Femoral nerve repair with nerve autografts

Report of two cases

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Two cases of femoral nerve lesions are reported, one in the pelvic region, and one in the femoral triangle. In both cases, secondary microsurgical autografting resulted in a good functional and electrophysiological recovery.

KEY WORDS • femoral nerve • peripheral nerve • neuroma • nerve grafting • microneurosurgery

Lesions of the femoral nerve are rare, compared to lesions of other peripheral nerve trunks, and reports of surgical repairs are few. From the Peripheral Nerve Registry of World War II, Woodhall\textsuperscript{26} reported only 21 (0.03\%) femoral nerve repairs among a total of 7050 nerve repairs. In 1968, Sunderland\textsuperscript{28} made a survey of the incidence of femoral nerve lesions in World War I and II, and confirmed Woodhall's figures. The number of nerve repairs, however, does not give a true picture of the incidence of this particular lesion, since lesions of the femoral artery are not uncommonly associated with war conditions, and often result in fatal hemorrhage.

Two cases of secondary repair of intra-abdominal femoral nerve lesions were described by Clare\textsuperscript{2} in 1956. Both cases were treated with end-to-end suture, and made a complete sensory and motor recovery. Seddon\textsuperscript{20} reported one case in 1972, in which nerve suture gave a poor result, but it is not disclosed whether the repair was primary or secondary.

Since the introduction of the microsurgical technique, and the use of autologous nerve grafts in secondary nerve repair, numerous reports of excellent results have been published, mainly comprising the upper limb. Samii and Wallenborn\textsuperscript{15,18,19} reported a total of seven cases of secondary femoral nerve repair with autografts, but gave no details of the recovery. In one recent case\textsuperscript{17} there was complete recovery of function, 1 year after a secondary repair with sural nerve autografts, of a total femoral nerve lesion in the groin. Kline\textsuperscript{7} reported three cases of femoral nerve lesions, treated only with neurolysis; two patients had reduction of their preoperative pain, and in only one did the sensory function improve. Iatrogenic lesions of the femoral nerve following radiotherapy of malignant tumors in the pelvis were reported.
by Laurent,8 and Kenrick5,6 reported iatrogenic femoral nerve lesions after surgical procedures, such as repair of inguinal hernia, and following the use of self-retaining retractors in abdominal surgery.

Within the last 2 years, we have treated two cases of femoral nerve lesions with autografts, in both cases with a good functional result.

Case Reports

Case 1

This 47-year-old man was injured in the right iliac fossa by a knife, accidentally fired from a gun designed for cutting high-voltage cables. The knife perforated the caecum and peritoneum over the right iliacus muscle. The lesion of the caecum was treated in a local hospital, and a few days later, paresis of knee extension and the absence of the right knee jerk was observed.

Examination. At the local neurological department, a paralysis of the right quadriceps muscle was found, together with a sensory loss on the anterior side of the knee joint and anteromedially on the crus. Electromyography showed denervation and absence of spontaneous activity in the muscle.

Operation. The patient was operated on at the neurosurgical department at Odense University Hospital 3½ months after the injury. The femoral nerve was identified and exposed in the solid scar tissue over the iliacus muscle, and was found to be completely severed. After removal of a proximal stump neuroma, there was a gap of 5 cm between the proximal and distal stumps. The stumps were divided into fascicle groups, and, under the microscope, seven sural nerve autografts were inserted between the two ends, using a 10-0 monofil microvascular atraumatic nylon suture.

Postoperative Course. Four months after operation, there was a positive Hoffmann-Tinel's sign 3 cm below the inguinal ligament. After 10 months, Grade III power, according to Seddon's scheme, was found in the right quadriceps muscle, and electromyography showed signs of reinnervation in the proximal parts of the vastus intermedius and rectus femoris muscles. About 2 years after operation, the patient is now able to walk without support, and Grade IV power is found in the vastus intermedius and rectus femoris muscles. The sensory function, however, has not recovered.

Case 2

This 7-year-old boy from Greenland was attacked by wild sled dogs, and received numerous puncture wounds all over his body, face, and extremities. At the local hospital a left peripheral facial paralysis and a right quadriceps paralysis was found, due to bite wounds behind the left ear and immediately below the right inguinal ligament. There was no sign of vascular lesion. The patient was transferred to Rigshospitalet, Copenhagen.

Examination. Electromyography revealed some activity remaining in the facial nerve, but there was complete denervation of the quadriceps muscle. The sensory loss could not be estimated clinically, as the boy did not understand Danish, but electrophysiologically no sensory response could be picked up proximal to the lesion.

