ROLE OF BONE SCINTIGRAPHY IN THE DIAGNOSIS OF PLANTAR FASCIITIS: A CASE REPORT AND LITERATURE REVIEW

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ABSTRACT

Bone scintigraphy is usually requested as a part of the investigation of foot pain, but its contribution to the diagnosis and management of plantar fasciitis has not been widely used. Pertinent published data are limited. This article demonstrates an example case presenting with chronic foot pain and shows the advantages of bone scintigraphy in the diagnosis of plantar fasciitis. Comparison of the information derived from bone scintigraphy and other imaging modalities is reviewed. Roles of bone scintigraphy in the management of patients with heel pain and in particular plantar fasciitis are also discussed.

Key words: calcaneus; plantar fasciitis; scintigraphy.

INTRODUCTION

One of the most common heel pain in clinical practice especially in the individuals older than 35 years, plantar fasciitis is usually diagnosed on the clinical basis of having heel pain and localized heel tenderness.[1] Although in some cases, it may occur in seronegative spondyloarthropathy,[2] typically plantar fasciitis results from repetitive trauma, leading to microscopic tears of the plantar fascia near its attachment to the calcaneus. These tears followed by the attempted repair lead to chronic inflammatory response evidenced by localized fibrosis or granulomatous changes in histological study.[3] The processes cause pain and tenderness at the medial aspect of its posterior attachment to the calcaneal tuberosity.[4]

Predisposing factors in developing plantar fasciitis include abnormal arch of foot, both flat foot and high arch of foot, overweight and prolonged period of standing or walking. These abnormal biomechanical and overload pressures on the foot enhance the inflammation of the plantar fascia.[3] Pain in plantar fasciitis typically starts as a dull, intermittent pain in the heel and may progress to sharp and constant pain. It is usually worse in the morning or after sitting, and then decreases as the patient begins to walk around. In addition, the pain usually increases after standing or walking for long periods of time and at the beginning of a sporting activity.

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Most cases of plantar fasciitis can be diagnosed on the clinical grounds of typical site of pain and tenderness as mentioned earlier. However, some have equivocal symptoms and signs, and thus raise the possibility of other causes of heel pain, which may require different treatment. It is these cases that need further investigations to disclose the real underlying pathology. The majority of cases of plantar fasciitis respond favorably to non-operative treatment such as activity modification, orthoses and corticosteroid injection.[4] In some intractable cases, however, plantar fasciotomy usually gives an excellent result.[5]

