

Case Report

Minor Foreign Bodies Remaining in the Stratum Corneum of the Plantar Skin Are Mistaken for Plantar Fasciitis: A Case Report (Mechanism of Injury Analysis and Literature Review)

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Penetrating injuries of the sole of the foot are common conditions for which patients seek emergency department care each year. Many of these injuries become extremely complicated due to the retention of various foreign bodies in the soft tissues of the sole of the foot. A small portion of puncture wounds will become infected and may lead to complications such as osteomyelitis, osteochondritis, and soft tissue abscesses. The injury caused by the retention of tiny metallic foreign bodies in the superficial layer of the sole of the foot is even more special. We report a case in which, due to the retention of a foreign body in the stratum corneum of the sole of the foot, the patient experienced pain in the sole of the foot. The symptoms persisted for two weeks, resembling "plantar fasciitis." This patient did not go to the hospital. Instead, the patient accidentally discovered the foreign body by himself and removed it. After the foreign body was removed, the pain disappeared.

Introduction

The foot is an important locomotor organ of the human body. Plantar heel pain in adulthood is the most common problem of the foot and can be provoked by bone, soft tissue, nerve, or systemic disease^{[1][2]}. With the exception of trauma, the most frequent cause of chronic pain in the lower surface of the heel is plantar fasciitis^{[3][4][5][6][7]}. Puncture wounds to the plantar surface of the foot are common injuries seen in emergency departments. These wounds generally occur in persons of all ages and in healthy patient populations. Plantar puncture wounds of the foot can be complicated by cellulitis, lymphangitis, soft

tissue abscess, osteochondritis, and osteomyelitis^[8]. For patients with "plantar pain" who show no clinical improvement after a long period of conservative treatment, there should be a high degree of suspicion regarding the possibility of tiny foreign bodies remaining in the superficial skin layer of the sole of the foot. Diagnostic needle probing is an effective diagnostic and therapeutic method. It is called for that the management of tiny metal scraps in society should be strengthened. It can be stabbed by various foreign bodies. Metallic foreign bodies include iron nails, iron wires, sewing needles, and broken injection needles. Non-metallic foreign bodies include glass, fragments of porcelain pieces, broken stones, gravel, thorns of bamboo and wood, and broken fishbone spines^[9]. According to Bairş Polat: Metal objects can remain in tissues without causing any complications, but wooden particles can cause infections and consequently should be extracted^[10].

Here, we report a case that occurred with a doctor who loves sports. There was a misdiagnosis of plantar fasciitis at first, and the discovery of the tiny metallic foreign body in the sole of the foot was quite accidental. The treatment was very simple and convenient, which quickly relieved the pain and restored the function. Therefore, this case is of great significance and is reported.

Case Presentation

Medical History

The patient is a male, born in 1970, working as a physician, and usually participates in outdoor sports. There is no family history of genetic diseases.

Chief Complaint

The patient has felt a stabbing pain in the left sole of the foot when walking and running for two weeks. He recalled that two weeks ago, when wearing flat shoes and climbing a mountain, he stepped on an uneven stone path. Suddenly, he felt a tearing pain in the skin of the left sole of the foot. He checked that the sole of the shoe was intact, and there was no foreign body on the ground. In the following two weeks, whenever he walked or ran, he felt a needle-like pain in the sole of the foot, and the pain disappeared when he rested. The pain recurred repeatedly without improvement. He always thought it was an attack of "plantar fasciitis" and did not seek further diagnosis and treatment.

Past Medical History

In the past few years, the patient had similar episodes of plantar pain before, which were diagnosed as plantar fasciitis and healed spontaneously after a period of rest.

Physical Signs

The general condition is acceptable, and the limbs can move freely. There is a black spot about 1mm in size on the lateral side of the forefoot of the left foot. It does not protrude above the skin surface, and there is no pain on palpation, and the movement is normal. There is no pain in the left sole of the foot when standing, but there is pain in the left sole of the foot when walking or running, and the pain disappears when resting.

Auxiliary Examination

No X-ray examination was done (this film was taken after the operation when the patient pasted the foreign body on the surface of the wound for analysis).



Figure 1. An arched stainless steel wire about 2mm long is located in the middle section between the third and fourth metatarsal bones.

Diagnosis

Foreign body in the left sole of the foot

Treatment Method

After disinfection, use a medical blood collection needle to pick open the stratum corneum on the surface of the black spot on the left sole of the foot. A 2mm arched stainless steel scrap was found buried horizontally inside and was removed.

