

REVIEW OF MORTON'S NEUROMA AND THE PLANTAR APPROACH FOR EXCISION

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INTRODUCTION

Morton's neuroma is a sensory neuropathy that is thought to be mechanically induced. There is no indication that it is of medical etiology. Over time the nerve becomes thickened, which seems to correlate with an increase in symptoms. Morton's neuroma is one consideration in the differential diagnosis of metatarsalgia. Others include capsulitis, flexor tenosynovitis, metatarsal stress fracture and joint arthropathy. When considering neuromas in the general sense, one thinks of a proliferative process. However, this is not the case with Morton's neuroma, which demonstrates a pattern of degeneration and perineural fibrosis. Demyelination occurs, along with infiltration of the epineurium and endoneurium with dense bundles of collagen. These collagen whorls are called Renault bodies.

ETIOLOGY

There have been a number of proposed causes of Morton's neuroma. Various authors have presented such possibilities as local ischemia, compression of the nerve by an intermetatarsal bursa, local trauma, and biomechanical abnormalities such as increased pronation. More recent data are more supportive of an entrapment phenomenon between the deep transverse intermetatarsal ligament and the common sensory nerve branch or between the nerve and the adjacent metatarsal heads. However, there is no conclusive proof of causation.

DIAGNOSIS

Morton's neuroma is more common in women than in men and is usually diagnosed between 40 and 60 years of age. Because there are several different conditions that can present similarly in such a small area, careful and thorough physical examination of the area is very important. My personal experience is that Morton's neuroma is more frequently over diagnosed rather than under diagnosed. It is easy to jump to the diagnosis of Morton's neuroma when the patient points to the third interspace area as the region of discomfort. However, upon careful examination, one may find the pain to actually be directly beneath the metatarsal

head and not in the interspace. Furthermore the pain may be of such a quality as to be more indicative of capsulitis or flexor tenosynovitis rather than of a neuritic quality.

There are, however, several specific examination techniques that can help identify the presence of an interspace neuroma when present: 1) Plantar percussion of the interspace. The examiner sharply and forcefully percusses the interspace along the distribution of the nerve. Along with pain, the patient may also experience neuritic or paresthetic sensations to the affected interspace. 2) Palpation of the webspace along with side to side compression of the forefoot. Pain may be produced, but remember the Morton's neuroma is not centered between the metatarsal heads (you can see this on magnetic resonance imaging [MRI]). It is below the deep transverse intermetatarsal ligament. Therefore a side to side forefoot squeeze test may not reproduce the symptoms associated with Morton's neuroma. This maneuver may also produce the Mulder's click, which some authors feel that when present correlates strongly with the presence of a neuroma. I personally do not, but do not have the evidence to support such a contention. It is merely skepticism on my part. 3) Toe tip sensation deficit. The examiner uses a Semmes Weinstein filament to compare the sensation to the affected interspace versus the adjacent interspaces. Sharp/dull testing can also be performed.

DIAGNOSTIC STUDIES

It is often stated that diagnosis of Morton's neuroma (and many other conditions as well) can be made with a careful history and physical examination. But sometimes no matter how thorough the history and physical examination, there will be inconsistencies where the diagnosis of interspace neuroma cannot be conclusively ruled in, nor can other diagnoses in the differential conclusively be ruled out. My personal approach is to keep an open mind and have several diagnostic considerations during the initial encounter or two, keeping my mind open to more than just one diagnosis. It is rare that the second or third encounter does not shed important light on the initial impression, sometimes making it obvious that my initial diagnosis was wrong. And as a part of these follow-up encounters the

importance of re-examination of the area cannot be over emphasized. If we only ask how the patient is doing after the initial treatment (for better or worse) without taking the time to re-examine, important information may escape us that had we been aware of, would have potentially changed the treatment or further work-up.

Radiographs are typically performed as a part of the diagnostic work-up forefoot pain/metatarsalgia. Plain film radiographs are most useful to help rule out diagnoses such as avascular necrosis, arthritis, fracture, etc.

There are no pathognomonic clinical tests to confirm Morton's neuroma. However, if most of the evidence (patient history as well as the examination) is compatible with the diagnosis of Morton's neuroma, the further diagnostic tests are normally not required. However, there are instances when the diagnosis is in question and therefore special studies can be very helpful, especially in differentiating between neuroma, bursitis, joint inflammation, capsulitis, and flexor tenosynovitis.

