common peroneal nerve sustained by a 34 year old woman. The lesion required a 14 cm long graft extracted from the superficial peroneal nerve that was done 3 months after the trauma. They sended the distal injury zone to anatomopathological analysis, and compared their findings with an amputated limb from a patient that had no trauma history. Using Masson trichrome stain for collagen, neurofilament and S-100 stain for nerve fibers and Schwann cells, the authors demonstrated collagen deposition between the peroneal nerve and the muscle.

These findings were not observed in the amputated limb. The use of electronic microscope corroborated the differences observed. The authors concluded that the stretch/traction injury zone extends into the myoneural junction, preventing otherwise successful neural regeneration through nerve grafts to reinnervate muscle. They also claim that with a distal zone of injury extending into the myoneural junction region, peroneal motor function may be better achieved by direct neurotization than with nerve grafting.

Analysis

This is a single case report without statistical value, and the authors even don´t mention its final outcome. Nevertheless, it is very important in terms of analyzing the etiological factors related to the failure of peroneal nerve reconstruction, especially when related to traction trauma.

The authors undoubtedly proved something that is usually suspected when the surgeon faces this kind of lesions: the extent of the injury goes well beyond the macroscopically observed injury to the nerve itself, and compromises zones as distally as the motor end-point of the neuromuscular union. This fact has undoubtedly consequences regarding the decision of reconstructing or not a peroneal nerve that sustained severe traction.

5) COMMON PERONEAL NERVE INJURIES, RESULTS WITH ONE-STAGE NERVE REPAIR AND TENDON TRANSFER

Ferraresi S, Garozzo D, Buffatti P.
Neurosurg Rev 26:175-9, 2003.

Information

The authors report their experience after an initial series of six patients to whom they reconstructed a common peroneal nerve injury with grafts and obtained very bad results. In the second and most important part of this series, they describe 39 patients where they performed a simultaneous posterior tibial tendon transfer and a grafted reconstruction of the nerve. At 2-year follow-up, the evaluated ratings were: good (M3 or higher) for full function against gravity, which allows good walking, fair (M1-2), and poor (M0). In the first group all patients had a poor outcome (5 patients did not recovered muscle function, 1 patient had M1-2 muscle contraction). The group of tendon transfer and nerve repair regained independent walking a few weeks after surgery. At 2-year, good outcome was evident in 28 of the 39 patients (72%), fair in 7 (18%), poor in 4 (10%).

Analysis

This article established a new paradigm among nerve surgeons: is it worth to reconstruct peroneal nerve lesions? The authors describe their 100% poor results for nerve repair, results that are fully expectable when considering blunt trauma and nerve stretching in knee dislocations. They compared afterwards these disappointing outcomes with those of the posterior tibial nerve transfer, which are inversely good. The authors quote Hanno Millesi, who postulated that the main reason for the bad results when reconstructing common peroneal nerve lesions is a misbalance between flexors and extensors muscles at the ankle, favored to the formers. Therefore, reestablishing this balance with a tendon transfer ameliorates the results in reinnervation of extensor muscles. Even though the authors claim that they´ve reinnervate those muscles in their procedures, it is not clear if they really have done that.

They don´t describe how they measured this reinnervation, neither establish, if the extensor function recovery was due to that reinnervation, or what seems more probable, due to the tendon transfer.

6) FUNCTIONAL OUTCOME AFTER PERONEAL NERVE INJURY

de Bruijn IL, Geertzen JH, Dijkstra PU.
International Journal of Rehabilitation Research 30:333-7, 2007.

Information

The objective of this study was to determine the effects of peroneal nerve palsy in the quality of life (QOL) of a cohort of patients. The authors included 27 patients with peroneal nerve injuries of different etiologies (48% trauma, 19% direct pressure, 19% tumoral and 15% iatrogenic). Surgical treatment was tendon transfer in 26%, tumor resection in 22%, primary neurorraphy in 15%, and neurolysis and graft repair both in 4%. Muscle strength in the Medical Research Council scale before and after rehabilitation, use of an ankle-foot orthosis, walking ability measured in the Walking Questionnaire and a structured interview designed to determine problems related to daily living, were assessed by the investigators.

The results showed that most of the patients recovered muscle strength after treatment, even though 62% showed paresis of some degree of ankle dorsiflexors. The necessity of orthesis decreased significantly after treatment, from 82% to 11%, but 66% of the patients experienced some kind of limitation in walking and climbing stairs, 59% showed a decrease in the maximum walking distance, 50% reported restrictions in leisure activities and 47% of patients with a paid job experienced some restrictions at work.

