CHAPTER 54

PLANTAR FIBROMATOSIS: Diagnosis and Management

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Plantar fibromatosis is a condition that every practitioner treating the foot can expect to encounter several times during his or her career. There are several key questions that must be asked when encountering a plantar mass. First, a differential diagnosis must be made. Malignancies must be ruled out by clinical examination and history, imaging studies, or through a biopsy. Once the diagnosis of plantar fibromatosis is made, a decision must be made as to what management strategy should be employed. Finally, if the lesion or lesions will be removed surgically, the excision must be planned in a way that reduces the risk of recurrence, avoids plantar scarring, and maintains plantar skin viability. These are the issues that will be discussed in this paper.

HISTORICAL PERSPECTIVE

Dupuytren, in 1832, reported on the occurrence of palmar and plantar lesions in the hands and feet of laborers.[1] Madelung described an isolated foot lesion in 1875.[2] Ledderhose (1897) was the first to note the same changes in the plantar fascia that had been described for the palmer fascia.[3] Much of the early literature deals with case reports and with the condition as it appears in the hand. Beginning in 1948, a series of articles has been published on the subject, including several retrospective studies.

CLINICAL CORRELATIONS

At various times, plantar fibromatosis has been reported to be associated with epilepsy, penile contracture, and palmer contracture. The author has observed one case that exhibited a palmar contracture, but none who had a history of epilepsy or penile contracture.

However, Lund described his observations in a series of 361 epileptic patients. Among the male patients, the following results were reported: 22.6% had nodules or thickening of the palmar fascia, an additional 15.8% had puckering of the skin of the palm, and another 11.8% had contractures of the fingers.[4] The incidence in female epileptic patients was approximately half that reported in the male patients. Twenty-five patients (6.8%) had plantar fibromatosis. A large control group had an incidence of 0.1% plantar fibromatosis.

A familial tendency toward the disease has been reported, which may indicate a defect in collagen metabolism.

PATHOLOGY AND BIOCHEMISTRY

There is more literature on the pathology and biochemistry of Dupuytren's contracture than plantar fibromatosis. Gabbiani and Majno described myofibroblasts present in palmar Dupuytren's contracture.[5] Biochemical changes associated with Dupuytren's contracture included increased hydroxylysine, and a change in the number of Schiff base intermolecular reducible crosslinks. Bailey et al. noted the presence of Type III collagen, which is different than the Type I collagen found in normal palmar fascia.[6] Gelberman et al. noted the same Type III collagen, increased collagen per unit of dry weight, and an increase in reducible cross links.[7]

Clinical recurrence was related to the presence of myofibroblasts in nodules and fibroblasts containing prominent microtubules in the fascia, rather than age, duration, or severity of disease. Shum and McFarlane reviewed 37 specimens from patients with Dupuytren's contracture after staining for the presence of desmin intermediate filaments.[8] They found desmin-positive cells in the proliferative nodules, with fewer present in those areas of the fibrous stage of the disease. They hypothesized that these perivascular smooth muscle cells migrate from the vessel wall, and are capable of transforming into collagen-producing myofibroblasts.

Brickley-Parsons et al. examined biochemical patterns in the palmar fascia of patients with Dupuytren's disease.[9] An important finding was that even fascia that appeared to be normal had the same biochemical changes, although to a lesser

degree. The fact that palmar fascia that appears grossly and histologically normal had biochemical changes associated with active repair may explain why wide resection of nodules must be undertaken to prevent recurrence.

Zamora et al. demonstrated the presence of transforming growth factor beta in palmer and plantar fibromatosis, with increased staining in the early stage of the disease.[10]

Luck suggested a correlation between histologic appearance and clinical staging of the disease.[11] He delineated three phases: 1) a proliferative phase characterized by increased fibroblastic activity and cellular proliferation, 2) an active phase with nodule formation, and 3) a residual phase with reduced fibroblastic activity but continued collagen maturation and tissue contraction.

