Ethical considerations in elective amputation after traumatic peripheral nerve injuries

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Summary

Traumatic peripheral nerve injuries often complicate extremity trauma, and may cause substantial functional deficits. We have encountered patients who request amputation of such injured extremities, with the goal of prosthetic replacement as a means to restore function. Data on long-term outcomes of limb salvage vs amputation are limited and somewhat contradictory, leaving how to respond to such requests in the hands of the treating physician. We present example cases, drawn from our experience with wounded soldiers in a peripheral nerve injury clinic, in order to facilitate discussion of the ways in which these patients stress the system of medical decision-making while identifying ethical questions central to responding to these requests.

Peripheral nerve injuries (PNI) are encountered in 2%–5% of all trauma patients,^{1,2} but occur much more often in wartime, where up to 88% of trauma survivors have extremity injuries, 15%–25% of which involve the peripheral nerves.^{3–10} Evaluation for traumatic PNI constitutes up to 3.7% of referrals for electrodiagnostic evaluation,¹¹ a percentage that is likely to increase as advances in battlefield medicine and body armor improve survival of combat trauma.^{5,12}

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PNI, particularly from military combat, are often associated with extensive coexisting skeletal, vascular, and soft tissue injuries that may require amputation. However, since the Korean War, rapid access to increasingly sophisticated surgical techniques has dramatically improved the percentage of salvageable extremities,^{6,13} in which varying degrees of residual neurologic dysfunction may remain. A variety of neurosurgical techniques are useful in attempts to restore function to affected individuals, including direct nerve repair, grafting, the use of nerve conduits, and root transfers. The timing of repair is critical: by 2 years, fibrotic replacement of denervated muscles is generally complete,¹⁴ limiting further treatment to orthopedic approaches such as tendon transfer and joint fixation. In some cases, all of the above approaches meet with limited success.

The limitations of current repair strategies contribute to continued high levels of disability experienced by both civilian and military extremity trauma victims.^{15,16} At the same time, advances in prosthetic design provide the opportunity for increasingly dramatic restoration of function.¹⁷ Patients with prosthetic limbs may be able to return to some or all of their premorbid activities. Preservation of independent activities of daily living and participation in exercise and other forms of physical activity may have substantial psychosocial as well as physical benefits.

Although the Lower Extremity Amputation Prevention study found similar functional outcomes after limb salvage and amputation in nonmilitary extremity trauma,¹⁶ the Military Extremity Trauma Amputation/Limb Salvage (METALS) trial found significantly less subjective disability in patients undergoing amputation.¹⁵ Although not without potential confounders, these conflicting results highlight a seemingly counterintuitive possibility: injuries requiring amputation, despite higher initial severity, may have better functional outcomes than those in which the extremity can be saved. The METALS study also found that post-amputation patients were more likely to engage in vigorous physical activity and less likely to screen positive for posttraumatic stress disorder.¹⁵ The relative benefit of limb salvage vs primary amputation on chronic pain is not well-established: studies suggest that pain often persists regardless of treatment strategy, although data on amputation after failed salvage are minimal.^{15,18}

Regardless of advances in prosthetic technology and the data suggesting improved functional outcomes for some amputees, elective amputation and prosthetic replacement of salvaged, physically intact, but functionally impaired limbs is not common. Faced with the question of how to manage considerable neurologic and functional deficits in a salvaged extremity when traditional therapeutic approaches have met with limited success, there is no clear indication for how best to proceed. Even determining when recovery has reached a plateau is difficult: while neuronal regeneration is generally thought to cease by 12 months postinjury, in our experience, subtle changes in symptoms and functional abilities may continue past this point. To provide context for discussion of these questions, we present 2 hypothetical cases, based on patients seen in our PNI clinic and representative of our experience with returning service members from Operation Iraqi Freedom and Operation Enduring Freedom.

