Single-Incision Endoscopic Sural Nerve Harvest for Cross Face Nerve Grafting

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ABSTRACT

Cross face nerve grafting followed by free muscle transfer has become a standard of care in rehabilitation of the paralyzed face. In an effort to address the surgical morbidity of sural nerve harvest, multiple groups have attempted to minimize lower extremity trauma from sural nerve harvest. In very preliminary studies, investigators have adapted the use of vein harvesting equipment for harvest of the sural nerve. In this article we describe the use of endoscopic vein harvesting equipment for sural nerve harvest in a series of eight patients undergoing facial reanimation, in which a single distal incision is made posterior to the lateral malleolus. Eight patients presented for first-stage cross face nerve grafting for facial reanimation over a 6-month period. Each patient was operated on using a two-team approach. One team exposed the donor branches of the facial nerve on the healthy side while the endoscopic harvest was simultaneously executed in the lower limb by the second team. In each case, the sural nerve graft >20 cm in length was removed through a single 1.5-cm incision. There were no complications. Operative times decreased steadily throughout the period examined and were <20 minutes for the last two patients. For the final two cases, a modified sural nerve stripper was introduced through the instrument portal of the VasoView device (Guidant Co., Natick, MA), which contained a small notch through which the nerve could be threaded, greatly facilitating dissection. This contributed to decreasing operative times. Thus we combined the technological advances of a sophisticated endoscopic system with our minimally invasive nerve stripper technique to improve sural nerve harvest. We found no increased morbidity from the endoscopic approach, and in all cases we were able to remove the nerve through a single incision. The endoscopic sural nerve harvest is an excellent addition to the armamentarium of the facial reanimation surgeon.

KEYWORDS: Endoscopic nerve harvest, sural nerve

BACKGROUND

Cross face nerve grafting followed by free muscle transfer has become a standard of care in the rehabilitation of the paralyzed face.[1–3] Because it offers the patient the only opportunity for mimetic, involuntary facial motion, it is often used as a first-line procedure, particularly in the pediatric population. Drawbacks to this two-stage procedure include donor site morbidity from sural nerve harvesting, morbidity from the gracilis harvest site, and the failure of introduction of dynamic movement of the

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face, despite proper execution of the operation.[3–5] In an effort to address the surgical morbidity of sural nerve harvest, multiple groups have attempted to minimize lower extremity trauma from sural nerve harvest. Historically, surgical approaches to the sural nerve have undergone constant evolution (Fig. 1). Whereas originally a long lower leg incision was used to harvest the nerve, over the past two decades there has been increased interest in reducing the incision length. A series of stair-step incisions have been described to avoid the long calf incision.[6,7] Others have described the use of a minimally invasive, two-incision technique, whereby a nerve stripper is introduced distally and passed proximally to remove >20 cm of sural nerve.[8,9] Although it is an efficient and elegant technique, it can require additional incisions when the branching pattern of the nerve is unfavorable. Over the past 15 years, interest has been generated in the endoscopic approach to the sural nerve, in an effort to further decrease the number and length of the incisions.[10–14] Also highly valued are techniques that decrease direct trauma to the donor nerve, thus disrupting neural microarchitecture to a lesser degree than what is likely to occur when blindly using the nerve stripper.

With the popularization of endoscopic vein harvest and the emerging application of this approach for radial artery harvesting for coronary artery bypass grafting,[15,16] both the equipment and the operator experience have reached a new level of sophistication. Investigators have adapted the use of vein harvesting equipment for harvest of the sural nerve but included only two patients, with harvest times of 20 to 25 minutes.[17] In this report, we describe the use of endoscopic vein harvesting equipment for sural nerve harvest in a series of eight patients undergoing facial reanimation, in which a single distal incision is made posterior to the lateral malleolus. Our experience has been that >20 cm of sural nerve can be harvested with operative times <20 minutes. We describe a novel hybridization of the nerve stripping technique coupled with the endoscopic vein harvesting equipment. This coupled approach has allowed us to achieve decreased operative time and reduced morbidity.