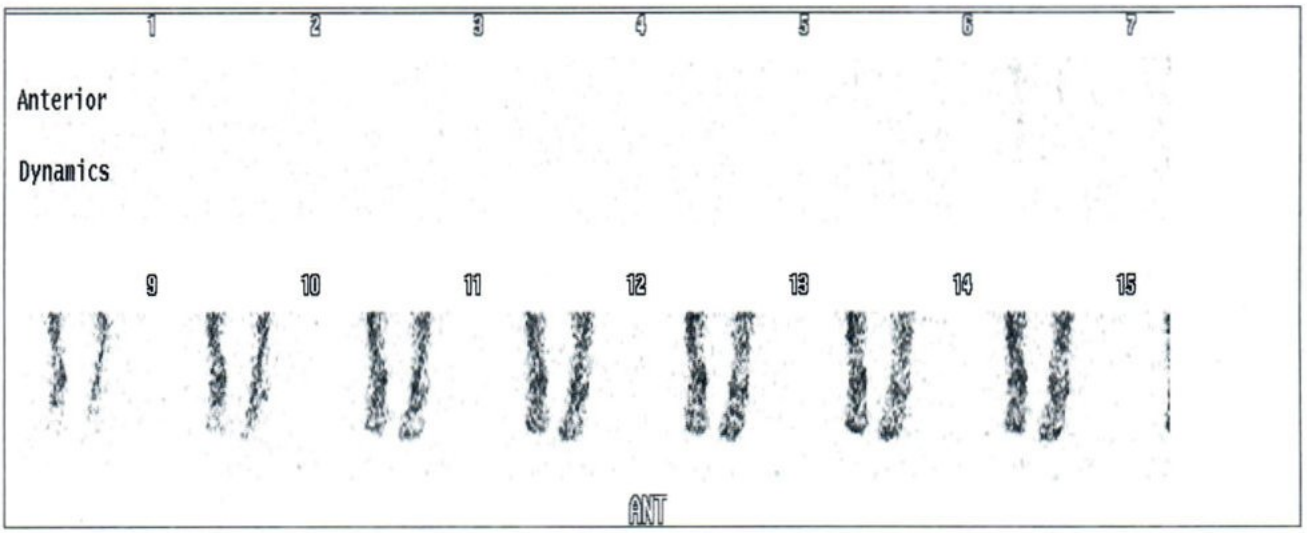
HISTORY

A 51-year old female was referred for bone scintigraphy for evaluation of her right foot. She had got intermittent pain at the right first metatarsophalangeal joint and right heel for three months. She had a history of continual exercise, but refused a history of prior trauma to the feet. On physical examination, the right first metatarsophalangeal joint appeared normal but a point of tenderness could be localized at the medial aspect of the plantar surface of her right heel. Plain radiograph of the right heel revealed a calcaneal spur at the plantar aspect. Plantar fasciitis is suspected.

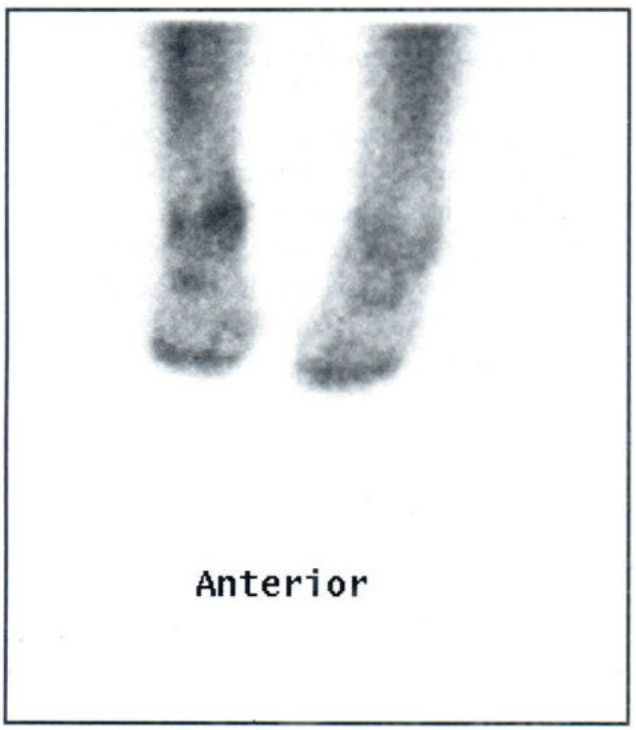
Three-phase bone scintigraphy was performed by intravenous injection of 800 MBq of ^{99m}Technetium methylene diphosphonate (^{99m}Tc MDP) to elucidate the possible causes of heel pain and other possible related pathologies at the metatarsophalangeal region. The blood flow and blood pool images revealed slightly increased vascularity to the medial aspect of the posterior part of the right foot (Fig. 1a and 1b). In three-hour delayed image, a focal area of increased radiotracer uptake was apparent at the plantar aspect of the posterior part of the right calcaneus medially, consistent with plantar fasciitis. Moreover, a focal increased radiotracer uptake is also noted at the right first metatarsophalangeal joint, likely from osteoarthritis (Fig. 1c).

Table 1. Common causes of heel pain

Calcaneal stress fracture
Archilles tendenitis
Plantar fasciitis
Retrocalcaneal bursitis
Calcaneal osteochondritis dissecans
Tarsal coalition
Osteomyelitis
Reflex sympathetic dystrophy



A.



