Endoscopically Assisted Sural Nerve Harvest in Infants

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ABSTRACT

A technique of endoscopic sural nerve harvest was devised to minimize the donor site scarring in infants requiring peripheral nerve grafting procedures. The harvests were performed under tourniquet control using three 2-cm incisions for access at the lateral malleolus, midcalf, and popliteal fossa. Endoscopic visualization and blunt dissection of the nerve was achieved with a 4-mm-diameter, 18-cm-long telescope with a 0-degree angle lens, stabilized in an Emory retractor and attached to a video camera. The medial sural nerve was divided in the popliteal fossa proximally under direct vision. The lateral sural nerve was identified and harvested when present. This technique has been in use since 1994 and has been undertaken in more than 200 patients. The most common indication for surgery was obstetrical brachial plexus palsy. No nerve graft injury was noted upon examination under the operating microscope. Postoperative pain, swelling, and ecchymosis were minimal. Most patients have a detectable area of sensory loss at long-term follow-up but are unaware of this finding. Donor site scarring has been aesthetically satisfactory.

KEYWORDS: Nerve, surgery, endoscope, infants, brachial plexus, obstetrical

Infants and children are not infrequently candidates for nerve grafting procedures. Indications for peripheral nerve reconstruction include congenital lesions, such as facial paralysis and obstetrical brachial plexus palsy, as well as posttraumatic nerve lesions. Donor nerves are selected depending on the length of graft required, the size of the patient, and donor site morbidity. The sural nerves remain the most abundant source of graft material. Additional advantages of the sural nerve autograft include minimal branching along its course and minimal deficit as a result of harvest.¹⁻³

Sural nerve harvest has traditionally been performed through a "stocking-seam" posterior lower-leg incision. This approach has the advantage of providing excellent visualization of the entire sural nerve anat-

omy.⁴⁻⁶ In particular, the lateral sural nerve, a communicating branch from the common peroneal nerve, can be identified and harvested if additional length of graft is needed. The resultant donor site scar has a tendency to thicken and widen, however, and can be aesthetically unsatisfactory (Fig. 1). Sural nerve harvest using multiple, small transverse incisions yields better donor site scars, but the limited visualization makes the nerve vulnerable to injury.⁷ Similarly, the use of a tendon stripper and a short incision at the ankle can result in injury to the nerve graft⁸⁻¹¹ and does not allow visualization of potentially useful branches.

A technique of endoscopic sural nerve harvest was devised to minimize donor site scarring in pediatric patients requiring nerve grafting procedures while

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Figure 1 Donor site scar 12 months postoperatively using the open technique of sural nerve harvest.

providing uninjured nerve material for grafting. In addition, good visualization of the entire sural nerve anatomy is possible, as is harvest of the maximal length of graft material.

TECHNIQUE

All sural nerve harvests are performed under general endotracheal anesthesia. The entire lower limbs are prepared from the groin distally and draped into the operative field.¹² For obstetrical brachial plexus palsy, we usually begin the procedure with the sural nerve harvest, undertaken with the patient in the prone position. This is possible in patients for whom we are reasonably certain to require nerve grafts and eliminates the need to turn the patient after the neck dissection has been completed. Harvesting the nerves in the prone position allows the surgeon to use the Emory retractor both to elevate the skin away from the nerve and to support the leg with one hand, freeing the other hand for the use of scissors (Fig. 1). Overall, the dissection is more rapid, less fatiguing, and less assistance is required than in the supine position. Both legs can be operated on simultaneously with ease.¹³

The expected course of the sural nerve is marked along the posterior aspect of the legs. Transverse 2-cm incisions are marked at the level of the lateral malleolus, at the midcalf at the inferior margin of the bulge of the gastrocnemius muscle, and in the crease of the popliteal

Figure 2 Equipment used in endoscopic sural nerve harvest: 4-mm-diameter, 18-cm-long telescope with 0-degree angle lens and attached video camera, stabilized in an Emory retractor.

fossa. All harvests are performed under sterile tourniquet control. The first incision is made posterior to the lateral malleolus, and the sural nerve is identified. An assistant is required to hold skin retractors while the incisions are being opened but not during the endoscopic dissection itself. A subcutaneous pocket is dissected around the distal nerve to allow insertion of the retractor and endoscope. This pocket is developed up to the level of the midcalf incision before the endoscope is brought into play.

A 4-mm-diameter, 18-cm-long telescope with a 0-degree angle lens with attached video camera (Fig. 2) is inserted into the proximal subcutaneous tunnel through an Emory retractor. The retractor, held by the surgeon, provides stabilization of the endoscope and maintenance of the optic cavity using the tent principle (Fig. 3). Blunt dissection of the nerve under endoscopic visualization is achieved using tenotomy or Metzenbaum scissors of a length proportional to that

Figure 3 The apparatus, inserted into the distal subcutaneous tunnel, is held by the surgeon while an assistant provides stabilization and countertraction.

of the limb. We have found the spreading width of endoscopic scissor blades too narrow to develop an adequate subcutaneous tunnel. Dissection is performed superficial to the nerve only to release it from the overlying subcutaneous tissue. Circumferential dissection is not necessary and may lead to inadvertent nerve injury. The sural nerve is easily differentiated from the adjacent lesser saphenous vein using the endoscopic view (Fig. 4).