Analysis

This study was not done by surgeons, but by physiatrists. It is an etiologically heterogeneous group of patients, and the numbers of the analyzed group are small.

Therefore, the surgical interest of this series is limited. Nevertheless, we thought it was interesting to quote it because it clearly shows that even though some injuries recover very well in pure mathematical terms as muscle strength or use of orthesis, peroneal nerve palsy is a problem that affects permanently the quality of life of the patients. The analysis of the remaining capacity to accomplish daily activities shows that even in a group of presumed excellent results patients, they are permanently limited by the peroneal nerve palsy.

7) SUCESSFUL MANAGEMENT OF FOOT DROP BY NERVE TRANSFERS TO THE DEEP PERONEAL NERVE

Nath RK, Lyons AB, Paizi M.
J Reconstr Microsurg 2008;24:419–428.

Information

The authors present a series of 14 traumatic nerve lesions of the common peroneal nerve, in wich they´ve made a nerve transfer to restore voluntary dorsiflexion of the foot. Donor nerves were functional fascicles of the superficial peroneal nerve or the tibial nerve, being the deep peroneal nerve the receptor of the axons. The authors obtained 11 good outcomes, with successful restoration of ankle dorsiflexion (3+ or 4/5, in the Medical Research Council scale), one case had a 3 and two cases had no restoration. of dorsiflexion.

Analysis

This is at present the longer series employing a nerve transfer to restitute foot dorsiflexion. Basically, two completely different techniques were used in this paper: the first one, for isolated injuries of the deep peroneal nerve, used the common peroneal nerve as donor (5 cases, 100% good results). The second one was the use of branches of the tibialis nerve to the gastrocnemius also transferred to the deep peroneal nerve (9 cases, 6 with good results: 66%).

This later technique was elegantly analyzed in terms of anatomical feasibility recently (Flores L: Proximal motor branches from the tibial nerve as direct donors to restore function of the deep fibular nerve for treatment of high sciatic nerve injuries: a cadaveric feasibility study. Neurosurgery. 2009 Dec;65:218-24). The authors claim that their nerve transfers did not produce any new motor deficit, even though they observe a calf diameter reduction of 5-10% in their cases. As in the aforementioned anatomical study, they dissected intraneurally the common peroneal and the tibial nerve through a distance wich allowed to perform the nerve transfer without tension. This is precisely the main pitfall of this transfer technique (but not of this study): excluding penetrating and gunshot wounds to the common peroneal nerve, which as seen before, respond well to graft reconstruction given the fact that the gap is usually not too long, the vast majority of the remaining common peroneal nerve lesions is related to traction during a sport injury.

Intraneural dissection of the peroneal nerve branches, in a scenario of a severe traction and fibrosis, is very difficult. Therefore, the nerve transfer would not be possible without tension or the use of interposed grafts.

The results described by the authors are incredibly good, but the exact place that this technique should have in the surgical armamentarium still has to be defined. It seems that this kind of transfers should be limited only to those cases where no local injury to the peroneal nerve is observed, for example in foot drop after spine surgery.

As mentioned, altough the results shown in this work are encouraging, bigger series should be presented to certify that these techniques are as good as described.

Synthesis

Common peroneal nerve have two main characteristics: are the most common nerve lesions of the lower limb, and also have the worst prognosis of recovery after nerve reconstructive surgery. After the literature analysis done in this article, we can conclude that these lesions should be divided in two different groups, according to its mechanism of injury. First, the open, lacerating and gunshot wounds, which produce a segmental affection of the nerve, requires a shorter graft and has a better outcome. Second, the traction injuries, clearly related to a bad prognosis after reconstruction when a graft is necessary, because this graft is usually longer than 6 cm. Convincing evidence of microscopically nerve affection beyond the observed limits of injury exists and explains the bad outcomes.

In light of the current state of microneural surgery, recovery is achieved in most cases where neurolysis is the treatment (with positive intraoperative nerve action potentials), while nerve-grafting leads to satisfactory results in approximately half of the cases (with grafts less than 6 cm long). For the remaining cases, posterior tibial tendon transfer has proved to be an excellent measure to palliate the foot drop and to abandon the ankle brace for walking and even for performing some sports activities.