In 1971, Joplin (1) described injury to the medial plantar digital nerve to the hallux in 3 patients related to surgery to correct a bunion but did not discuss the treatment for the pain problem that now bears his name. He did illustrate the excised and fibrotic portion of the nerve in 1 patient (1). The pathophysiology relates to entrapment or compression neuropathy from repeated athletic trauma or to a true neuroma related to previous trauma or surgery (2,3). Additional confusion occurs with considering medial plantar hallux pain a Morton’s neuroma” (4). In the present report, we have discussed our long-term experience with the surgical management of Joplin’s neuroma in a series of patients.

Patients and Materials

A computer database search was performed in our office for the “International Classification of Diseases,” 9th edition, code 355.6, plantar digital nerve injury, and these patients’ medical records were reviewed retrospectively, specifically for those whose interdigital nerve was the one to the medial side of the hallux. This search identified 8 patients. They underwent surgery from October 2006 to May 2012. In each of these 8 patients, the physical examination demonstrated pain over the medial plantar nerve to the hallux, and a nerve block of this nerve relieved that specific pain. Each of these patients was, therefore, considered to have a Joplin’s neuroma.

Of the 8 patients, 2 (25%) were males and 6 (75%) were females. Their mean age was 39.7 (range 16 to 54) years. The etiology for Joplin’s neuroma consisted of excision of the medial sesamoid in 3 (37.5%), bunonectomy in 4 (50%), and crush injury in 1 (12.5%), with the diagnosis determined from the history and physical examination and/or findings. The duration of the pain before consultation with us was a mean of 63.5 (range 15 to 120) months. Before their referral for surgery, each patient had undergone ≥1 corticosteroid injection, topical corticosteroid massage, and foot orthotic treatment, and had taken anti-inflammatory and neuropathic pain medications. Of the 8 patients, 3 (37.5%) had undergone a trial of radiofrequency ablation that proved ineffective.

Each patient underwent a local anesthetic block of the proper digital nerve of the medial plantar nerve to the hallux, with surgery performed on those appreciating alleviation of their symptoms. Specifically, after preparation of the skin just proximal to the point of pain at the medial hallux, 4 mL of 1% lidocaine and 0.5% bupivacaine, without epinephrine, mixed 50:50, was infiltrated into the subcutaneous tissue along the course of the medial plantar nerve branch to the medial hallux. Each of the 8 patients responded to the block with pain relief. The surgical approach was modified from that...
described by Dellon in 1989 for a recurrent Morton’s neuroma (5). After identifying the distal portion of the injured digital nerve at the level of the first metatarsophalangeal joint, the nerve was injected with a local anesthetic to shield the central nervous system from neural impulses. Then, the nerve was cauterized to prevent bleeding and divided using scissors. The neuroma itself was not dissected and was not submitted for pathologic examination. A new incision was made in the medial plantar arch, and the proximal portion of this nerve was identified. The plantar nerve was pulled through this tunnel and then dissected proximally toward its origin from the medial plantar nerve. A clamp was then inserted into the arch above the plantar quadratus muscle to create a tunnel and to estimate the length required for a nerve to be placed into this location. That distance was measured to the dissected plantar nerve from the medial hallux. The most distal portion of this nerve, which did not have the neuroma, was submitted to the pathologist for examination. The proximal end, after cauterization to prevent bleeding, was blindly implanted into the fibrous structures of the arch, cephalad to the muscle layer. The wound was dressed with a bulky, supportive Robert-Jones type dressing, allowing immediate ambulation using a walker. The dressing was removed on postoperative day 7, the sutures were cleansed with povidone iodine twice a day, and the stockinette was reapplied by the patient, with ambulation in a slipper allowed. The sutures were removed at 21 days postoperatively, after which the patient began 1 to 3 weeks of water walking, 3 to 4 times per week, progressing to walking on land in sneakers, as tolerated.

The patients determined their own level of pain relief and postoperative status. An excellent result after surgery was defined as complete relief of pain and a return to normal activities or work without special footwear. A good result entailed some residual pain with occasional use of pain medication and some limitation of function. Failure entailed the lack of improvement after surgical treatment of the nerve.

