

AUTOGENOUS NERVE GRAFTING

Report of a Case

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Nerve grafting should be considered in lesions of peripheral nerves with gaps so extensive that they cannot be bridged by the usual methods (viz. mobilization of nerve-stumps, resection back to healthy bundles centrally and peripherally, and end-to-end suture with the limb in a position that permits of easy approximation, followed by nerve stretching, and in isolated cases bone shortening). In a comprehensive analysis of 1681 cases of nerve injuries from the last war Seddon (1947) found that nerve grafting was necessary in 8 per cent of the cases requiring operative repair, while the lesions in 19 per cent were so extensive that surgery was not undertaken.

In Department II of the Orthopaedic Hospital, Copenhagen, a case of peripheral nerve injury caused by an open fracture has been treated with nerve grafting.

Case report: The patient is a 14 year old boy. At the age of seven he fell from his bicycle and sustained an open supracondylar fracture of the left humerus. After emergency treatment at the provincial hospital he was transferred to our department. A total paralysis of the left musculospiral nerve was diagnosed. After the primary wound had healed, exploration of the nerve and operative reduction of the fracture were decided upon. At operation (Aug. 10th., 1943) the left musculospiral nerve was found imbedded in fibrous tissue just beside the fracture, flattened and partially severed; one third of the trunk was undamaged. A partial suture was undertaken and the fracture set. There were, however, some difficulties with the fracture before satisfactory healing took place.

A total left radial paralysis persisted, and in the autumn of 1944 it was decided to explore the nerve once more (Nov. 10th., 1944). At operation it was found to be thin and was compressed by scar tissue adhering to the periosteum of the distal part of the left humerus to about 8 cm proximal to the lateral epicondyle of the humerus. About an inch further proximally (inside the triceps muscle) the nerve trunk was normal. As Faradic stimulation of the nerve did not provoke any muscular response, a 10 cm. piece of fibrous nerve was resected. The resulting

gap was bridged with an autogenous graft from the right sural nerve, the proximal part of which consisted of two branches. The suture was done with no. 0 silk and the graft was covered with fat (Fig. 1).

After a period of immobilization, physical treatment and electric stimulation were started.

However, as a follow-up two years later showed no function in the musculospiral nerve, a tendon-transplantation was planned.

In October, 1949, when he was 14 years old, the boy was admitted to our department for operation. At this time slight, but useful function of some of the extensor muscles of the left forearm was found.

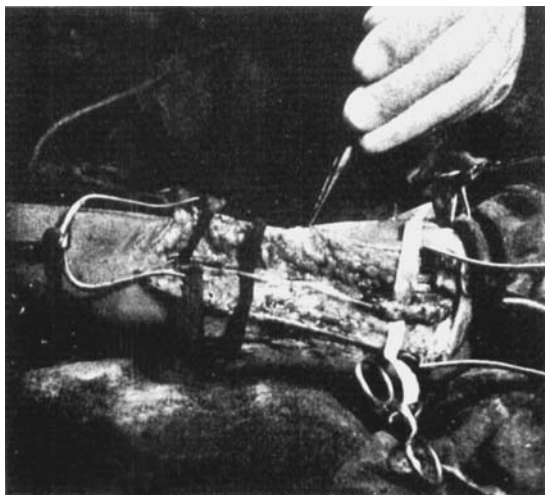


Fig. 1.

The proximal end of the graft is to the right.

He could extend his left hand, but no active dorsal flexion could be undertaken. With the wrist-joint in maximal volar flexion the fingers could be extended (trick-movement). Active extension and opposition of the thumb could be performed. Muscle examination showed: E. C. Rad. L. 3, supination 5, E. Com. D. O, E. C. Uln. 2, Abd. P. L. O, E. P. Br. ?, E. P. L. 4. There were no sensory disturbances of the skin.

Electromyography showed a heavy loss of motor units in the left E. Com. D., i.e. a neurogenic paresis, but no total disruption. No isolation examination of the left Abd. P. L. could be carried out.

On November 8th. 1949 the left musculospiral nerve was explored (vide fig. 1). The thin graft was seen to have neuroma of the size of a small cherry stone at the proximal end, and a fusiform swelling at the distal end; there were fine fibrous adhesions at the points of suture. Proximal and distal to the graft the nerve was normal. Faradic stimulation above and below the graft caused contraction of E. Com. D., E. C. Rad., and E. P. L. (2-3).

To strengthen the weak E. Com. D. function a transplantation of the F. C. Uln. tendon to the E. Com. D. tendons was performed with good result.

After-treatment with plaster and later splints.

Epicrisis: A case of total paralysis of the left musculospiral nerve in a boy is treated with autograft. 4 years later slight, but useful function of some of the extensor muscles of the left forearm was found. To strengthen the weak E. Com. D., a tendon transplantation was done.

Discussion: Heterogenous nerve grafting with grafts from animals, fixed with formalin (*Gosset and Bertrand*) or alcohol (*Nageotte*), has been an unqualified failure. The same applies to fresh and stored homografts from cadavers or amputation stumps. The best results have been obtained with autogenous grafts (*Klar* (1943), *Sanders* (1945), *Seddon* (1946), *Bristow* (1947), *Forrester-Brown* (1950)); peripheral sensitive nerves are also used, in rare cases peripheral motor nerves.