CHARACTERISTIC HISTORY AND CLINICAL FINDINGS

Plantar fibromatosis can have different presentations. Typically, there is a large, superficial nodule along the central portion of the medial band of the plantar fascia or the medial aspect of the central band (Fig. 1). The lesion may or may not be

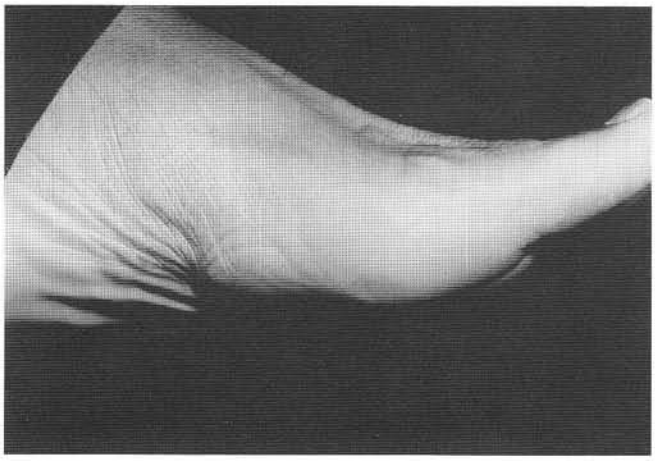

Figure 1. Medial view of the foot showing a large plantar fibromatosis.

adherent to skin. Commonly, the lesions are not particularly painful. Patients are often concerned about the possibility of malignancy, though they may have had the lesion for a long time. There is a gradual onset, and the lesion is clearly palpable superficial to the plantar fascia. Plantar fibromatosis may also present with multiple nodules along both the central and medial bands of the plantar fascia (Fig. 2). In either presentation, there is usually no involvement of the flexor hallucis longus.

A third presentation is recurrent plantar fibromatosis. In this situation, there is often tenderness of the scar, nerve entrapment and/or skin adherence. The recurrent nodules are often formed around the area of the scar and may be smaller, but more tender than the original lesions.

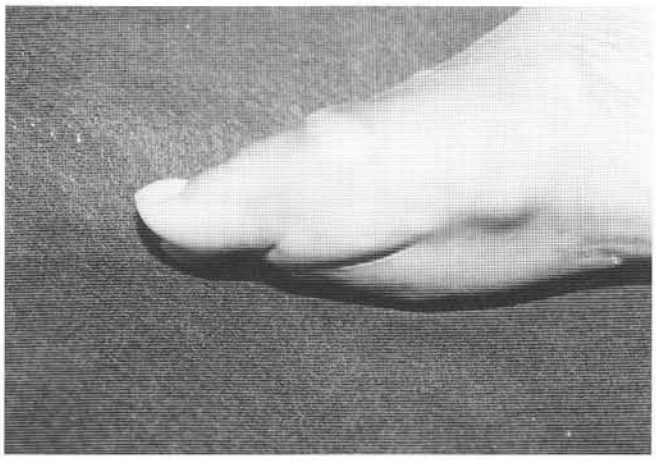

Figure 2. Medial view of the foot demonstrating multiple nodules.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of plantar fibromatosis can include Stage I fibrosarcoma, which can be distinguished by characteristic histologic findings, as well as later stages of fibrosarcoma which can be distinguished by a more rapid onset and larger mass. A variety of other conditions can present as a mass in the foot including leiomyoma, lipoma or liposarcoma, synovial sarcoma, a ganglion, schwannoma, rheumatoid nodule, and many others. It is critical to recognize that a wide range of conditions, including malignancies may present as a mass in the foot.

IMAGING

Radiographs are frequently performed when a patient presents with plantar fibromatosis. These radiographs may demonstrate some other underlying pathology which can be helpful in establishing the differential diagnosis.

Magnetic Resonance Imaging (MRI) can also be used to assist in the differential diagnosis, and in determining whether or not biopsy is necessary

(Fig. 3). Quinn et al. reviewed the MRI appearance of 26 fibromatoses with pathologic correlation.[12] They determined that fibromatoses have a varying appearance, depending upon the composition and cellularity of the lesions. Morrison et al. identified 27 lesions from 19 feet for MRI evaluation.[13] Four lesions (15%) grew deep to the aponeurosis, and 25 lesions (92%) had some signal heterogeneity. Contrast enhanced 16 (60%) of the lesions. The usefulness of MRI in evaluating recurrent plantar fibromatoses seems to be limited because of the difficulty in distinguishing lesions from scar tissue.

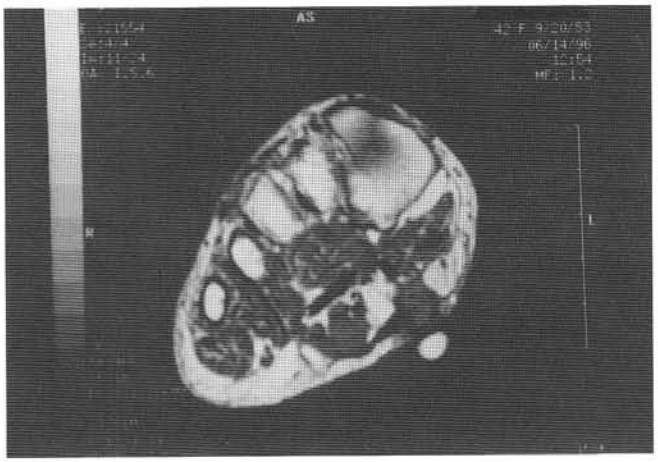

Figure 3. MRI with white capsule demonstrating the location of fibromatosis.