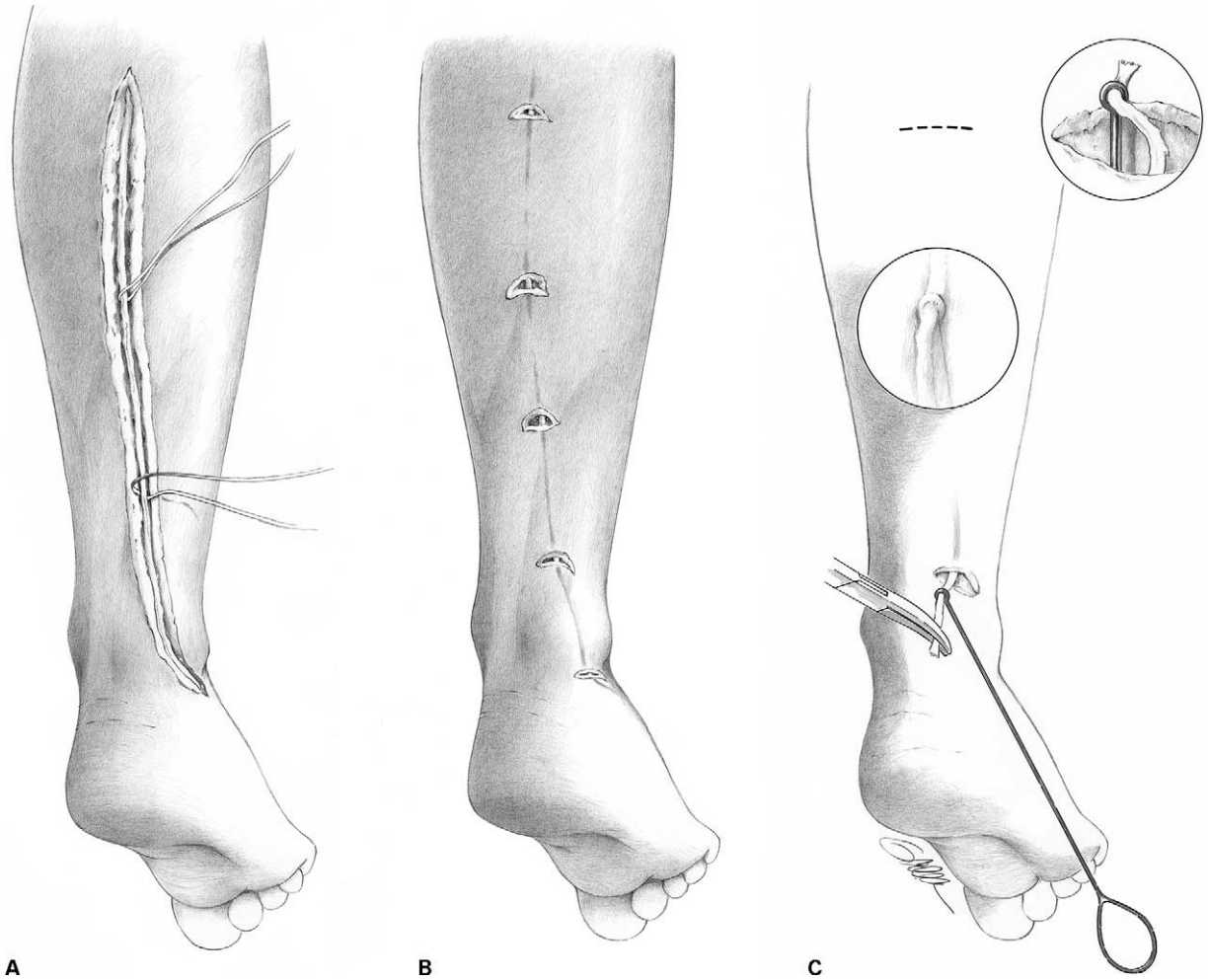

Figure 1 Approaches to the sural nerve. (A) Traditional open approach. (B) Stair-step incisions. (C) Two-incision nerve stripper technique.

METHODS

Between May 2007 and November 2007, eight patients presented for first-stage cross face nerve grafting for facial reanimation. They ranged between 5 and 51 years of age. Each patient presented for the first stage of a two-stage facial reanimation procedure, involving free gracilis transfer in the second stage. In a single patient, the sural nerve was cut into two segments following its removal from the leg and used both for cross face nerve grafting purposes (14 cm) and as a cable graft between the masseteric branch of the trigeminal nerve and the facial nerve on the paralyzed side (3 cm), to provide early reinnervation to the facial musculature. Each patient was operated on using a two-team approach. One team exposed the donor branches of the facial nerve on the healthy side while the endoscopic harvest was simultaneously executed in the lower limb by the second team.