**Results**

Of the 7 patients who had undergone neuroma excision with proximal implantation of the nerve into the arch of the foot, 6 (85.7%) had excellent relief of pain, resumed walking without special shoes, and had discontinued the use of narcotic analgesic medication. The

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**Fig. 1.** Surgical approach for the patient with pain after medial sesamoidectomy. (A) The previous surgical incision is shown cross-hatched, with the digital nerve branches outlined. (B) Digital nerve branches identified with vessel loops. (C) Neuroma attached to nerves at previous surgical site. (D) Extended proximal incision to identify the proximal medial plantar nerve to the hallux. (E) Proximal end turned and implanted blindly into the fibrous structures of the arch, cephalad to the muscle layer.
seventh patient had a good result. The eighth patient, who had had pain primarily localized to the lateral posterior aspect of the toe nail and had undergone 6 previous attempts at partial nail removal and topical acid applications or freezing did not wish to undergo the proximal incision necessary to implant the nerve proximally into the arch and, therefore, had undergone just local resection. This pain had recurred at 6 months postoperatively, but the patient had not yet requested a more proximal implantation site even at 12 months after surgery. This patient was considered to have treatment failure for the purposes of the present report. None of the patients complained about the loss of hallux sensibility, probably owing to the crossover or overlap of the 2 digital nerves at the tip of the toe.

Discussion

Joplin’s neuroma refers to perineurial fibrosis of the medial plantar digital nerve to the hallux arising from the following etiologies:

1. Trauma
2. Biomechanical imbalances
3. Entrapment

It should most probably be considered, in its chronic form, to represent a true neuroma. The medial plantar nerve gives off the medial proper digital nerve that innervates the first metatarsophalangeal joint and extends to the medial and plantar aspect tip of the hallux, which is sometimes called the proper digital nerve to the hallux (Fig. 1). Its superficial course leaves it susceptible to trauma and chronic compression at the metatarsophalangeal joint and plantar aspect of the foot.

An actual scarcity of information exists on this problem, with Joplin’s first report in 1971 referencing 3 patients whose cause was bunion surgery (1) and the report by Still and Fowler (2) in 1998 referencing 3 patients whose pain was not iatrogenic in origin. Of the latter 3 patients, all of whom had refractory chronic pain, each had undergone resection of the mass, which pathophysiologically was interpreted to be a neuroma (2). The proximal end was left at the metatarsal head level, and 2 of 3 patients had significant residual pain after initial relief. These investigators documented relief of pain with a local anesthetic block before resecting the palpable, painful mass. They also documented that by 1 year after surgery, static 2-point discrimination had recovered in the medial plantar half of the hallux.
Our experience has confirmed that a local anesthetic block with relief of pain should be a prerequisite to surgical excision, both to confirm for the surgeon that this digital nerve is the source of pain, rather than a more proximal cause, and to confirm that the patient is willing to accept the area of numbness. Conceivably, certain sports, such as ballet dancing, might preclude that loss of sensibility. Technically, our 1 treatment failure was in a patient who did not want the proximal implantation site and developed recurrent neuroma at the level of the resection, similar to patients in the small series reported by Still and Fowler (2).

Although our series was small and retrospective, it represents the largest experience reported and has confirmed that Joplin’s neuroma should be considered a true neuroma in continuity and that a neurolysis of this exposed, superficial digital nerve is not likely to result in significant pain relief. The diagnosis of Joplin’s neuroma, an injury to the medial plantar nerve to the hallux, can be confirmed by the physical findings correlating with the history and site of the patient’s pain, history findings (e.g., surgery for a bunion or a medial sesamoid) consistent with injury to the nerve, and, finally, relief of pain with a local anesthetic block of this nerve proximal to the site of pain. Moreover, we hinged the outcomes on the subjective relief of pain experienced by the patient in the postoperative period, which we believe was an advantage in the present small case series. The results of the present case series should prove useful in the development of future prospective randomized trials that investigate the outcomes of treatment of Joplin’s neuroma.

References