Example case 1

A 34-year-old soldier had a right lower extremity injury in a mortar attack resulting in a severe sciatic mononeuropathy. He was initially unable to feel or move the foot. His deficits persisted on evaluation at 1 month, with absent dorsiflexion and plantar flexion and complete sensory loss in the sural, superficial peroneal, and plantar nerve territories. Electrodiagnostic studies

demonstrated a complete sciatic mononeuropathy with no motor unit potentials in any of the sciatic-innervated muscles, consistent with neurotmesis or severe axonotmesis. Magnetic resonance neurography showed transection of the sciatic nerve. Examination at 4 months showed marked atrophy of the distal leg and foot musculature, no change in motor or sensory deficits, and no electrodiagnostic evidence of improvement. Grafting was attempted using autologous sural nerve, but despite a technically successful surgery and good adherence to physical therapy, 6-month and 1-year postoperative assessment showed no change in strength and continued absence of voluntary motor units on EMG.

Prior to his injury, the patient was a competitive distance runner, having completed multiple marathons. His military duties were also extremely physically demanding. Since his injury, he had been unable to run, despite the use of an adaptive ankle-foot orthotic (AFO). He had been reassigned to classroom teaching and administrative duties. He noted extreme dissatisfaction with the inability to run and frustration with limitations in his work abilities.

He expressed interest in elective below-the-knee amputation and prosthetic replacement. He was frustrated that his extremity, while intact and—with the AFO—capable of ambulation, was, to him, functionally useless, preventing almost all of the activities that defined his life. He had been told that given his current level of function, this course of treatment was not an option, but asked to be treated according to his subjective impairment, noting that had the injury severed his leg, prosthetic replacement would have been unquestioned. His injury left him functionally impaired, precluding his desired lifestyle, but intact enough to prompt uncertainty about the treatment that he desired.

Example case 2

A 24-year-old infantryman had a left lower extremity injury in a rocket-propelled grenade blast with open tibia-fibula fractures. After initial stabilization, he was offered the choice of attempted limb salvage vs amputation, and elected to attempt salvage. Further surgical procedures to stabilize the leg were completed. Over the ensuing year, he developed atrophy of the distal leg musculature and had persistent difficulty with dorsiflexion of the ankle despite diligent adherence to physical therapy. At 2 years postinjury, he had Medical Research Council grade 2/5 strength with dorsiflexion, with 20° of active range of motion. Use of an adaptive brace did not allow him to resume desired activities. He also complained of persistent, severe neuropathic pain in the distal lower extremity, which had been refractory to a variety of pharmacologic and complementary medicine approaches.

He requested a trans-tibial amputation and prosthetic replacement in order to achieve pain control, at times acknowledging a “tunnel vision” fixation on this procedure as the only possible option. His providers expressed concern that his chronic pain complaints might continue postoperatively. He hoped to recover enough function to seek work as a police officer, although at the urging of providers concerned about his understanding of realistic outcomes and goals, he began working toward becoming a physical therapist or trainer, in the hope of transition to his desired occupation eventually.

His case underwent a comprehensive, multilevel review, with input from his various care providers, physical and occupational therapists, social workers, case managers, and his military chain of command. As part of the review process, he was required to undergo a psychiatric evaluation pertaining to his request for amputation. Eventually, he was approved for an elective amputation. Leading up to the procedure, the patient continued to express mixed feelings, including a substantial amount of anxiety. He underwent surgery, which was complicated by a postoperative abscess that required prolonged antibiotics and persistent pain control problems.

DISCUSSION

Although hypothetical, these accounts are consistent with our experience evaluating wounded soldiers, and the wishes expressed in these cases are drawn directly from actual patients. We have also seen patients who, as in case 2, initially elected to undergo limb salvage, but despite

a poor functional outcome, resist subsequent recommendations by medical personnel to undergo a delayed, elective amputation and prosthetic replacement. In our experience, these patients are highly motivated to achieve functional improvement, and often place a great deal of import on regaining their physical abilities. They also have direct exposure to other amputees, and are, to one extent or another, aware of the subsequent abilities and limitations.

Working through such cases can be challenging, as treatment planning may create tension within the shared decision-making framework and among the core values of medical ethics: respect for autonomy, beneficence, nonmaleficence, and justice. Balancing these ethical principles while trying to determine what the physician's role should be for these patients is a complex process.