The surgical technique was as follows: A 1.5-cm transverse incision was made posterior to the lateral malleolus. The sural nerve was identified, and a vessel loop was used to isolate the nerve from the surrounding soft tissues (Fig. 2A). Employing the VasoView Uniport Endoscopic Vessel Harvesting System (Guidant Co., Natick, MA), the 5-mm endoscope with conical dissection tip was introduced into the wound (Fig. 2B), and a superficial dissection over the sural nerve was executed superiorly toward the popliteal fossa. This was performed by introducing the endoscope and conical tip directly onto the superficial surface of the exposed segment of the nerve at the wound and advancing the scope in that superficial plane under constant camera visualization on a monitor (Storz Instruments/Bausch and Lomb, San Dimas, CA), permitting the development of a plane between the nerve and the superficial soft tissues. The endoscope was advanced until the desired length of nerve was reached. The endoscope was withdrawn and then readvanced in a plane deep to the sural nerve, to free the soft tissues from the overlying sural nerve (Fig. 2C). A blunt-tipped trocar was then introduced, and a sheath containing both the camera and an instrument port were inserted. A bipolar cutting instrument was passed into the instrument port to facilitate removal of any remaining attachments of the nerve to the surrounding tissues. Once the nerve was freed from all of its attachments, and its branches, if any, were identified and sharply transected, the device was advanced toward the popliteal fossa, until the desired length of nerve was exposed, and the nerve was transected superiorly using the cutting instrument. The device was withdrawn through the distal incision, to accomplish the removal of the entire nerve through a single 1.5-cm incision (Fig. 2D).

