Surgical Treatment of Upper Extremity Pain

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KEYWORDS

• Neuroma • Nerve compression • Complex regional pain syndrome • Reflex sympathetic dystrophy • Joint pain

KEY POINTS

Critical steps in surgical treatment of hand/upper extremity pain

1. History suggests injury to nerve.
2. Physical examination consistent with nerve injury.
   a. Positive Tinel sign at site of nerve injury or compression.
   b. Pain with joint movement.
   c. Altered sensation.
3. Nerve block.
   a. Results in loss of sensation in the skin territory of interest.
   b. Relieves pain, and if not, then a second nerve must be blocked.
4. Permits pain-free joint movement, increased grip strength.
5. Surgical treatment.
   a. Neuromas are resected.
   b. Nerve compressions are released.
   c. Proximal end of divided nerves is implanted into muscle.
   d. Partial joint denervation is done.

INTRODUCTION

The current approach to surgical treatment of the painful hand and upper extremity stems from basic science and translational research from the early 1980s. This research focused on why dorsoradial wrist pain had such a high rate of treatment failure. Typically these patients would have a dorsal wrist ganglion excision or release of the first dorsal extensor compartment to treat extensor tenosynovitis and have postoperative pain over the dorsoradial aspect of the wrist/hand, the territory of the radial sensory nerve. The classic teaching for this problem was: do not disturb the "mature end-bulb neuroma," but move it to a different location. The problem was that these patients had a radial sensory nerve neuroma but a treatment plan of moving the neuroma to a new location without resecting the neuroma would *not* relieve the pain. There were several reasons for treatment failures including (1) the in-continuity or mature end-bulb neuroma was the source of the pain signals and had to be resected,[1] (2) the initial surgical site represented an overlap of the radial sensory nerve and the lateral antebrachial cutaneous nerve in 75% of people,[2] and (3) resecting a nerve and leaving the proximal end in the subcutaneous tissue near a joint resulted in recurrent neuroma formation.

Thus a different strategy was required. Research suggested that implanting the resected nerve end into muscle optimized the environment where the nerve attempts regeneration.[3,4] Using

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this new research, an algorithm was created for treatment of the painful hand that has withstood the test of time (**Fig. 1**).[5–11] This algorithm is outlined in the Key Points. The same algorithm also applies to lower extremity pain.[12–15]

PATIENT PRESENTATION

Patients with nerve pain typically present in four ways, outlined next.

Typical Presentation One: The Cutaneous Neuroma

In this scenario surgical intervention has resulted in a painful scar. There are several common examples of cutaneous neuromas in the upper limb surgeon's practice. **Table 1** highlights common nerves injured during upper limb exposures. These patients typically come to the office and the surgeons' challenge is to recognize that the pain is from a cutaneous neuroma, and not from recurrence of the pathology that necessitated the initial procedure.

Typical Presentation Two: Nerve Compression

Although hand surgeons are expert at recognizing chronic peripheral nerve compression, they may overlook this diagnosis in the setting of diffuse pain with a history of multiple interventions or a patient with a diagnosis of complex regional pain syndrome (CRPS). Another diagnostic problem is that acute nerve compression typically causes more pain compared with chronic nerve compression.[17,18] Neurolysis of compressed peripheral nerves can relieve pain and even successfully treat the patient with CRPS.[19]

Typical Presentation Three: Joint Pain

The classic teaching is that joint pain is related to a biomechanical problem with bone, ligament, and/or cartilage of the painful joint. Clearly this is true and almost always the source of the pain. It is also true classically that anatomy books do not have illustrations of the innervations of any upper extremity joint or lower extremity joint. If joints are not innervated, how can any joint be a source of pain? Although total wrist denervated was reported in the second issue of *Journal of Hand Surgery* in 1977,[20] the approach was more a destructive cauterization of ligaments than a true identification and removal of individual nerves. The failures in this total wrist denervation approach were in those patients with unstable wrists, who went on to require partial wrist arthrodesis, confirming that biomechanical factors must be corrected before any attempt to relieve joint pain of neural origin. In 1979, the approach to identifying the posterior interosseous nerve was described,[21] and in 1984 the approach to identifying the anterior interosseous nerve was described.[22] The typical situation is that a person has fallen on to an outstretched wrist, and has persistent pain despite appropriate treatment of the skeletal abnormalities. If wrist movement still hurts or is limited by pain, the diagnosis must include joint pain of neural origin. For the wrist joint, this includes the differential diagnosis of injury to the terminal branch of the posterior interosseous nerve or the anterior interosseous nerve, which is determined with differential diagnostic nerve blocks. Then, based on which of these gives pain relief, or perhaps both nerves had to be blocked, the surgical approach to treat this wrist pain is to resect the distal posterior interosseous nerve,[23] the anterior interosseous nerve,[22] or both (see **Fig. 3**).[24] Reviews of the operative approach to the joint afferents to the upper[25] and lower extremity joints[26,27] and the outcomes of nerve resections have been published. Techniques to joint denervation are discussed later.[28–32] There has been concern that denervation would adversely impact the joints. Studies on the joint afferents and their effect on reflexes and proprioception have concluded that partial joint denervation does not cause dysfunction.[33–36]

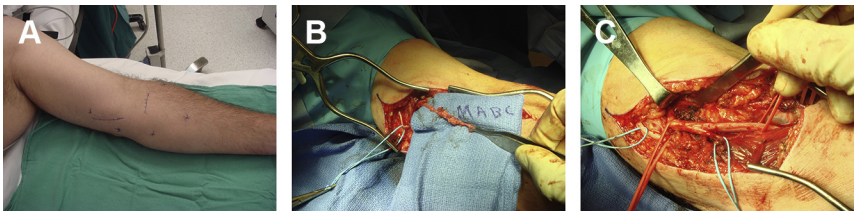

Fig. 1. (*A*) Patient with chronic pain syndrome after vascular surgery in antebrachial region, trigger points noted by the asterisks and the *incisions* from the intervention marked. (*B*) The neuroma of the medial antebrachial nerve is on the background material. After resection of the neuroma, the proximal end was implanted into the medial head of the triceps muscle. (*C*) Neurolysis of the swollen median nerve (*red vessel loops*) included the anterior interosseous nerve (*distal blue loop*). The ulnar nerve is noted within the proximal blue vessel loop.