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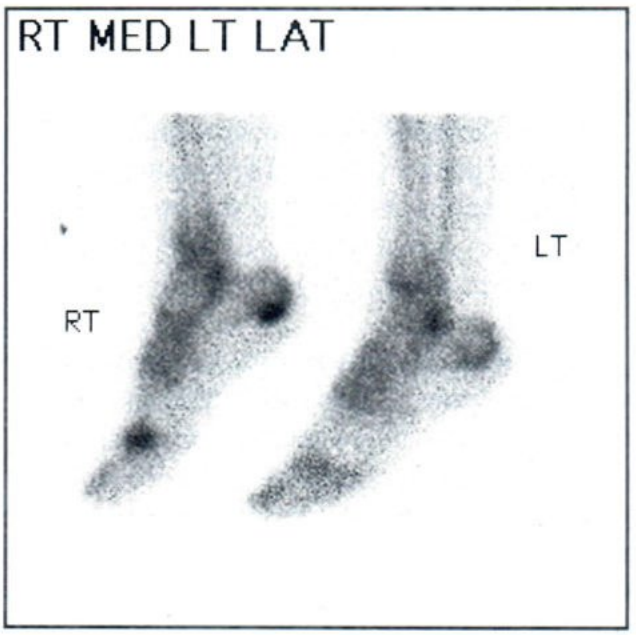

C.

Fig. 1. Three-phase bone scintigraphic findings of the feet (a: blood flow images, b: blood pool image, c: delayed static image)

DISCUSSION

The sites of tendon, ligament and articular capsule insertion to bone are called entheses.[6] Entheses act like the periosteum of bone at the region attached to bone. The disease process at the entheses can cause periosteal reaction, therefore creating osteoblastic activity at the region to the subjacent bone.[7]

Various imaging modalities can help diagnose the equivocal cases of plantar fasciitis. Plain radiographs are of limited value as a diagnostic imaging method for plantar fasciitis, although may be helpful in identifying stress fracture or articular cartilage loss for other possibilities contributing heel pain. Radiograph on the lateral projection of the foot may show the characteristic pattern of fascial swelling with displacement of the overlying fat line.[8] In chronic case, fascial calcification may be visualized. The presence of plantar calcaneal spur seems to be an incidental finding rather than the true contribution to pain. About only a half of patients with heel pain was reported to have a spur.[9]

Plantar fasciitis is also considered when ultrasonographic findings show that the plantar fascial thickness is greater than or equal to 4.5 mm, or there is more than one- mm difference in plantar fascial thickness between symptomatic and asymptomatic heels, with reduced echogenicity or loss of definition of fascial border distal to the antero-inferior aspect of the calcaneus.[10,11] Kane et al.[11] studied 23 patients with a clinical diagnosis of plantar fasciitis in 28 symptomatic heels, and found these sonographic findings in 24 of 28 (85.7%) heels. In addition, they also compared the clinical response after corticosteroid injection into the plantar fascia between ultrasound-guided method and palpation-guided method to the point of tenderness, and found no significant difference in the response rate in terms of decreasing pain, tenderness and plantar fascial thickness. Nonetheless, the apparent weakness of ultrasonography is that it essentially provides an anatomical detail without little or no information on physiological change.

Magnetic resonance imaging has been increasingly used in the diagnosis of plantar fasciitis, since it can provide useful information on changes in water content within the bone and soft tissue with high-resolution anatomical details, thus accurately identifying areas of inflammation. The thickness of the plantar fascia could be determined and an increased signal on T1-weighted images was found to suggestive of plantar fasciitis. 9 However, its relatively high cost seems to be a major limitation for evaluation of patients with clinically suspected plantar fasciitis.

Since bone scintigraphy can provide the objective evidence of an inflammatory process at the entheses, it can be used to diagnose plantar fasciitis in the cases of clinical uncertainty. An increase in bone turnover at the region of plantar fascial insertion to the calcaneus, resulting from the inflammatory process, causes abnormal radiotracer accumulation. Focally increased radioactivity in the delayed images restricted to the sites of tendon or ligament insertions, associated with increased blood flow and blood pool in the early images, is typical of enthesopathy.[12]

Plantar fasciitis is a common enthesopathy causing heel pain. Surprisingly, the clinical benefit of bone scintigraphy for this issue seems to be underused. In 1980, Sewell et al.[13] reported the diagnostic value of bone scintigraphy in painful heel syndrome in identifying the site of inflammation at the calcaneus in the patients with plantar fasciitis. However, validation of its performance in the diagnosis of plantar fasciitis has been rarely reported in the literature. Typically, the scintigraphic findings of this condition

include increased blood flow and blood pool to the medial aspect of the affected heel and focally intense radioactivity on the plantar surface of the calcaneus at the site of insertion of the plantar fascia.[10,14] This pattern is specific for plantar fasciitis, and helps to differentiate it from a retrocalcaneal bursitis and Achilles tendinitis, which would show increased radioactivity extending posteriorly or superiorly, respectively, beyond the margin of the calcaneus.[14] Our demonstrated case also had the characteristic findings of plantar fasciitis. Overuse injury leading to degenerative process was probably, in part, a shared predisposing factor for developing both plantar fasciitis and osteoarthritis of the metatarsophalangeal joint.

