Challenges in sciatic nerve repair: anatomical considerations

Laboratory investigation

S. Shelby Burks, M.D., David J. Levi, Seth Hayes, M.D., and Allan D. Levi, M.D., Ph.D.

Department of Neurological Surgery and the Miami Project to Cure Paralysis, University of Miami Miller School of Medicine, Miami, Florida

Object. The object of this study was to highlight the challenge of insufficient donor graft material in peripheral nerve surgery, with a specific focus on sciatic nerve transection requiring autologous sural nerve graft.

Methods. The authors performed an anatomical analysis of cadaveric sciatic and sural nerve tissue. To complement this they also present 3 illustrative clinical cases of sciatic nerve injuries with segmental defects. In the anatomical study, the cross-sectional area (CSA), circumference, diameter, percentage of neural tissue, fat content of the sural nerves, as well as the number of fascicles, were measured from cadaveric samples. The percentage of neural tissue was defined as the CSA of fascicles lined by perineurium relative to the CSA of the sural nerve surrounded by epineurium.

Results. Sural nerve samples were obtained from 8 cadaveric specimens. Mean values and standard deviations from sural nerve measurements were as follows: CSA 2.84 ± 0.91 mm², circumference 6.67 ± 1.60 mm, diameter 2.36 ± 0.43 mm, fat content 0.83 ± 0.91 mm², and number of fascicles 9.88 ± 3.68. The percentage of neural tissue seen on sural nerve cross-section was 33.17% ± 4.96%. One sciatic nerve was also evaluated. It had a CSA of 37.50 mm², with 56% of the CSA representing nerve material. The estimated length of sciatic nerve that could be repaired with a bilateral sural nerve harvest (85 cm) varied from as little as 2.5 cm to as much as 8 cm.

Conclusions. Multiple methods have been used in the past to repair sciatic nerve injury but most commonly, when a considerable gap is present, autologous nerve grafting is required, with sural nerve being the foremost source. As evidenced by the anatomical data reported in this study, a considerable degree of variability exists in the diameter of sural nerve harvests. Conversely, the percentage of neural tissue is relatively consistent across specimens. The authors recommend that the peripheral nerve surgeon take these points into consideration during nerve grafting as insufficient graft material may preclude successful recovery.

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Key Words • injury • nerve • repair • sciatic • sural • peripheral nerve • anatomy

Sciatic nerve injuries are relatively uncommon among peripheral nerve injuries. Typically, injury to this nerve occurs with trauma to the buttock, hip, or posterior thigh. Iatrogenic injury can occur in the setting of injections in the gluteal region or after hip and knee surgery. The sciatic nerve is the largest peripheral nerve in both length and cross-sectional area (CSA), and its size presents anatomical challenges for repair. Furthermore, muscle and sensory targets can be located at considerable distances (for example, 90 cm) from the site of injury. As nerve regeneration progresses at a rate of only 2.5 cm per month—successful regeneration to distal targets is one of the most demanding in peripheral nerve repair. While neurorization techniques have revolutionized the surgical treatment of upper-extremity injuries (for example, brachial plexus injuries), repair of lower-extremity peripheral nerve defects involving a gap relies on more traditional sensory nerve autografts.

Transection of the sciatic nerve occurring distal to the innervation of the posterior thigh (Fig. 1) musculature spares knee flexion so that a patient’s ability to ambulate is often preserved. Ambulatory function in these cases is contingent on a normally functioning quadriceps and an ankle foot orthosis. However, the loss of sensory innervation to the plantar aspect of the foot can lead to serious morbidity, including pressure sores. In addition to restoring motor and/or sensory function, nerve repair can mitigate and/or reduce the incidence and severity of neuroma formation and subsequent development of neuropathic pain. With recent advances in surgical technique and the use of tendon transfers, patients can expect better functional outcomes than ever before. When the damage to the sciatic nerve is extensive enough to preclude coaptation, nerve grafting techniques with autologous sensory nerve graft are used. With large gaps of the sciatic nerve, surgeons will face the challenge of insufficient donor nerve graft material.

In the following study we investigate the detailed anatomy of the sural nerve, which is the nerve most commonly used for autologous grafting. We explore the variability in the size, fascicular content, and amount of epineurium connective tissue in several cadaveric specimens and use these measurements to make assertions about the constraints of this graft material. To further illustrate anatomical constraints of sciatic nerve repair, we pres-
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ent a series of 3 cases in which sural nerve grafting was used to repair lacerating injuries to the sciatic nerve. We present these clinical data to highlight the important issue of insufficient graft material, which is often faced in peripheral nerve surgery. Strategies and future directions in the repair of nerve defects with significant segmental loss will be explored.