MANAGEMENT

When To Biopsy

A plantar mass should be biopsied if it shows any features atypical of plantar fibromatosis. A rapidly-growing lesion, a lesion with indistinct borders or deep penetration of tissue, ulceration, atypically painful, or having other unusual aspects may need to be biopsied prior to definitive excision. Should a lesion need to be biopsied, a frozen section can be obtained at the time of biopsy to ensure that adequate tissue has been sampled for the pathologist.

Nonsurgical Management

When a lesion has all of the classical signs of plantar fibromatosis, and no serious pain, non-surgical treatment can be considered. For some patients, accommodative appliances may reduce some discomfort in shoes. Usually, however appliances seem to neither help nor hurt. Corticosteroid injections may serve to reduce the size or pain of the lesion. The injection must be deep into the nodule and avoid the superficial skin.

There are two highly important caveats to remember. The first point is make sure that the lesion being evaluated really is plantar fibromatosis and not something else. The author is aware of two cases where malignancies were missed by practitioners who treated "plantar fibromatosis" with accommodative inserts - with truly disastrous consequences for the patients. The second point to remember is - if in doubt about the first point, then biopsy!

Surgical Management

Philosophy and Approach. There are three important aspects to surgical management of the foot with plantar fibromatosis. The incision should be designed to minimize scarring and wound contraction while enhancing surgical exposure. Second, sufficient fascia must be excised to prevent recurrence. Third, critical anatomy must be preserved undamaged. This includes the blood supply to the plantar aspect of the foot, the medial plantar nerve, and the flexor hallucis longus.

Incision Planning. Selection of the correct incision for excision of plantar fibromatosis is critical to achieving a good result. The relaxed skin tension lines (RSTL) play an important role in the incision design. The RSTL (as opposed to Langer's lines) represent the patterns of tension in the skin from muscle movement and the protrusion of underlying structures. Incisions made perpendicular to the RSTL will gap widely, whereas those incisions made parallel to the RSTL will remain easily approximated (Fig. 4). Wounds with excessive tension will also have longer and more extensive collagen productive phases with more scarring. The RSTL on the plantar aspect of the foot are transverse. The exposure needed for excision of the plantar fascia is longitudinal, thus creating a dilemma. Additional consideration must be given to the weight-bearing areas of the plantar aspect of the foot. Incisions should be designed to avoid weight-bearing areas of the foot.

Several incisions have been proposed and used in practice, linear, curved, and zig-zag. Linear incisions provide direct access to the plantar fascia, but are more likely to hypertrophy and contract. Gently curving "S"-shaped incisions give only marginally better results than linear incisions in

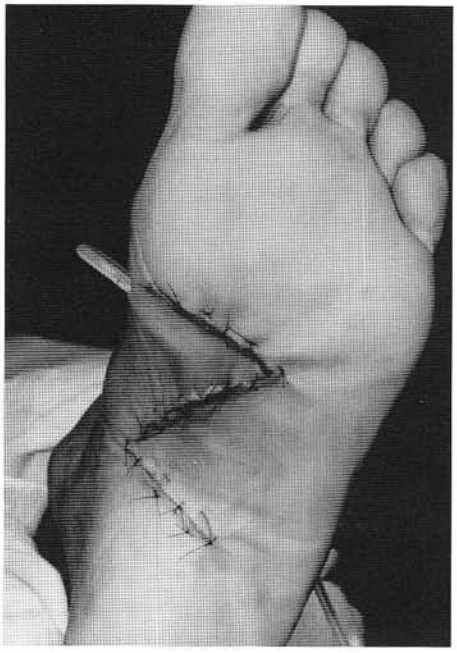

Figure 4. Plantar view of foot showing closure of incision. Note drain. Proximal and distal arms of the incision are aligned with relaxed skin tension lines (RSTL). The central arm is oblique to RSTL.

terms of hypertrophy and contracture. Functionally, curved incisions are essentially anti-tension line incisions, as are linear incisions on the plantar aspect of the foot.