Result

After the operation, it was observed that the pain disappeared rapidly when walking immediately. On the next day, the surgical site of the wound on the left foot was covered with a new stratum corneum.



Figure 2. The photograph of the sole of the foot after the operation. The location pointed by the black tip is where the foreign body was located.

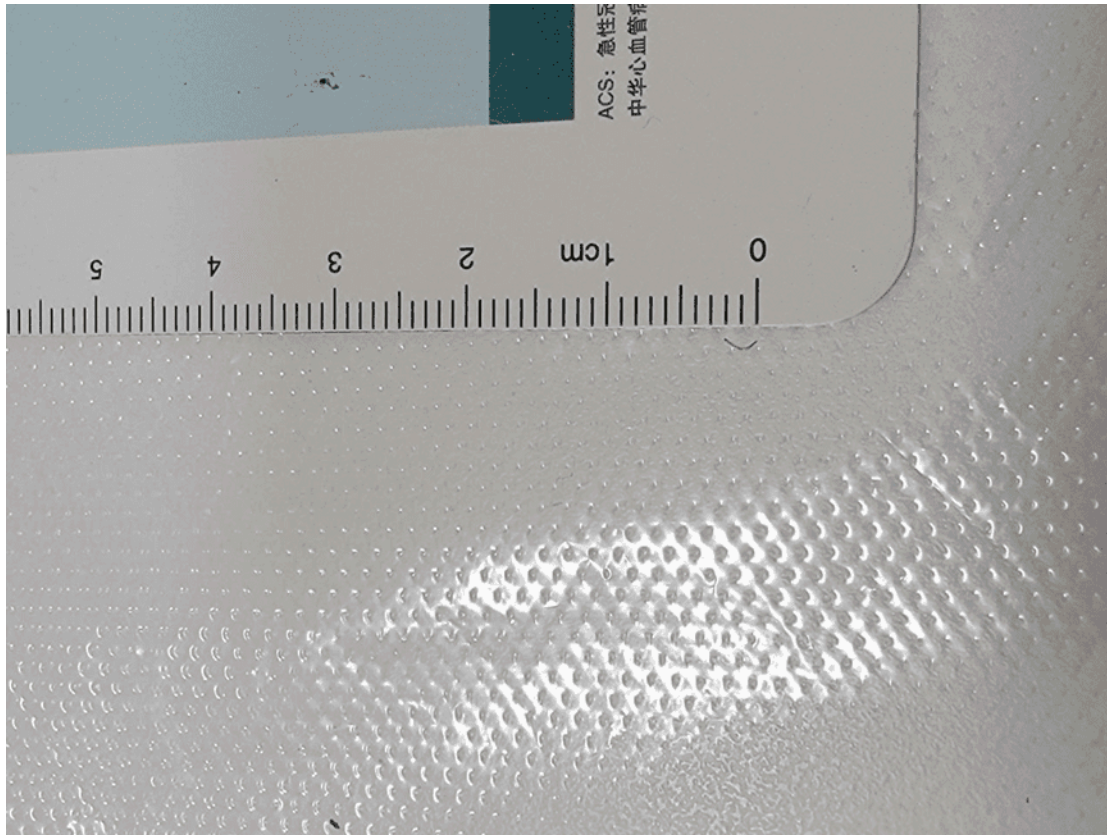


Figure 3. This arched stainless steel wire, which is the foreign body in the sole of the foot, is about 2mm long and the height of the arch is approximately 1mm.



Figure 4. During exercise, the sole of the foot rubs against the ground, and the tiny metallic foreign body sandwiched between the skin and the ground is pierced into the stratum corneum of the plantar skin.

Discussion

Both the retention of foreign bodies and plantar fasciitis are common causes of plantar pain in orthopedics. The plantar fascia is a thick tissue on the sole of the foot, mainly providing support for the arch of the foot and absorbing the reaction force from the ground during exercise. If the tendons or fascia of the sole of the foot are in a stretched state for a long time, or are subjected to local strong collisions, aseptic inflammation may occur, which is what we commonly call "plantar fasciitis". Plantar fasciitis is a common sports injury, which occurs frequently not only in sports events such as track and field, basketball, football, volleyball, tennis, badminton, etc., but also in the general population^[11]. Diagnostic imaging examinations are rarely used for patients with plantar fasciitis. Clinically, there are many diseases that may produce clinical features highly similar to those of plantar fasciitis, so misdiagnosis is likely to occur. Plantar fasciitis remains a well-studied topic, most likely owing to the high prevalence of the condition and the lack of clarity regarding how best to treat the condition^[12].