With nerve-autografts full function can be obtained in experimental animals (*Huber* (1920), *Cajal* (1928), *Bentley & Hill* (1936), *Sanders* (1942)). After inserting a 2 cm. autograft into a gap in the lateral popliteal nerve of a rabbit *Gutmann & Sanders* (1942) obtained the same full recovery as that seen after end-to-end suture. Experiments have pointed out the important rôle played by the Schwann sheaths in the growth of nerve fibres from the central stump (*Young, Holmes & Sanders* (1940), *Holmes & Young* (1942)). To allow growth of all its fibres, a graft must exceed, or at least equal, the diameter of its host nerve. In thick nerves with thick grafts, however, experiments have shown that no recovery followed, and microscopy revealed a widespread fascicular necrosis and fibrous tissue replacement (*Woodhall* (1949)). The so-called cable or multistranded grafts with several parallel thin grafts have given excellent results in experiments and are a necessity in lesions of thick nerves (*Sanders* (1945)). In this connexion the plasma "glue" method of *Young & Medawar* (1940) has been useful.

Until 1939 the clinical results obtained with nerve grafts were, on the whole, poor.

Foerster (1929) obtained isolated successes with autografts in nerve lesions of the upper extremities, and *Gosset and Charrier* claimed 5 successful autografts out of a total of 216 cases. Surgical opinion remained adverse for a long period; this was in accordance with the results of *Platt's* series (1920) from the war 1914-18 comprising 18 cases of nerve grafting, which were all failures.

In lesions of the digital nerves *Bunnell* (1927) obtained promising results. In 1932 *Ballance & Duel* applied nerve grafting in lesions of the facial nerve in cases of otogenic paralysis; in this country *Kettel* (1944, 1950) has continued this work. In both the above regions a graft of suitable thickness is easily obtained. In lesions of thicker

nerves the difficulty is to get grafts of suitable thickness. On the clinical value of cable graft opinions remained divided for a long time (*Davis, Perret & Carroll (1945)*).

Since grafting of the digital and facial nerves has become a generally accepted procedure, there is no reason why grafts should not succeed when implanted into peripheral nerves. In 1939 *Bunnell & Boyes* described 5 cases of grafting in main nerve-trunks with a partial though useful recovery. Our own case is of this type.

Much scepticism prevails in U.S. literature on the value of nerve grafting in clinical surgery and especially concerning cable grafts (*Spurling, Lyons, Whitcomb & Woodhall (1945)*). *Davis, Perret & Carroll (1945)*). Thus *Coleman (1946)* writes that grafting is of doubtful clinical use, and *Woodhall* in his recent review (1949) of peripheral nerve surgery writes that "more energy and talent has been wasted on the method than it deserves".

British surgeons, on the whole, are more positive in their approach (*Seddon, Holmes & Young (1942)*, *Bristow (1947)*, *Forrester-Brown (1950)*).

In *Seddon's* material from the Peripheral Nerve Injury Centre at Oxford from the late war autogenous grafting was performed in 58 out of 699 cases of peripheral nerve lesion. 52 of these have been observed for a sufficient length of time to permit assessment of the efficacy of the operation. In 20 cases (38 %) functional recovery was as good as that seen after the most satisfactory end-to-end suture. In a further 7 cases recovery is progressing so satisfactorily that it will probably be as good as in the first 20. Partial, but useful recovery was seen in 8 cases. The operation has thus been of value in no less than 35 of 52 cases, i.e. 67 %. And most cases were lesions of main nerve trunks in the upper extremities.

On the basis of his experience *Seddon* recommends early operation as soon as the original wound has healed. Resection of the peripheral stumps may be necessary on account of scarring. To allow for shrinking of the graft, cable transplants about 15 per cent longer than the defects to be bridged are recommended, and should be at least of the same calibre as the stumps. Scar tissue should be excised, as the graft is nourished from the stumps and from tissue surrounding it. The plasma glue method is preferred.

Thus autogenous nerve grafting is a method which, according to *Seddon*, in suitable cases may yield results equal to those obtained in end-to-end suture. For technical reasons operations of this category should probably be centralized in clinics with experience in the treatment of peripheral nerve lesions.

SUMMARY

A case of autogenous nerve grafting in the repair of a lesion of the left musculospiral nerve complicating an open supracondylar fracture of the humerus in a boy is reported. Partial, but useful restitution resulted, especially in the thumb extensors. As the action of E. Com. D. was very weak, a tendon transplantation of F. C. Uln. was done. The literature is reviewed, and the remarkable results obtained by *Seddon* with autogenous grafts in peripheral nerve lesions are stressed.

ZUSAMMENFASSUNG

Ein Fall von autogener Nervenverpflanzung zur Wiederherstellung einer Schädigung des linken n. radialis, die bei einer komplizierten Fraktur des Humerus eines Knabens auftrat, wird berichtet. Teilweise, doch nutzbringende Wiederherstellung war das Ergebnis, besonders in der Funktion der Daumenstrecker. Da die Funktion des Ext. digit. commun. sehr schwach war, wurde eine Sehnentransplantation des Flex. carpi uln. ausgeführt. Die Litteratur wird besprochen und die bedeutenden Erfolge, die *Seddon* mit der autogenen Nervenverpflanzung erzielt hat werden hervorgehoben.

RESUME

Il est rapporté un cas de greffe autogène nerveuse pour la réparation d'une lésion du nerf gauche musculospiral, compliquée de fracture supracondylaire ouverte de l'humérus chez un garçon. Il en est résulté une guérison partielle mais utile, particulièrement des extenseurs du pouce. Etant donné que la capacité d'action du m. ext. dig. com. était très faible, il a été pratiqué une transplantation du tendon du m. flex. carp. uln. La littérature est passé en revue et les remarquables résultats obtenus par *Seddon* avec les greffes autogènes dans les lésions des nerfs périphériques ont relevés.

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