Management of Pain in Complex Nerve Injuries

Gabrielle Davis, MD[a], Catherine M. Curtin, MD[a,b,*]

KEYWORDS

• Pain • Nerve injuries • Neuropathic pain • Neuroma • CRPS

KEY POINTS

- Nerve injuries often result in severe pain.
- This pain can prevent recovery and return to preinjury function.
- Those who treat nerve injuries need to have several strategies to address pain to achieve the best results for their patients.

INTRODUCTION

Traumatic nerve injuries can be devastating and life changing events leading not only to functional morbidity but also to psychological stress and social constraints. Advances in nerve regeneration and repair have led to significant improvement in motor and sensory outcomes following traumatic injuries. However, despite these advances, certain patients still develop neuropathic chronic pain syndromes (**Fig. 1**). Even in the event of a successful surgical repair with recovered motor function, pain can result in continued disability and poor quality of life. Pain also significantly limits participation in physical and occupational therapy, leading to inferior outcomes. It is difficult to predict which patients will develop persistent pain, and once incurred, pain can be even more challenging to manage. Although there have been numerous studies evaluating the functional, psychosocial, and quality of life after peripheral nerve injuries, few studies have evaluated chronic pain. This review seeks to define the types of pain following peripheral nerve injuries, investigate the pathophysiology and causative factors, and evaluate potential treatment options.

NEUROPATHIC PAIN

Pain after nerve injury is called neuropathic pain and is defined by the International Association for the Study of Pain as pain directly resulting from a lesion or disease affecting the somatosensory system.[1,2] Neuropathic pain often has distinct qualities that set it apart from the pain from soft tissue injury. It can persist long after the injury has healed. Neuropathic pain can occur spontaneously.[3] Common features to neuropathic pain include allodynia, in which pain is induced by typically an innocuous stimuli such as light touch, and hyperalgesia, which is severe pain induced by a typically painful stimuli. Patients will often describe neuropathic pain as burning, pins and needles, shooting, or electrical-type sensation. However, this pain can also be described as throbbing, so that the description of the quality of the pain cannot differentiate neuropathic pain from other processes. For the provider, a diagnosis of neuropathic pain should be considered in the patient with severe pain or prolonged pain after the soft tissue has healed. When a patient has a known nerve injury, the provider should have a low threshold for diagnosing the pain as neuropathic in origin. Neuropathic pain has a unique treatment algorithm, and early recognition and initiation of therapy are key factors.

CHRONIC REGIONAL PAIN SYNDROME

Complex regional pain syndrome (CRPS) is a severe variant of neuropathic pain, and any article

[a] Department of Surgery, Palo Alto VA, Suite 400, 770 Welch Road, Palo Alto, CA 94304, USA; [b] Division of Plastic Surgery, Stanford University, Suite 400, 770 Welch Road, Palo Alto, CA 94304, USA
* Corresponding author. Suite 400, 770 Welch Road, Palo Alto, CA 94304.
E-mail address: curtincatherine@yahoo.com

Hand Clin 32 (2016) 257–262
http://dx.doi.org/10.1016/j.hcl.2015.12.011
0749-0712/16/$ – see front matter Published by Elsevier Inc.

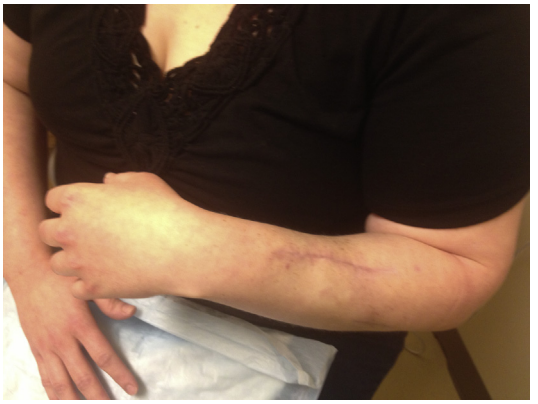

Fig. 1. A woman with chronic nerve pain of the arm after prior nerve injury.