As one approaches the midcalf, the sural nerve lies deep to the fascia of the superficial posterior compartment of the leg, between the two heads of the gastrocnemius muscle.^{4,14,15} Dissection from the distal subcutaneous tunnel becomes more difficult, and this anatomy is best approached from the midcalf incision.

A second, transverse, midline 2-cm incision is made at the level of the distal gastrocnemius muscle and is extended through the fascia. The nerve is identified, and a subfascial pocket is created. The dissection is then continued under direct vision both distally to join the original distal pocket and proximally toward the popliteal fossa. The telescope can then be directed through the midcalf, subfascial incision proximally, toward the popliteal fossa. The dissection exposes the medial or common sural nerve lying between the muscle bellies of the gastrocnemius muscle. The lateral sural nerve, when present and joining the medial sural nerve distally, is usually seen at this point during the procedure. Additional branching is only rarely encountered, and blunt, spreading dissection can be continued to the level of the popliteal fossa.

The final incision is made in the crease of the popliteal fossa where the origins of the branches of the nerve can be identified under direct vision as they

arise from the tibial or common peroneal nerves. The branches are divided as far proximally as possible under direct vision.

The nerve graft is delivered into the proximal, midcalf incision with gentle traction. It is then identified distally, at the ankle incision, and gentle traction is again applied. If the sural nerve does not deliver easily through the subcutaneous tunnel into the ankle incision, reinsertion of the endoscope and blunt dissection at the point of tethering releases it. This is most readily accomplished by advancing the endoscopic apparatus through the midcalf incision toward the ankle incision. The nerve is then dissected distally into the lateral foot and divided as far distally as possible through the ankle incision. The proximal end of the nerve is marked with ink to facilitate orientation during grafting.

The tourniquet is then released and removed. The incisions are closed with absorbable subcutaneous and intracuticular sutures. Skin tapes and a light bandage complete the dressing. Weight bearing is permitted on the first postoperative day in ambulatory patients, and the leg dressing is usually discarded after 48 hours.

RESULTS

This technique has been in use since 1994 and has been undertaken in more than 200 patients. The most common indication for surgery was obstetrical brachial plexus palsy followed by other nerve lesions in childhood. Postoperative pain, swelling, and ecchymosis appeared minimal.

All nerve grafts were examined under the operating microscope. No visible nerve graft injuries were noted during the harvesting procedure, and minimal defatting was required prior to neurorrhaphy.

All patients have been assessed in follow-up. Donor site complications have been limited to suture extrusion and several small areas of superficial skin slough in one child who had a tensor bandage applied too tightly in the operating room. We no longer apply tensor bandages after this procedure. Postoperative pain, swelling, and ecchymosis have been minimal. No hematoma, seroma, infection, or wound dehiscence has been encountered. Resultant scarring has been aesthetically satisfactory to date (Fig. 5).

The postoperative sensory loss has been evaluated by mapping sensory thresholds in the sural nerve distribution using the Semmes Weinstein monofilament method and a questionnaire to elicit subjective findings.³ In 14 operated patients, 86% of the operated feet demonstrated a measurable sensory deficit. The patients reported no concerns regarding the sensation of their feet in the questionnaire. Although sural nerve harvesting in children leaves a measurable sensory deficit, this does not seem to have clinical implications for the patients.

Figure 4 Endoscopic view of the subcutaneous distal sural nerve (SN) and adjacent lesser saphenous vein (LSV).

Figure 5 Donor site scars 6 months postoperatively using endoscopic sural nerve harvest technique.

DISCUSSION

In plastic surgery, the indications for endoscopic techniques are expanding. Obvious advantages include shorter incisions and therefore less visible scarring, as well as decreased postoperative pain and shorter recovery time.^{16,17}

Pediatric patients are good candidates for minimally invasive endoscopic procedures for several reasons. Using open techniques, the incisions required for adequate visualization are often longer relative to the patient's size than in the adult. Unfavorable healing, such as hypertrophic scarring, is more common in this patient population. Additionally, the resultant scarring is present during the formative years of these young patients' lives and may impact negatively on their psychosocial development.

Pediatric patients undergoing nerve reconstruction frequently require harvest of long segments of nerve graft. The traditional incisions used in sural nerve harvest result in conspicuous lower-extremity scars or leave the nerve vulnerable to injury. The use of the described endoscopic technique for sural nerve harvest limits this donor site morbidity without compromising visualization of the graft. Maximal length of graft may be obtained through three short incisions.

The lateral sural nerve can also be harvested using the endoscopic technique. Whereas the incidence of the lateral sural nerve in adult cadaver studies is reported to be between 40% and 100%,^{4,6,14,15} we found this communicating branch in about one quarter of our patients.

Possible explanations would include true absence of the lateral sural nerve, very-small-caliber nerves that escaped detection, or limited sensitivity of endoscopic visualization. The charts of 17 earlier patients who underwent 28 open sural nerve harvests were retrospectively reviewed for comparison. The lateral sural nerve was identified in only 18% of these lower extremities, arguing against a limitation of the endoscopic technique.

There is doubtless a learning curve associated with this technique, and operative time should diminish as the surgeon's experience increases. In spite of the novelty of the technique, however, associated morbidity has been minimal. Endoscopic sural nerve harvest is a safe, predictable technique that minimizes donor site morbidity without compromising the nerve graft.

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