Methods

Obtaining Neural Tissue

Sciatic and sural nerve segments were harvested from cadavers with the permission of the University of Miami, Miller School of Medicine Anatomical Board. Sural nerves were identified at their retromalleolar location, and nerve samples were obtained in a location 8–12 cm superior to the lateral malleolus. The sciatic nerve was identified in the superior aspect of the popliteal fossa and was transected 6–10 cm proximal to where the nerve clearly bifurcated into tibial and common peroneal nerves.

Histological Analysis

The nerve samples were postfixed with 1% osmium tetroxide overnight. The fixative was removed, and the specimens were washed in buffer and dehydrated in a graded series of ethanol. The sural and sciatic samples were embedded by passage through propylene oxide and then propylene oxide/Epon-araldite (1:1). Polymerization of Epon-araldite was complete after 16 hours (overnight) at 64°C. The resulting blocks were cut using an ultramicrotome to obtain 1-μm semi-thin transverse sections of the peripheral nerves at their epicenter, which were then stained with toluidine blue. With the aid of a grid, sections were examined for the axonal and connective tissue and a ratio was determined relating the two. Camera lucida drawings were made of the transverse sections and colored for clarity. Measurements were carried out using widely available ImageJ software. The laboratory methods were adopted from Levi et al.25

The sural nerves were measured for total cross-sectional area (CSA), circumference, diameter, percentage of neural tissue, fat content, and number of fascicles. The percentage of neural tissue was defined as the CSA of fascicles lined by perineurium, or the intraperineural tissue, relative to the CSA of epineurium-lined sural nerve. The neuronal fat content was measured as separate globules, and the total fat CSA was then determined. Measurements were carried out by 2 members of the research team and subsequently validated by an independent observer.

Statistical Analysis

The mean fascicle content, diameter, circumference, and CSA for samples were obtained. The means and standard deviations are included in the analysis. Basic mathematical analyses were performed using Microsoft Excel.

Results

Nerve samples were obtained from total of 8 cadaveric specimens (Fig. 2A). Their ages ranged from 60 to 88 years. There were 5 males and 3 females.

The results of this analysis including means and standard deviations are displayed in Table 1. The mean CSA of the sural nerves was 2.84 ± 0.91 mm². The average number of fascicles within the sural nerve was 9.88 (range 4–15 fascicles). Finally, the percentage of neural tissue was remarkably similar for each sural nerve, with a mean value of only 33.2% ± 5%. Thus, only a third of the cross-sectional area of each sural nerve graft represents a regenerative environment for sciatic nerve axons. With a total CSA ranging from a low of 1.20 mm² to a high of 3.75 mm², the relative amount of neural tissue, which regenerating axons would encounter, was thus quite variable.

Some sural nerves have a remarkable amount of fat around and within the nerve. With regard to fat content, there was an average of 0.83 ± 0.91 mm² of fatty tissue located within and outside of the epineurium. The average percentage of fat present within the epineurial borders was 18.18% ± 14.37%. Such measurements demonstrate the wide degree of variability in total fat content. Additionally, they suggest that location of fatty tissue is not uniform among sural nerves. These results are displayed in Table 2. Cross-sections of all 8 sural nerves are displayed in Fig. 1. The tabulated results and images demonstrate the fairly high degree of variability between sural nerve specimens.

We also evaluated one sciatic nerve cross-section (Fig. 2B). Here we calculated a total CSA of 37.50 mm² and a fascicular CSA of 21.00 mm², representing a nerve content of 56%. We then calculated the average length.
of sural nerve (y-axis) required to repair increasingly lengthy segmental defects within the sciatic nerve (x-axis). The large deviations in the error bars illustrate the enormous variability in the CSA of the sural nerve as well as the need for considering alternative measures for nerve graft material with even limited defects (see Fig. 4).