on nerve injuries and pain must include a discussion of CRPS. CRPS is a syndrome with a constellation of symptoms. The one feature common to all patients with CRPS is pain out of proportion that is not explained by any other conditions. To meet the criteria for a diagnosis of CRPS, there must also be other features, including changes in blood flow, disturbed cold or warm perceptions, sudomotor activity, edema, and pigmentation changes[4] (**Fig. 2**). CRPS has been subdivided into 2 types. Type I is not associated with an identifiable nerve lesion, and type II is the result of a detectable nerve injury. The symptoms can develop immediately after injury or several months later, and commonly involved nerves include the median, ulnar, sciatic, and tibial nerves. The somatosensory profiles between CPRS I and II are almost identical.[5] Often CPRS II patients are misdiagnosed for CPRS I because of missed nerve injuries. CRPS generates fear among surgeons, but if there is a nerve injury, it will not get better until the nerve is dealt with. To address this, surgeons may be called on to assist in the treatment of this condition.

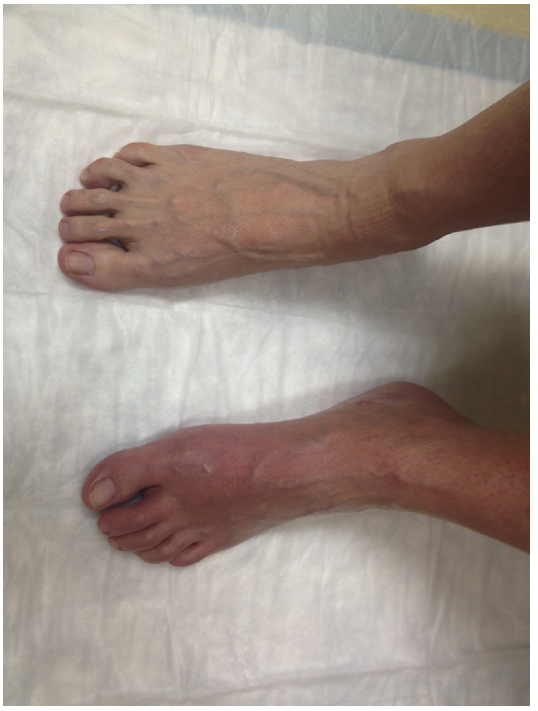

Fig. 2. A woman with CRPS of the foot. Note the changes in the color of the foot.

MECHANISM OF NEUROPATHIC PAIN

The exact pathophysiology or mechanism of neuropathic pain has not been completely elucidated. However, what is known is that it involves complex interactions of both the peripheral and the central nervous system. Similarly to the normal wound-healing pathways, immediately following nerve injury, a cascade of local inflammatory cytokines and neurotrophic factors are released that promote tissue healing and regeneration. Depending on the extent of injury, programmed cell death occurs at the disrupted ends in the form of Wallerian degeneration to create more favorable environment for nerve reinnervation. Reinnervation can occur via axonal sprouting at nerve ends to reconnect the proximal and distal nerve stumps. Although neuroplasticity plays a critical role in functional adaption after peripheral and central nervous system injury, it can also lead to unfavorable circuitry that can predispose to the development of neuropathic pain. The release of trophic factors by an injured cell can lead to chronic stimulation of uninjured neighboring neurons. These changes can lead to increased activity or dysregulation of ion channels in these neurons, lowering action potential thresholds and even leading to the development pacemaker activity.[3] Hyperexcitability can be generated by upregulation of sodium channels and calcium-gated voltage channels and downregulation of potassium channels in involved neurons.[6] These modifications occur not only occur at the site of injury but also at other remote sites, including at the spinal cord level. Another mechanism for chronic pain is that the persistent sensory input to the dorsal horn neurons leads to frequent depolarization and release of neurotransmitters glutamate and norepinephrine, which leads to dorsal horn excitability.[7] Pain is the result of a system with competing influences of excitatory and inhibitory pathways. Not only can nerve injury result in increased excitability but also the inhibitory