MRI

MRI can be very helpful with the diagnosis of Morton's neuroma. However, the scan should be performed on a high field scanner, and interpreted by a radiologist experienced in musculoskeletal pathology. The coronal images at the metatarsophalangeal joint area are the easiest to pick out the neuroma if present. On the T1-weighted images, it appears as a rounded soft tissue nodule of low to intermediate signal intensity. It looks distinctly different from the adjacent subcutaneous fat. The low signal intensity is due to the fibrous infiltration of the nerve. A neoplasm such as a schwannoma or an intermetatarsal bursitis will appear as an area of increased signal intensity on T2-weighted images due to the high fluid content.

USE OF ULTRASOUND

Diagnostic ultrasound can also be of use as a special study in the diagnosis of Morton's neuroma. It is also useful as an option where an MRI is contraindicated (such as presence of a pacemaker). Generally, it is also less expensive than an MRI. With ultrasound a Morton's neuroma has a hypoechoic signal and is best observed in the coronal view. Structures are said to be hypoechoic when only low-level echoes are reflected, producing the darker grey areas of the image. Anatomically, the neuroma appears as an ovoid mass parallel to the long axis of the metatarsals. Ultrasonography has also been used in an office setting for guidance with both corticosteroid and alcohol sclerosing-type injections.

CONSERVATIVE TREATMENT

After the diagnosis is made, conservative treatment is initiated, and for many patients obviates the need for surgical intervention.

Mechanical Management

The goal of mechanical treatment is to decrease pressure on the nerve. If successfully accomplished, the pain from local irritation of the nerve can improve with time. Specific recommendations include avoiding high-heeled and narrow toe box type shoes. A metatarsal pad can be placed just proximal to the metatarsal heads, which has long been considered to encourage divergence of the metatarsal heads. However, due to the local anatomic structures, including the deep transverse intermetatarsal ligament, one has to wonder to what degree this proposed benefit actually occurs. And when patients do improve from the use of this treatment variable, how do we know it is for the reason we have traditionally supposed? Over the counter as well as prescription orthotics have also been used as mechanical treatment options.

Medical Treatment

Oral nonsteroidal anti-inflammatory drugs (NSAIDs) and injectable corticosteroids are the mainstay of medical treatment for Morton's neuroma. If NSAIDs are used, a short course is generally recommended. Longer term use can increase the risk of gastrointestinal, renal, and cardiovascular adverse events. If steroid injections are used, short acting phosphates are considered more favorable, and generally the number of injections are limited to not more than 3 in any 6 month time period.

Sclerosing Alcohol Injections

Although some recent studies have challenged the effectiveness of sclerosing alcohol injections for treatment of intermetatarsal neuroma, there are studies that report a success rate as high as 89%. The solution is typically a 4% solution and is injected directly into the nerve if possible. A series of 3 to 7 injections are given at an average of one week intervals.

Surgical Management

When conservative management fails and pain persists, surgery becomes the treatment of choice. Because there are several options available, there is debate about what type of surgery as well as what approach is most effective. Studies seem to indicate that surgical excision of the nerve is done more frequently than nerve release by sectioning of the deep transverse intermetatarsal ligament.

Approach

Excision of an intermetatarsal neuroma can be performed through a dorsal or plantar longitudinal incision. And although less common, transverse plantar, web splitting, and Y-incision approaches have also been described. The preferred approach of the author is a plantar approach. This technique is not new and was originally described by Betts in 1940. Surgeons are sometimes tentative about making plantar incisions for fear of a high risk of producing hypertrophic painful scars; there is however, no credible evidence of this in the literature. That is of course not to say a patient will not have a painful sensitive scar postoperatively. But the reality is, the incidence is very low. And as will be noted later, dorsal incisions are as statistically likely to be associated with incision problems as plantar incisions are.

Plantar Approach

The dissection from a plantar approach is reasonably simple. Furthermore, a tourniquet is not necessary to provide hemostasis. Time should be taken and care given to accurately mark the location of the adjacent metatarsal heads so as not to place the incision in a weight-bearing area. Also, this approach will not be the best choice if the patient has a history of hypertrophic scar formation. The nerve is easily found after dissection through the subcutaneous tissue, and in contrast to the dorsal approach, traumatic dissection through the interspace and retraction of muscle and bone during the procedure are avoided.