Illustrative Cases

Case 1

A 52-year-old male sustained a deep posterior thigh injury resulting in near amputation of his right leg from a boat propeller. There was a deep soft tissue injury to...
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TABLE 1: Anatomical measurements from sural nerve cross-sections*

<table>
<thead>
<tr>
<th>Nerve</th>
<th>CSA (mm$^2$)</th>
<th>Circumference (mm)</th>
<th>Diameter (mm)</th>
<th>Fascicular CSA (mm$^2$)</th>
<th>Neural Tissue (%)</th>
<th>No. of Fascicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.15</td>
<td>6.54</td>
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<tr>
<td>2</td>
<td>2.62</td>
<td>5.83</td>
<td>1.98</td>
<td>0.86</td>
<td>32.86</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>3.75</td>
<td>9.87</td>
<td>2.96</td>
<td>1.11</td>
<td>29.68</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>3.71</td>
<td>7.30</td>
<td>2.87</td>
<td>1.12</td>
<td>30.22</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>3.69</td>
<td>7.03</td>
<td>2.52</td>
<td>1.02</td>
<td>27.68</td>
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</tr>
<tr>
<td>6</td>
<td>2.43</td>
<td>6.11</td>
<td>2.34</td>
<td>0.78</td>
<td>31.99</td>
<td>14</td>
</tr>
<tr>
<td>7</td>
<td>2.16</td>
<td>6.50</td>
<td>2.13</td>
<td>0.88</td>
<td>40.79</td>
<td>9</td>
</tr>
<tr>
<td>8</td>
<td>1.20</td>
<td>4.20</td>
<td>1.68</td>
<td>0.49</td>
<td>40.79</td>
<td>4</td>
</tr>
<tr>
<td>mean</td>
<td>2.84</td>
<td>6.67</td>
<td>2.36</td>
<td>0.90</td>
<td>33.17</td>
<td>9.88</td>
</tr>
<tr>
<td>SD</td>
<td>0.91</td>
<td>1.60</td>
<td>0.43</td>
<td>0.21</td>
<td>4.96</td>
<td>3.68</td>
</tr>
</tbody>
</table>

* Sural nerves were obtained from formalin-fixed cadaveric specimens 8–12 cm superior to the lateral malleolus. CSA = cross-sectional area.

the thigh and midshaft femoral fracture but no vascular injury present. Neurological examination demonstrated complete loss of motor function (0/5 strength) in foot dorsiflexion, eversion, and plantar flexion, as well as extensor hallucis longus (EHL) function. Loss of sensation was noted on dorsal and plantar aspects of the foot as well as lateral malleolus and posterior and lateral leg, while sensation was preserved on the medial malleolus and medial leg from the femoral nerve/saphenous branch. Knee flexion was 3/5, as the sciatic nerve injury was distal to the branches to the biceps femoris, and obturator nerve function was normal.

Surgical exploration demonstrated complete transection of the sciatic nerve 11 cm above the popliteal fossa, distal to hamstring innervation. Additional injuries to the leg were significant, and repair of the sciatic nerve was delayed for 12 days to allow for definition of the nerve ends. Intraoperatively, the proximal and distal ends of the sciatic nerve were identified, with an estimated 3.5 cm gap between them. After removal of obvious neuromatous portions on both ends the gap was measured as 6.5 cm in length. Bilateral sural nerve grafts were used to connect the sciatic nerve ends. Ultimately, 12 individual sural nerve fascicles were utilized to bridge the defect (Fig. 3A). Graft attachment was achieved with 8-0 nylon sutures supplemented with fibrin glue. Given the paucity of graft material, emphasis was placed on repair of the tibial division of the sciatic nerve.

Case 2

This 31-year-old man was injured when a mortar detonated 15 feet from his location. Metal fragments entered the posterior aspect of his left leg, and he immediately experienced paralysis of the lower leg, including foot dorsiflexion, plantar flexion, and EHL function. The injury was stabilized at a military facility in Iraq. Electromyographic studies performed 4 months postinjury revealed complete loss of function of the tibial nerve and moderate dysfunction of the common peroneal nerve. The hamstring musculature was intact. By this time the patient had regained some function in foot dorsiflexion (2/5 strength) as well as eversion of the foot. He also had