Operation. At operation 1 month after the injury, the femoral nerve was found completely severed at the site of its division, immediately below the inguinal ligament, and embedded in solid scar tissue. Three muscular branches could be identified, and after resection of a proximal stump neuroma, and division of the stump into fascicle groups, three sural nerve autografts, each about 3 cm long, were used to bridge the defect. The sutures were placed under the microscope, using a 10-0 microvascular atraumatic nylon.

Postoperative Course. Four months after operation, Grade III power was found in the right vastus lateralis and rectus femoris muscles, and the boy could walk normally. Electromyography showed reinnervation of the rectus femoris and vastus lateralis muscles, but the complete denervation of the vastus medialis muscle still remained.

Discussion

In all peripheral nerve repairs, two main factors have previously jeopardized a successful result; they are tension at the suture line, which results in suture-line scarring, and the formation of fibrous tissue between the fasciculi, which serves as a barrier for the ingrowth of axones into the distal stump.

The importance of avoiding tension has been recognized for almost a century, and
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Samii and Wallenborn, in an experimental study in 1972, demonstrated the correlation between increasing tension and a poor functional result. Many techniques have been described to gain additional length of the nerve, such as osteotomy, transposition, flexion of joints, and neurolysis. The "critical resection length" was stated for each individual major nerve trunk by Seddon in 1972.

The interstitial fibrosis and scar formation at the suture line is dependent on the diameter and quantity of the suture material, on the operative trauma and formation of blood clots between the nerve ends, and on the presence of epineurium at the suture line. To avoid the use of suture material, Freeman and Braun recommended the use of various synthetic plastic glues, but the results have been discouraging because of the histotoxicity of the substances. Wrapping the anastomosis with various substances such as collagen sheath, millipore, and Silastic membrane to prevent the ingrowth of scar tissue has been tried by many authors, but the results were disappointing. Millesi, et al., demonstrated that these procedures even increased the proliferation of connective tissue at the anastomosis. The introduction of microsurgical technique to peripheral nerve surgery solved many of these problems.

The epineurium can be resected with minimal trauma to the nerve, the bleeding controlled with bipolar microcoagulation, and the problem of tension solved by using nerve grafts. Marmor used irradiated homografts, and recommended the use of immunosuppressive therapy to prevent graft rejection. The technique generally employed now is the use of cable autografts, usually from the sural nerve, with an atraumatic monofil nylon suture of 25-μ diameter. By applying only one or two stitches at each fascicular anastomosis, the tissue reaction becomes minimal.

Numerous cases have been reported using the latter technique, including a large series with over 300 cases involving lesions of cranial nerves and of peripheral nerves, mainly in the upper limbs. According to Millesi and Samii, protective sensibility and a two-point discrimination around 10 mm of the repair can be achieved in the majority of cases, regardless of the delay in repair. Concerning motor function, the general belief is that repair more than 1 year after injury is rarely successful.

As mentioned above, the reports of nerve repairs in the lower limbs are greatly outnumbered by those involving the upper limbs. This is because of the greater incidence of injuries to the median, ulnar, and radial nerves, and the hitherto somewhat disappointing results of repair of the sciatic nerve, which is the nerve most frequently injured in the lower extremity. In a 5-year study including 20 sciatic nerve lesions, 11 patients were treated with end-to-end suture; of these only three, all with a clean-cut wound, achieved a useful recovery. Secondary repair of the sciatic nerve has been reported by Millesi, who used autografts, but the motor-function outcome was equally disappointing, especially in the peroneal part of the nerve. Despite these results, all attempts at an accurate repair should be made, because of the good prognosis for sensory function, thus avoiding the problem of recurrent pressure sores. Reports of repair of the tibial nerve and the peroneal nerve are very few. Kline reported two peroneal nerve repairs with end-to-end suture, and Millesi reported seven peroneal nerve repairs with autografts, but the results cannot be evaluated, as an additional transposition of the posterior tibial muscle was done in the majority of these cases.

Contrary to the sciatic nerve, the femoral nerve seems to have an excellent ability to recover. With microsurgical autografting, femoral nerve repair both in the abdomen and in the femoral triangle is no more difficult than other nerve repairs. The use of nerve grafts will prevent any tension at the suture line, which means that it is no longer necessary to immobilize the hip joint in a flexed position for several weeks, as was the case with Clare's two patients. In lesions at the site of the nerve branching, one can use as many grafts as desired to achieve reinnervation in all parts of the quadriceps muscle. In cases with extensive defects, where the distal stumps cannot be found, the grafts can be implanted directly into the muscle bulk at the site of its maximal electrical irritability.

References


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