Postoperative Management

Several studies that advocate use of a plantar approach allow postoperative weightbearing as tolerated. More often I recommend nonweightbearing with crutches or a walker until sutures are removed at the 2.5 week mark. If a dorsal approach is chosen, the patient may ambulate in a surgical shoe immediately postoperatively.

A frequent question during the pre-operative consultation process concerns the length of the recovery process. One study looked at the average time to recovery and showed the following: a comfortable return to light athletic activity in 2.2 months, resumption of full athletic activity 4.1 months, and the ability to restart jogging in 5.0 months.

Complications

The most worrisome complication of neuroma surgery in general is the formation of a painful stump neuroma. And to this end, one of the proposed benefits of the plantar approach is a better ability to follow the nerve more

proximal so that once it is resected the remaining distal end is within the plantar musculature.

Another complication is not finding the nerve at all and removing a fibrous strand or adipose tissue or mistaken resection of the digital artery instead of the sensory nerve. When performing the procedure from a plantar approach, these complications tend to be less frequent. Most likely this is due to the fact that from a plantar perspective the sensory nerve is superficial to the arterial supply to the toe, and therefore is encountered prior to the artery. Also, by not using a tourniquet, if the artery was inadvertently cut, the surgeon would immediately know that the wrong structure was being focused on.

AKERMARK STUDY

One of the largest studies to specifically compare the results of dorsal versus plantar approach for removal of the intermetatarsal neuroma was performed by Akermark and colleagues and published in *Foot and Ankle International* in 2008. Some highlights of the report are worth reviewing.

The study was performed in Sweden and evaluated 145 patients that had intermetatarsal neuroma removal (from either a dorsal or plantar approach). Two surgeons performed all of the procedures (one performed all the dorsal approaches and the other all of the plantar approaches). Prior to surgical intervention physical examination was performed, including documentation of pain, Mulder's click, and plantar sensory function. None of the patients in the study had any other type of foot surgery at the time of the neuroma surgery, or within the follow-up period after the surgery. All of the procedures were for primary intermetatarsal neuromas (i.e., none were for revisional surgery for previously failed neuroma surgery). Before reporting the data, 20 of the 145 patients were excluded for various reasons. Some were lost to follow-up, others had additional foot surgery etc. In the plantar group there were 19 males and 54 females. The dorsal group consisted of 8 males and 51 females. The average patient age in the plantar group was 52 years and 49 years in the dorsal group.

All of the procedures were performed on an outpatient basis. All were performed with the use of a tourniquet. The deep transverse intermetatarsal ligament was divided in the dorsal group but not in the plantar approach. In both groups patients were allowed to begin weight bearing after 2-3 days postoperatively as tolerated. Sutures were removed at approximately 2-3 weeks postoperative. All specimens were sent for histologic examination.

Follow-Up Investigation

The follow-up period for all patients was no less than 2 years following the surgery. The follow-up investigation was performed by 2 independent orthopedic surgeons, neither of which performed any of the procedures. At follow-up patients were asked to complete a questionnaire to evaluate the degree of pain at follow-up. This was considered the primary outcome variable. Part of the questionnaire was the 100-mm visual analog scale (VAS). The extreme on one end represented no pain (0 mm), and the extreme on the other end (100 mm) represented the worst pain possible.

There were also several secondary outcome variables that were evaluated:

- Subjective residual pain (estimated by a 4 step Likert Scale – never, monthly, weekly or daily)
- Overall satisfaction with the outcome of the procedure (excellent, good, fair or poor).
- Questioning about specific variables (restriction of daily activities, scar tenderness, subjective sensory loss to the adjacent digits)
- Expectation of the results with a VAS (range not at all to totally)
- Would the patient have the surgery again?
- How long were they out on sick leave?

Objective testing was performed by the 2 independent orthopedic surgeons. They evaluated the amount of scar tenderness, and performed a pinprick test to assess sensory loss to the specific interspace.