TABLE 2: Analysis of intraneural and extraneural fat content*

<table>
<thead>
<tr>
<th>Nerve</th>
<th>Extraneural (mm$^2$)</th>
<th>Intraneural (mm$^2$)</th>
<th>Total (mm$^2$)</th>
<th>% Intraneural</th>
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<tbody>
<tr>
<td>1</td>
<td>0.16</td>
<td>0.02</td>
<td>0.18</td>
<td>9.00</td>
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<tr>
<td>2</td>
<td>0.20</td>
<td>0.04</td>
<td>0.24</td>
<td>17.63</td>
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<tr>
<td>3</td>
<td>0.48</td>
<td>0.20</td>
<td>0.68</td>
<td>29.70</td>
</tr>
<tr>
<td>4</td>
<td>2.15</td>
<td>0.52</td>
<td>2.68</td>
<td>19.58</td>
</tr>
<tr>
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<td>1.01</td>
<td>0.04</td>
<td>1.06</td>
<td>3.96</td>
</tr>
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<td>6</td>
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<td>0.05</td>
<td>0.10</td>
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<td>0.11</td>
<td>0.02</td>
<td>0.13</td>
<td>12.22</td>
</tr>
<tr>
<td>mean</td>
<td>0.71</td>
<td>0.12</td>
<td>0.83</td>
<td>18.18</td>
</tr>
<tr>
<td>SD</td>
<td>0.77</td>
<td>0.17</td>
<td>0.91</td>
<td>14.37</td>
</tr>
</tbody>
</table>

* Displayed are the cross-sectional area measurements of fat globules present around and within the sural nerves. Fat was deemed to be intraneural when located within the epineurium of the sural nerve and extraneural when located outside of the epineurium.
increasing degrees of neuropathic pain over the entire lateral leg and foot.

Five months after injury the patient was taken to surgery. Intraoperatively, a large area of scar tissue was noted at the site of shrapnel penetration. After extensive resection of the neuroma, the tibial and common peroneal divisions were identified. Intraoperative nerve action potentials revealed weak conduction through the common peroneal nerve and no conduction through the tibial nerve. A 4-cm gap was left in the tibial portion of the sciatic nerve. A sural nerve graft was obtained from the right leg; the length of the harvested nerve tissue was measured 25 cm. Using $5 \times 4$-cm grafts, the gap in the tibial division was approximated (Fig. 3B). Anastomosis was achieved with 7-0 Prolene sutures.

Case 3

This 17-year-old male patient sustained a degloving injury to his posterior right thigh when a tile floor eroded beneath him. When seen in the emergency department, he had no sensation below the knee and 0/5 strength in dorsiflexion, plantar flexion, and EHL function. The patient was brought immediately to the operating theater for repair of an associated venous injury. There were no arterial or osseous injuries. Exploration of the sciatic nerve revealed a complete transection, and the nerve ends were anchored with epineurium tacking sutures.

After his skin, muscular, and venous injuries were stable, about 1 month after the initial injury, the patient underwent sciatic nerve repair. Intraoperatively, a large sciatic nerve neuroma was resected, revealing a 4.5-cm defect. Bilateral sural nerves provided 60 cm of autologous graft material; 10 fascicular segments were applied to the tibial division and 4 to the peroneal division (Fig. 3C). Repair was accomplished with 8-0 nylon sutures.

Discussion

Repair of sciatic transection with the use of nerve grafting has yielded variable success in the past. Some of the largest published studies have been generated from data collected between 1968 to 1999 at Louisiana State University Hospital. Other notable studies include those of Gousheh et al. and Aydin et al., representing primarily military-related injuries of the sciatic nerve. These studies show variable rates of success, depending on the level of injury and whether the tibial or peroneal branches were involved. Focusing on repair requiring autologous nerve graft, the worst outcomes are seen in the peroneal division of the sciatic nerve at the level of the buttock, with good outcomes being reported in 21.4%–24.3% of cases. In contrast, the highest rates of recovery were seen with tibial graft repairs in the mid-thigh, with good outcomes reported in approximately 80% of the cases reported. In addition to location and branch involved, other factors cited as affecting the success of nerve grafts include length of time to surgery (delay > 4 months being associated with worse outcomes), and length of the nerve defect (length > 5 cm being associated with worse outcomes).

The anatomy of the sciatic nerve has been well described in the literature. The sciatic nerve originates from the anterior divisions of L-4 through S-3 and the posterior divisions of L-4 through S-2, thus forming the tibial and peroneal branches, respectively. The sciatic nerve begins as these fibers coalesce entering the gluteal region through the greater sciatic foramen below the piriformis muscle and then courses inferiorly at the midway point between the ischial tuberosity and greater trochanter of the femur. Running down the thigh, it lies just beneath the biceps femoris muscle. Along the entire length of the sciatic nerve, its tibial and peroneal branches are separate and distinct. The tibial and common peroneal nerves are technically formed as the sciatic nerve bifurcates, which is usually in the distal thigh.
nents, which are branches from the tibial and common peroneal nerves, respectively. From its origination in the popliteal fossa, the sural nerve courses down the posterior leg to its, relatively nonvariable, destination at the retromalleolar region. Cadaveric studies have demonstrated a median sural nerve length of 43 cm (range 35–47 cm). In cases of lengthy (> 5 cm) sciatic defects it would be beneficial to know, given the length of the sural nerve, how much nerve tissue will be harvestable. Thus, a central factor would be the cross-sectional area (CSA) of both the sural and sciatic nerves in the patient.

