A TECHNIQUE FOR TRANSPLANT OF THE MUSCULOSPIRAL NERVE IN OPEN REDUCTION OF FRACTURES OF THE MID-SHAFT OF THE HUMERUS

MAX T. SCHNITKER, M.D.*
Toledo, Ohio

(Received for publication May 27, 1948)

Fractures of the mid-shaft of the humerus have associated injury to the musculospiral nerve frequently because of the peculiar course of the nerve along the bony groove approximately 7 inches long. Technical difficulties arise in dealing with the nerve when open reduction and internal fixation of the fractured humerus are desirable. This can be solved by transplanting the nerve.

The incidence of injury to the musculospiral nerve in fractures of the mid-shaft is given as about 4 per cent in civilian practice and about 30 per cent in war wounds. In cases of simple transverse fractures with contusion of the nerve, spontaneous recovery occurs in most instances under proper treatment, especially with the use of the hanging cast. However, in spiral type fractures that occur in the line of the radial groove, and in comminuted fractures, complete immobilization is more difficult so that repeated trauma accentuates the original nerve damage. Ununited fractures occur most frequently in the mid-shaft of the humerus, also with an associated higher incidence of musculospiral nerve injury. Of 226 fractures of the humerus reported by Campbell, 52 (23 per cent) were ununited, with an associated nerve injury in 8 cases (15 per cent).

Operative treatment is usually reserved for cases of non- or mal-union of the bone or for progressing paralysis or delayed recovery of the musculospiral nerve function. In cases requiring bony fixation, but without nerve injury, this is best accomplished through the incision of Henry by splitting the brachialis muscle just lateral to the edge of the biceps and leaving the nerve buried in the posterior muscle. In the cases requiring nerve exploration or repair in conjunction with the fixation of the fracture, it is felt that the nerve should be transplanted to the medial side of the arm particularly in cases of neurorrhaphy so that the nerve will follow a shorter course under less tension, be protected by a muscular bed and be far removed from the foreign body used for internal fixation. Such a transplant can be done easily whether the nerve has been divided or even when the nerve continuity is still intact.

TECHNIQUE

The operation to be described can be done under local or general anesthesia. The entire upper arm is prepared by sterile technique and the arm abducted at the shoulder with the elbow flexed. A straight incision is made along the lateral aspect

* 1081 Secor Hotel Bldg., Toledo 4, Ohio.
of the arm from a point just proximal and posterior to the insertion of the deltoid muscle and carried distally along the external intermuscular septum toward the external epicondyle of the humerus to the groove between the brachioradialis and the brachialis muscles. (This incision is posterior to the usual one that separates the brachialis fibers.) The fascia of the lateral intermuscular septum is divided from bone distally to the origin of the brachioradialis muscle. The brachialis muscle is retracted anteriorly and the lateral head of the triceps retracted posteriorly. This will expose the musculospiral nerve lying in its bony groove. The nerve is then freed

for its entire length, proximally to the composite teres-latissimus tendon and distally into the brachialis-brachioradialis groove, care being exercised in preserving the anterior radial recurrent artery at this point. A ½” linen umbilical tape is passed around the nerve and it is retracted laterally out of the way. The lateral and medial bellies of the triceps muscle are gently stripped off the posterior surface of the humerus (proximal segment) to above the upper end of the radial groove, care being taken to preserve the superior profunda artery which lies lateral to the nerve. The branch of the nerve going to the lateral head of the triceps will be seen at this point and its fasciculus can be dissected from the main nerve for several cm. if necessary to procure mobilization of the main trunk. The superficial cutaneous branch of the nerve is given off in this vicinity also, but since it runs an independent course in the loose fascia of the main trunk (Sunderland), it, too, can be dissected free to the brachio-axillary angle to allow for mobilization of the main trunk, or it can be sacrificed with minimal sensory impairment. Similarly, the brachialis muscle is then gently stripped off the anterior surface of the humerus (distal segment) to the point where the branch of the musculospiral is given off to the brachioradialis muscle (Fig. 1). By gentle manipulation, the bone ends are then separated and the intact nerve is passed posterior to the upper fragment and anterior to the lower fragment with the nerve passing between the bone ends as one would pass a key chain through a key ring (Fig. 2). This places the nerve along the medial surface of the humeral shaft (Fig. 3).
A longitudinal counter incision is then made about 7 cm. long along the midportion of the medial aspect of the upper arm, along the bicipital groove. The neurovascular bundle comprising the median and ulnar nerves and brachial vessels are identified and retracted anteriorly. The musculospiral nerve is then placed posterior to the neurovascular bundle and comes to lie between the medial head of the triceps posteriorly and the attachment of the coracobrachialis muscle anteriorly (Fig. 4). In its new bed, the nerve lies between the medial border of the triceps and the coracobrachialis muscle in the upper portion of the arm and beneath the brachi-
alis muscle to curve around its lateral border in the lower portion of the arm (Fig. 3). This transplanted position removes the nerve entirely from the lateral surface of the fracture so that fixation of the fracture with a metallic plate, bone inlay graft or on-lay grafts can be carried out without interference to later nerve function.

When using a metallic plate or on-lay graft transfixed with through-and-through screws, care must be taken that the screw point protruding through the opposite cortex is made to lie buried in muscle and not to lie adjacent to any of the nerves or blood vessels in the neurovascular bundle. Control of bleeding must be carried out meticulously, especially along the new bed for the nerve. Muscle fibers of the inner head of the triceps and the medial brachialis are then coapted over the fracture site and beneath the transplanted nerve to protect it from the bone fragments. Closure of both wounds is then done in the accepted manner without drainage. A well-fitting plaster cast is then applied with the hand in a cock-up position with the thumb in a grasping position and a little abducted, nearly opposite the index finger. Free movement of all fingers is imperative.

Measurements made at the operating table and on cadaver specimens show that in cases in which the musculospiral nerve has been severed, the largest gap that can be closed for an end-to-end anastomosis along the normal course of the nerve is 4–6 cm. By means of the transplant described, an additional 3–4 cm. of nerve can be gained, permitting closure of a gap up to 9–10 cm. Seddon suggests sacrificing the branch of the nerve going to the brachioradialis muscle in order to gain additional nerve length, but the same gain can be accomplished by the transplant without the sacrifice of this important branch. If additional nerve length is required, the humerus can be shortened as necessary.

The question arises as to what length of nerve can be stripped safely out
of its bed without jeopardizing its blood supply. The large experience gained during the last war seemed to indicate that a large nerve could be dissected out of its bed for its entire length from joint to joint in either the upper or lower arm or leg, if gentle and meticulous technique were used. Sunderland has pointed out that the intraneural vascular plexus is adequate for the entire length of a nerve providing the main nutrient arteries are preserved. In the case of the musculospiral nerve in this discussion, the most constant nutrient arteries that must and can be preserved are the profunda brachii at the upper end of the spiral groove and the anterior radial recurrent artery in the intermuscular furrow between the brachialis muscle medially and the muscles arising from the supracondylar line laterally.

SUMMARY

A technique is proposed and described for the transplant of the intact musculospiral nerve through the fissure between the bone fragments in selected cases of fracture of the mid-shaft of the humerus that require open reduction. This procedure is recommended for the complicated cases requiring bony fixation, especially if the musculospiral nerve has been injured and recovery is not complete. The transplantation of the nerve places it into a more suitable soft-tissue bed and removes it from possible further injury incident to the operative repair and healing of the fracture.

REFERENCES