Results

Pain With Daily Activities at Follow-up (after at least 2 years postoperatively). Utilizing the VAS, the plantar group showed an average of 8 mm, whereas the dorsal group showed an average of 11 mm (where 0=no pain and 100=the worst possible pain). A way to verbalize these findings would be to state that a patient after neuroma surgery from either a dorsal or plantar approach can expect to have on average “very mild pain” at the 2 year follow up mark.

Using the 4-point Likert scale the patients had to indicate whether they 1) never had pain, or had pain on a 2) monthly, 3) weekly, or 4) daily basis. Unfortunately, the authors of the paper, when giving the results, reported the “no pain at all” group as one category, but then grouped together the other 3. However, the results are as follows: 67% of the patients in the plantar group, and 71% of the patients in the dorsal group reported having no pain at all, and 33% of the patients in the plantar group and 29% of the patients in the dorsal group had pain either on a monthly, weekly, or daily basis. It would have been of interest to know how patients fell into each of these 3 individual categories.

Activity Restrictions. This parameter was also evaluated using the Likert scale. The authors arbitrarily reported the “not having any activity restriction” as one category and the “having activity restrictions on either a monthly, weekly, or daily basis” grouped together as a second category. The results showed that 74% of the plantar group and 70% of the dorsal group reported not having any activity restrictions, and 26% of the dorsal group and 30% of the plantar group had activity restrictions in the monthly, weekly, or daily group.

Scar Tenderness. A total of 70% of the plantar group and 84% of the dorsal group reported having no scar tenderness, and 30% of the patients in the plantar group and 16% in the dorsal group reported having either slight, moderate, or severe scar tenderness. In the plantar group there were 2 slightly hypertrophic scars, and one small inclusion cyst.

Sick-Leave. There was also a difference in the amount of time patients missed due to sick leave between the two approaches. The patients that had the neuroma removed from a dorsal approach missed an average of 3.7 weeks of work, whereas the patients having plantar incisions missed an average of 2.2 weeks.

Histology evaluation. Histologic examination of the submitted specimens showed that no nerve tissue was present in 3 of the 59 patients having the neuroma approached from a dorsal approach. This represents 5% of the specimens submitted. It is of interest, that dorsal surgeries were performed by the same surgeon, having more than 20 years of experience. It seems to be an alarmingly high rate. In the plantar approach, there was nerve tissue present in every specimen, although one of the specimens submitted showed normal nerve tissue, without the characteristic histologic features of neuromas. This does not seem terribly surprising.

Overall Satisfaction. Patients were given four possibilities to choose from to gauge overall satisfaction (excellent, good, fair and poor). The results were as follows: Excellent 73% (plantar) 15% (dorsal); Good 61% (plantar) 23% (dorsal); Fair 5% (plantar) 9% (dorsal); Poor 7% (plantar) 7% (dorsal).

FOLLOW-UP STUDY BY AKERMARK ET AL

A follow-up study published in 2008 by the same author was performed for the purpose of specifically evaluating postoperative pain in patients having removal of Morton’s neuroma from a plantar approach. The authors state in the materials and methods that the study is prospective. However, review of the design protocol seems to indicate it was really an after the fact decision (therefore retrospective

analysis) to assess preoperative versus postoperative pain following a plantar approach to Morton's neuroma. In this study patients completed the VAS for pain both preoperatively as well as postoperatively. The minimum follow-up was 24 months.

On a VAS (range 1-100), the average preoperative value was 74. The average postoperative value was 9. None of the patients had worse pain at follow-up than they had prior to the surgery. A total of 93% of the patients had a pain reduction of at least 50%. The overall satisfaction rate was 86% (excellent or good). If the patients were involved in athletics the satisfaction rate went up to 93%.

SUMMARY

The medical literature is favorable toward the plantar approach for removal of Morton's neuroma. Fear of higher rates of complications such as painful scar formation has not been credibly substantiated. In fact, the overall rate of complication seems to be lower with a plantar approach than

with a dorsal approach. One difference in the postoperative management from a podiatric standpoint versus the authors of the 2 studies summarized in this article is the issue of weight bearing after the surgery. The author suspects that on average podiatrists performing Morton's neuroma surgery from a plantar approach would more often have the patient remain nonweightbearing until the sutures were removed. It is interesting to note however, that in the studies presented, the patients were allowed to weight bear immediately to tolerance, which apparently had no adverse affect on wound healing.

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