In order to provide both good exposure and acceptable scarring, a zig-zag, anti-tension line incision is the pattern of choice. Both Curtin [14] and Burns and Harvey,[15] have described incisions that follow this pattern: proximal and distal ends of the incision are transverse with an oblique middle portion. Curtin's incision is, however, composed of an excessively long linear portion. Burns and Harvey described a modification of Curtin's incision that is somewhat more transverse. The brevity of their incision makes its routine use somewhat questionable if adequate fascia is to be excised to prevent recurrence. The length of the incision is almost as important as the direction. A short incision inevitably gets stretched and devitalized from excessive retraction and surgical trauma, with a poor cosmetic result and inadequate tissue visualization and resection.

A modified incision that has been utilized for the past several years accomplishes the following objectives: it provides exposure for access to the majority of the plantar fascia for excision; it avoids weight-bearing areas; it prevents scar hypertrophy and contracture; and it avoids compromise to the plantar skin flaps. This incision is a "Z"-shaped incision, with the distal and proximal arms of the incision directly following the RSTL, unlike the more oblique incision of Burns and Harvey. The middle portion is oblique, unlike Curtin's linear mid-portion. The incision extends from behind the metatarsals to distal to the calcaneus and heel pad.

Dissection and Extent of Excision. The dissection for excision of plantar fibromatosis is quite intricate. The author's preference is to perform this surgery under tourniquet hemostasis. The tourniquet is released prior to closure. After the initial incision, a "controlled depth" incision is made through the dermis so that blood vessels can be identified, clamped and ligated or bovied. The two flaps created by the "Z" incision are then raised by careful separation of the superficial fascia from the underlying plantar fascia. This step is quite delicate and is vital to the preservation of the skin's blood supply. This is particularly true in revisional surgery, and when nodules are adherent to skin. A suture can be used near the flap tip for retraction.

The plantar fascia must then be separated from the underlying flexor digitorum brevis (FDB) muscle belly and excised. Simple excision of the fibromatosis nodules is inadequate and results in a high recurrence rate. Wide excision of the fascia requires good exposure (Fig. 5). Dissection begins

Figure 5. Plantar view of the foot showing the extent of tissue excision.

distally at the level of the digital slip formation of the fascia. Medially, one must be careful to avoid the medial plantar nerve, which exits between the abductor hallucis and the FDB. The tendon of the flexor hallucis longus must also be protected.

After transecting the fascia distally, the fascia is clamped and held under tension while the dissection is continued proximally toward the calcaneus. Careless dissection in this area can result in laceration of the FDB muscle with resultant excessive bleeding.

A drain is inserted prior to closure after the tourniquet has been released and hemostasis achieved. The superficial fascia is reapproximated with 3-0 or 4-0 absorbable synthetic suture. Skin closure is accomplished with 4-0 nylon or polypropylene with simple interrupted and/or loose horizontal mattress sutures. A good Jones compression splint is applied.

Postoperative Course. The patient is kept non-weight bearing for three weeks, at which time sutures are removed. The patient then returns to a soft shoe, or running shoe with an elastic support. There is generally little pain or swelling associated with this surgery. An arch support may be necessary to provide support of the foot when there has been significant resection of the central band of the plantar fascia.

Complications. The most common complication following excision of plantar fibromatosis is recurrence, usually associated with inadequate resection of fascia. If recurrence does occur, it may present as multiple lesions along the scar. Patients should be followed at regular intervals, and recurrent nodules injected with corticosteroid as an initial therapy. Hematoma from muscle injury can occur, as well as anesthesia or nerve entrapment. Scar contracture and hypertrophic scar formation can be problematic, but proper incision design, atraumatic technique with gentle tissue handling, and good wound closure can reduce this risk. An interesting question is whether or not the loss of a substantial portion of the plantar fascia will eliminate the windlass effect and result in flatfoot and hammertoes. Pontious and Flannigan reported the development of hammertoes after surgery for plantar fibromatosis.[16] The author includes this information in his preoperative discussions with the patient.

Management of Recurrent Plantar Fibromatosis. Recurrent plantar fibromatosis can be a difficult problem. Scar tissue makes it more difficult to perform the meticulous dissection, and it becomes easier to perforate the thinned skin. Usually the initial surgery was performed through a small incision. The expanded "Z" incision gives excellent exposure so that wide resection of the fascia can be achieved. The scar tissue may create additional bleeding, which makes the use of a drain even more important.

SUMMARY

The problem of plantar fibromatosis still has many important questions remaining. The proper diagnostic procedures, the role of conservative therapy, and the appropriate indications for surgery are all remaining questions. Meticulous technique is critical to success.

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