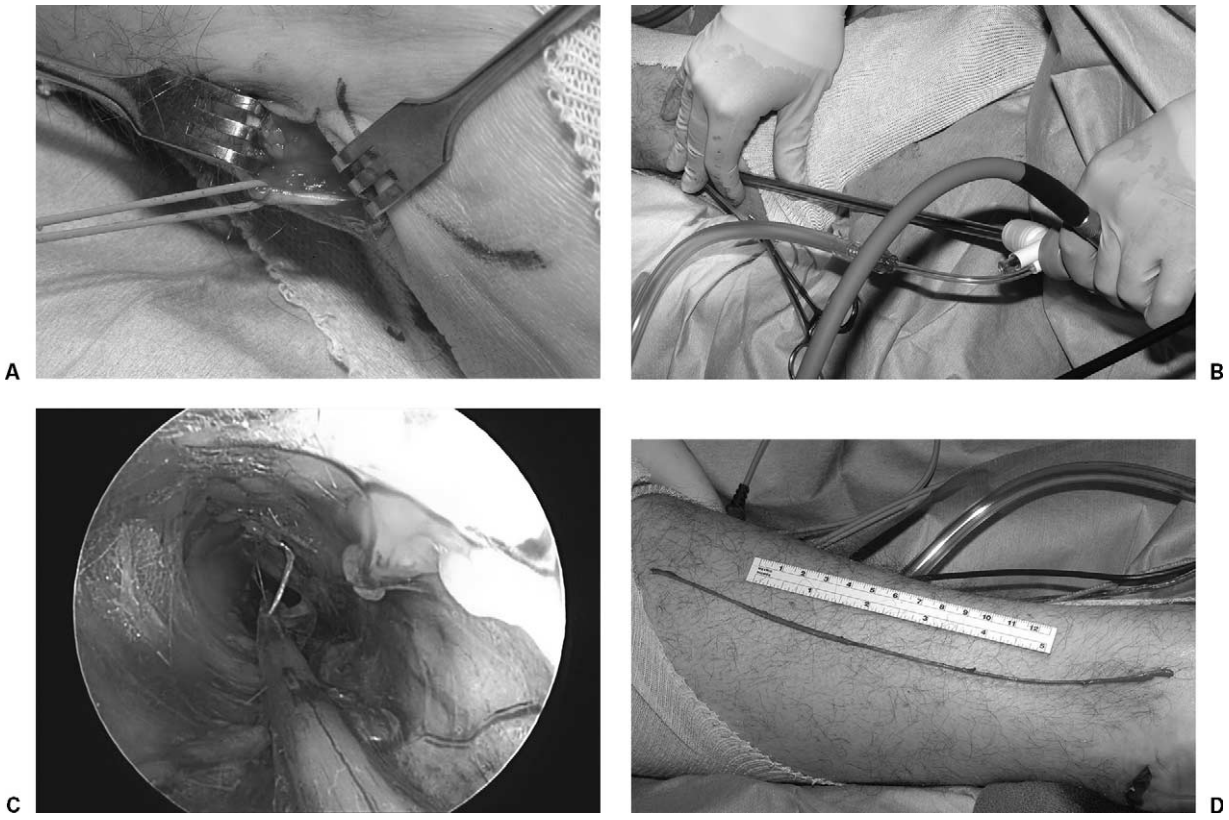

Figure 2 Operative procedure. (A) Identification of sural nerve at ankle. (B) Endoscope introduced through short horizontal incision. (C) Endoscopically isolated sural nerve. (D) Nerve removed through single incision.

RESULTS

In all cases, a sural nerve graft >20 cm in length was easily harvested (range, 20 to 26 cm). No intraoperative injuries to the sural nerve occurred nor were there any inadvertent transections. In each case the visualization of the nerve and its dissection from surrounding tissues proceeded straightforwardly. There were no near-term wound complications in this small series, specifically no breakdown, no infections, and no postoperative hematoma formation. There were no cases of prolonged pain syndromes in the lower limb and no early evidence of traumatic neuroma formation.

Operative times decreased steadily throughout the period examined, with the early cases requiring $\sim$55 minutes and declining to <20 minutes for the last two patients (range 18 to 70 minutes). For the last two cases, a modified sural nerve stripper was introduced through the instrument portal of the VasoView device, which contained a small notch through which the nerve could be threaded (Fig. 3). The nerve stripper was then able to be passed up the length of the nerve under endoscopic visualization, greatly facilitating the nerve's release from surrounding soft tissue and quickly identifying any side branches. This contributed to decreasing operative times and permitted us to achieve the complete harvest in $\sim$20 minutes. This matches the time that it took us, on average, to harvest the sural nerve through a two-nick approach using a closed eyelet nerve stripper technique (Fig. 1C) when we were not impeded by significant sural nerve branching.

DISCUSSION

Free tissue transfer driven by a cross face nerve graft offers patients the unique possibility of mimetic facial function to the paralyzed face. Although the reported success rates from this operation vary widely in the reported literature, failure to achieve dynamic movement remains a troubling possible outcome.[4,5] Attempts to decrease morbidity from any specific stage of this multistage operation are thus worthwhile because surgeons are more inclined to embark on procedures whose eventual outcome is uncertain if the morbidity is minimal.

Over the years, many investigators have attempted to minimize morbidity from sural nerve harvest, and the use of endoscopic equipment has proven to aid achievement of this goal. With the increasing sophistication of endoscopic devices, the technical aspects of the procedure have become easier, and with the widespread employment of endoscopic vein harvest in cardiac surgery operating rooms, the technology has made rapid advances. We combined the technological advances of these more sophisticated endoscopic systems with our minimally invasive nerve stripper techniques to improve sural nerve harvest.

In a series of eight patients who underwent unilateral sural nerve harvest for facial reanimation, we demonstrate shortened operative times and a method that does not require a prone position for harvest, thus permitting facial nerve exploration to proceed in parallel with the nerve harvest. We found no increased morbidity from the endoscopic approach in our small series, and in all cases we were able to remove the nerve through a single incision. This is not technically possible through any of the other techniques already cited.

Figure 3 Modified nerve stripper. Note small notch through which the sural nerve can be passed while still in anatomical continuity.

SUMMARY

Endoscopic harvest of the sural nerve is technically feasible and may offer several advantages over existing techniques. Among these are a single short incision, a reliable harvest time despite any branching pattern, the ability of harvest easily with the patient in a supine position, and possibly less trauma to the nerve than that occurring using blind stripper techniques. Although time and increased numbers of patients will test these potential advantages, it appears that endoscopic sural nerve harvest may be an excellent addition to the armamentarium of the facial reanimation surgeon.

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