According to our data, the CSA of a sural nerve ranges from 1.2 to 3.75 mm²; additionally, the percentage of the tissue that contains valuable neural structures, represented as the fascicles, averaged about 33%, with a relatively narrow range. To correlate our results with in vivo studies we reviewed ultrasound and MRI data from sciatic and sural nerves in healthy controls (Table 3). Specifically, the sural nerve CSA as measured by ultrasound ranged from 1.44 to 5.3 mm². When averaged, these in vivo measurements have a weighted mean of 3.79 mm². Comparing this to our mean CSA value from the cadaveric studies, 2.84 mm² ± 0.91 mm², we see that the value obtained from ultrasonography is more than 1 standard deviation above that obtained in the laboratory. This may be explained in part by dehydration of the specimens in processing and fixation. Also, one would be more likely to capture fatty and connective tissue surrounding the epineurium when using ultrasound, and we did not include such tissue in our CSA calculation. Furthermore, data from our analysis of nerve-associated fatty tissue (Table 2) suggests that if fat is considered with sural CSA measurement there will be a further increase in the variability between samples. Notably, our cadaveric samples came from a group of donors with an advanced mean age, as would be expected from our method of collection. Although it is known that this type of traumatic injury most commonly occurs in younger adults, we do not believe age to be a factor affecting the measurements presented. While age typically equates to an increased CSA, this correlation has not been seen with the sural nerve near the ankle. Furthermore, at the level of the nerve fascicle; cadaveric data from individuals of various ages showed no correlation between fascicular diameter and age. On the other hand, at the level of individual myelinated axons, changes with age have been documented. It appears that these age-related changes do not affect the nerve CSA at the macroscopic level. To determine the theoretical maximum length of sciatic gap that could be bridged, one can calculate nerve volumes of the sural nerve with the CSA measurements that we have obtained. These results are displayed on Fig. 4. As can be seen, the length of bridgeable gap would be largely dependent on the CSA of the sural nerve and length of the harvested sample. Further extrapolating from these measurements, we estimate, using a 95% confidence interval, that sural nerves with a small CSA would only be able to cover 2.5 cm of sciatic nerve defect, whereas those with larger CSA may bridge up to an 8-cm gap. The calculation of the required sural nerve graft length was based on a volumetric analysis of the product of CSA and the length of the sural nerve needed to fill the 3-dimensional sciatic nerve defect. With the problem of insufficiency in mind, peripheral nerve surgeons can use preoperative imaging (MRI and ultrasonography) to better anticipate graft insufficiency. In such cases, surgeons could employ similar volumetric calculations to those presented here in developing their operative plan.

With the challenges to sural nerve grafting in mind, it would be advantageous to consider the alternatives. One strategy has been to focus the repair on the tibial division of the sciatic nerve and not on the peroneal division. In this method more graft material will be used on the medial portion of the sciatic nerve. The rationale for this stems from a desire to restore plantar flexion and heel sensation as well as the historically poor success with peroneal branch repair. Another option, in line with the previous strategy, is to sacrifice the ipsilateral common peroneal nerve and use this in repair of the tibial branch. Doubt about peroneal branch sacrifice arises from concerns of vascularization of this relatively large-bore nerve. Furthermore, as improvements in peroneal branch restoration are made, this method will become less favorable. Heading in a different direction, an option would be to look for alternative autologous nerves. In the past, small sensory nerves of the forearm and dorsal foot have been harvested, but these nerves may not provide sufficient material for grafting. Use of intercostal nerves has been reported, but