While the physician's role in patient-centered health care transactions continues to evolve, the shared-decision model has widespread appeal.¹⁹ This model requires both physician and patient involvement, with both sides exchanging information and expressing treatment preferences.²⁰ Tensions arise when the parties, despite a shared information-gathering and deliberative process, cannot come to consensus on the best course of treatment,¹⁹ as demonstrated in case 1. Options for resolving these tensions are limited and not intuitively appealing: the provider may transition to an alternative decision model, either conceding the decision or insisting on his or her own preference, or the patient may seek a second opinion. However, cases requiring amputation usually involve multiple providers, ultimately including a surgeon willing to operate.

We therefore raise several questions based on the intersection of medical ethical principles, with the goal of prompting discussion as to how providers should approach these cases. Although neurologists will rarely be making final decisions about whether or not surgical treatments like amputation will go forward, our role in the diagnostic workup, and in counseling on potential treatment options, affords a stake in the discussion. Perhaps, by considering these questions, we will be better able to negotiate the difficult process of shared decision-making and consensus building.

Balancing autonomy and beneficence

Difficulty in achieving consensus stems in large part from the challenge of resolving patient autonomy with the other ethical principles. Respect for autonomy demands that providers allow the patient to request or refuse care. However, in requests for amputation of a partially functional extremity, the interaction between autonomy and beneficence—acting in the best interest of the patient—is far from clear. How much knowledge of the risks and benefits of a procedure does the exercise of autonomy require, especially when long-term data on the use of modern prosthetics are relatively minimal? Is the patient better served by attempts to restore prior function or encouragement to adapt to limitations? How do the patient's immediate interests in resuming physical activities balance against long-term outcomes?

Furthermore, if a patient is determined to pursue one treatment course, whether it be amputation or limb salvage, how deeply should the physician be compelled to inquire as to the psychological factors that influence such a decision? What standard should be used to determine how reasonable a particular request is? As noted in case 2, in-depth psychological screening may be used to evaluate for pathologic drives to self-modification or other underlying motivations, as is done with bariatric and cosmetic surgery (although even in bariatric surgery, formal standards for this screening do not exist).

Finally, an amputated limb with a prosthetic is often quite conspicuous. Weighing the psychosocial advantages and disadvantages of being easily recognized as a trauma survivor or wounded veteran may be necessary to understand the long-term risks and benefits of elective amputation.

Balancing autonomy and nonmaleficence

How do decisions about amputation interact with the physician's directive of *primum non nocere*: first, do no harm? How should one balance the potential harm of an elective

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amputation and lifetime exposure to stump care and prosthetic management with the psychological and physical harm of losing all or most of a patient's baseline functional abilities, not to mention subsequent difficulties maintaining fitness, with the associated risk of a variety of systemic diseases that deconditioning entails?

Balancing autonomy and justice

In an environment of increasing scrutiny and control of medical expenditure, how does one resolve these issues with the principle of justice? Amputation and limb replacement represent a major investment of time and financial expenditure. At what point does a functional impairment become so substantial that these resources should be devoted to a patient with a retained, incompletely functional limb, which can, if nothing else, bear weight and allow ambulation? Does the patient's premorbid ability affect this judgment? In the military medicine practice environment, the majority of these injuries are incurred by individuals whose baseline physical capabilities often exceed those of a similarly aged cohort, as illustrated by the world-class runner in case 1. Is the request for restored function more or less reasonable if the goal is a premorbid level of function that most would agree is above the societal norm?

CONCLUSION

As service members return to the community with traumatic limb injuries, amputations, and prosthetic replacements, the increased public exposure, coupled with the media prominence of amputee athletes, is likely to increase the perception of the functional ground to be regained—or surpassed—with prosthetic limbs. As the science and practice of prosthetics advances, questions about the application of this technology seem likely to grow both more common and more difficult. Beginning a discussion about the ethics surrounding replacing an intact, neurologically impaired extremity will help prepare the neurologic community for a future in which great advances in potential recovery of function arrive hand-in-hand with questions about the appropriate applications of these abilities.

As part of the team of providers involved in caring for patients with traumatic peripheral nerve injuries, neurologists should work to develop answers to the questions above. Answering such questions requires recognition that a functional outcome acceptable to one patient may seem debilitating to the next. This suggests a need for deliberation and consensus-building as a professional society, and should also prompt consideration of further research, particularly on the long-term outcomes in both amputee and limb salvage patients with respect to both their physical health and psychosocial well-being.

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