Intenzo et al.[15] studied 15 patients with chronic heel pain without a known traumatic event or excessive exercise, and found that three-phases bone scintigraphy correctly diagnosed plantar fasciitis in 10 patients, and ruled out plantar fasciitis in the remaining five patients. They found that typically plantar fasciitis showed a linear or elongated appearance of increased tracer activity along the medial ventral surface of the calcaneus, while on static images there was a more focal region of increased uptake localized within the inferior calcaneal surface anteriorly. Of five patients without plantar fasciitis, two had normal scintigraphic findings and their pain eventually subsided without treatment. Other two cases had calcaneal stress fracture and the other case had a calcaneal spur that required no treatment. These findings demonstrated the role of bone scintigraphy not only in the diagnosis of plantar fasciitis, but also in the differentiation of the causes of heel pain. Various causes of heel pain are shown in Table 1.[16-18]

In comparing bone scintigraphy with other imaging modalities, Tudor et al.[19] more recently compared bone scintigraphy and plain radiograph in the evaluation of 33 patients with clinically diagnosed chronic plantar fasciitis refractory to treatment. Increased 99mTc MDP uptake at the medial calcaneal spur was found in 28 cases, while the calcaneal spur was shown in 21 cases. Furthermore, almost all patients (95%) with the spur had abnormal radiotracer uptake, while only 75% of patients with abnormal uptake had the spur, indicating that bone scintigraphy could help to diagnose plantar fasciitis in about a quarter of patients without the spur or with atypical symptoms and signs. On the contrary, it may not provide additional diagnostic information in the group of patients having the spur.

Although a number of studies reporting the performance of ultrasonography in the diagnosis of plantar fasciitis,[20-22] there is rarely study comparing its performance with the bone scintigraphy. Only the study of Kane et al.[11] that showed significant correlation between ultrasonographic and bone scintigraphic findings in the diagnosis of plantar fasciitis is noted. Unlike ultrasonography, bone scintigraphy, even giving a low radiation dose to the patients, can provide significant information in patients presenting with heel pain in terms of early focal metabolic alteration without apparently anatomical change,[23] which could not be derived from ultrasonography. This value is crucial in making differential diagnoses of heel pain patients, particularly, who have previously been diagnosed as plantar fasciitis, but are refractory to conventional treatment, since other bone or soft tissue pathologies causing pain such as stress fracture may be discovered.[24]

Role of bone scintigraphy in the management of plantar fasciitis was demonstrated by Dasgupta and Bowles.[25] They studied 15 patients with a clinical diagnosis of plantar faciitis and found that 12 of them (80%) had abnormal focal uptake of ^{99}mTc MDP at the subcalcaneal region on the medial and posterior part. Additionally, corticosteroid injection into this abnormal uptake area, instead of the site of maximal tenderness,

provided the positive response, evident by improvement of the symptoms evaluated at 4-week postinjection, in all 12 cases. It was surprising that the site of abnormal uptake was usually at the region of more medial and more posterior than the site of maximal tenderness at the plantar aspect of the heel. Since the technique could enhance the accuracy and efficacy of cortcosteroid treatment, they therefore recommended bone scintigraphy as a guide for the site of corticosteroid injection in the patients who had failed more than one steroid injection before. This could reduce the need for repeated injection, since it had been reported to cause plantar fascia rupture.[26]

CONCLUSION

Bone scintigraphy can provide a useful information for evaluation of appropriately selected patients with plantar fasciitis, since it can help to confirm the diagnosis in atypical cases or those intractable to conservative treatment. Furthermore, it may be used to guide the site for corticosteroid injection in cases without satisfactory response to prior steroid treatment.

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