<table>
<thead>
<tr>
<th>Nerve</th>
<th>CSA (mm²)</th>
<th>Variability of CSA (mm²)</th>
<th>Sample Size</th>
<th>Measurement Tool</th>
<th>Authors &amp; Year</th>
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</thead>
<tbody>
<tr>
<td>sciatic</td>
<td>56</td>
<td>range 28–102</td>
<td>19</td>
<td>ultrasound</td>
<td>Latzke et al., 2010</td>
</tr>
<tr>
<td>sciatic</td>
<td>34.2</td>
<td>SEM 5</td>
<td>58</td>
<td>ultrasound</td>
<td>Tagliafico et al., 2012</td>
</tr>
<tr>
<td>sciatic</td>
<td>43.3†</td>
<td>IQR 19.9</td>
<td>10</td>
<td>MRI</td>
<td>Sinclair et al., 2011</td>
</tr>
<tr>
<td>sural</td>
<td>3.6</td>
<td>SEM 11</td>
<td>58</td>
<td>ultrasound</td>
<td>Tagliafico et al., 2012</td>
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<tr>
<td>sural</td>
<td>5.2</td>
<td>95% CI 4.7–5.7</td>
<td>25</td>
<td>ultrasound</td>
<td>Hobson-Webb et al., 2013</td>
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<tr>
<td>sural</td>
<td>1.44</td>
<td>SD 0.34</td>
<td>50</td>
<td>ultrasound</td>
<td>Liu et al., 2012</td>
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<tr>
<td>sural</td>
<td>5.3</td>
<td>SD 1.8</td>
<td>60</td>
<td>ultrasound</td>
<td>Cartwright et al., 2008</td>
</tr>
</tbody>
</table>

* This table depicts the cross-sectional area of both sciatic and sural nerves as measured by various techniques. All sciatic measurements were obtained from the mid-thigh level and all sural nerve measurements were obtained at the level of the calf. SEM = standard deviation; SEM = standard error of the mean; IQR = interquartile range.
† In noted study the approximate CSA measurement was listed as a median.
Due to anatomical considerations, the lower extremity is less amenable to nerve transfer. After exploiting all autologous nerve sources, the next place to look might be cadaveric, allograft tissue. Such a strategy was explored in a case series published by Mackinnon et al. One of their 10 patients did have sciatic nerve injury, and in that case authors were able reconstruct the posterior tibial nerve with 230 cm of allograft tissue and restore protective sensation to the foot. Such an extensive amount of tissue would be impossible to obtain from autograft sources. Lastly, newer options include the use of axon guidance channels (AGCs). AGCs can be made with either acellular autograft tissue or nonbiological material, such as silicone, polyglycolic acid, or collagen. Currently, the FDA has approved 11 types of conduits for clinical use. Many reports of successful nerve repairs using AGCs have been published, with a majority of data pertaining to their use in small-diameter nerves or very short gaps. As AGC technology advances, large-bore nerves with longer gap repairs are being attempted. A recent study addressed this issue of large-bore nerves in 4 patients with injuries.

Fig. 4. Graph showing the length of sural nerve required to bridge sciatic nerve defects of different lengths. The plotted values are based on the means for the sural and sciatic nerve cross-sectional area (CSA) calculated from measurements performed in the cadaveric specimens used in this study. The error bars represent 95% confidence intervals, based upon variation in sural CSA.

Fig. 5. Schematic illustration of of auto-transplantation protocol that could potentially expand Schwann cells from a sural nerve biopsy and transplant them within a tube into a segmental defect within the sciatic nerve. Copyright Allan D. Levi. Published with permission.
of the median nerve (1 case), ulnar nerve (1 case), and brachial plexus (2 cases), using absorbable collagen or polyglycolic acid conduits. Authors followed the patients for variable lengths of time (range 9 months–4 years) and, unfortunately, observed relatively poor outcomes in all 4 cases. They went on to hypothesize that the larger diameter of the nerves grafted played a major role in their poor results. Regarding AGC improvement strategies, some approaches include incorporation of extracellular matrix proteins and/or neurotrophic factors. Results from animal models have been promising. As these supplementation strategies advance, the use of AGCs can be expected influence the repair of large-bore peripheral nerves more dramatically; however, AGCs appear poorly suited for the treatment of sciatic nerve injury at this time.

Conclusions

When appraised collectively, the anatomical data along with the current literature offer much information about the potential for autologous grafting in large-bore peripheral nerve injury. Sciatic nerve injury, specifically, presents its own challenges for the peripheral nerve surgeon. When considering graft repair with sural tissue, several factors must be taken into consideration. In particular, the CSA and fascicular content should be considered, as variability here can preclude successful recovery.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author contributions to the study and manuscript preparation include the following: Conception and design: all authors. Acquisition of data: all authors. Analysis and interpretation of data: all authors. Drafting the article: all authors. Critically revising the article: all authors. Reviewed submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: AD Levi.

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Address correspondence to: Allan D. Levi, M.D., Ph.D., University of Miami Miller School of Medicine, Department of Neurological Surgery, Lois Pope Life Center, 1095 N.W. 14th Terrace (D4-6), Miami, FL 33136. email: alevi@med.miami.edu.