Plantar heel pain is one of the most common problems in orthopaedic practice. A variety of soft tissue, osseous, and systemic disorders can cause heel pain. These include plantar fasciitis, fat pad atrophy, peripheral nerve disorders, plantar fascia rupture, and tendinitis of the flexor hallucis longus. Less common causes of heel pain, which should be considered when symptoms are prolonged or unexplained, include osteomyelitis, bony abnormalities (such as a calcaneal stress fracture), or a tumour^[13]. A soft tissue chondroma of the heel mimicking plantar fasciitis was reported by Eitan Melamed^[13], a case of lung cancer metastasis to the heel was reported by HAO DAI^[14], and atypical rheumatoid arthritis was reported by Liang Bo^[15], and so on.

The sole of the foot has a special anatomical structure, with a thick stratum corneum, abundant muscles, and numerous tendons. The contraction of muscle fibers and tendons can cause the displacement of foreign bodies. Therefore, the best time for the removal of foreign bodies is within 6 to 8 hours after the injury^[16]. Once a foreign body is retained in the foot, the presentation varies according to the size, nature, location, and contamination^[17].

"Our heel has several shock-absorbing mechanisms that assist the efficiency of movement. Some impact force is first absorbed by a firm and thick fat pad on the heel before it makes its way through to the bone. That fat pad is further protected by skin layers that quickly thicken in response to increased change." "The ground reaction force (GRF) is oppositional to the body's contact with the terrain, and as such, it is continually changing as the foot progresses from heel to toe"^[18]. The possible principle of the arch-

shaped foreign body stab wound in this case is as follows: During the walking process, the sole of the foot moves forward in a semi-rolling manner relative to the ground. The sole of the foot is stretched and then contracts instantaneously. The foreign body gets caught in the middle and is rubbed and rolled. When it rolls to a certain angle at the sharp part, it is stabbed into the sole of the foot. In this case, the height of the arch of the foreign body is just about 1mm, and it can be hidden in the stratum corneum of the sole of the foot, which can be as thick as 1.5mm, without touching the dermis layer where the blood vessels and nerves are located. It is only when walking that the dermis layer is touched and pain is generated.

Just as the mechanism of a large number of tires being stabbed by metal scraps every day is the same, the rapid rolling of the tires causes the metallic foreign objects on the ground to pierce into the tires. Foreign bodies are small objects that enter through the epidermis. The foreign body then travels to the dermis, causing pain and inflammation due to nerve injury and foreign body attack. Examples include splinters, thorns, and cactus spines known as “glochids.”^[19]

The skin is divided into three layers: the epidermis, the dermis, and the subcutaneous tissue (fatty membrane). The outermost layer is the epidermis, which is composed of metabolically active keratinocytes and is covered by a layer of keratin, that is, the stratum corneum. The main component of the dermis is fibrous collagen. Below the dermis is the subcutaneous tissue, which is composed of lobules of adipocytes and is separated by collagen septa rich in neurovascular bundles. There are considerable differences in the relative thickness of the three layers of the skin in different parts of the body. The epidermis of the palms and soles is the thickest, about 1.5mm^[20].

There are no blood vessels or nerves in the epidermis. If only the epidermis is damaged, there will be no bleeding, no pain, and no scarring, and the healing is rapid. The feet and hands were the most affected parts of the body, since they are open to external penetrant injuries^[19]. The sole of the foot is a special part of the human body. In our daily life, we often encounter the situation where foreign bodies are embedded in the stratum corneum of the hand skin. In common parlance, it is called “clavus.” It doesn't hurt when not touched, but only hurts when touched. Due to the clear history of trauma and hand pain, as the skin of the fingers is thinner than that of the sole of the foot and is non-weight-bearing, symptoms such as pain and infection are likely to occur, and it is convenient to check and easy to detect.

The hand is close to the head. By stretching out the hand and turning the palm, it can be brought close to the front of the eyes. One can carefully check and distinguish it with the naked eye. Elders with life experience can be asked for help to pick out the foreign body with a sewing needle. Sometimes, people will seek the help of emergency department doctors. However, for the foreign bodies on the superficial

layer of the sole of the foot, due to the limitations of the human body structure, the sole of the foot is far from the head, and it is difficult to turn the sole of the foot and place it in front of the eyes for examination. Even if the sole of the foot is turned over, the person will be in a nervous and uncomfortable state, and it is very difficult to check and identify whether there is a foreign body with the naked eye.

We report a case of a tiny foreign body remaining in the superficial stratum corneum of the sole of the foot. The foreign body was in the sole of a 56-year-old doctor who usually likes sports. During an outdoor sport, there was a sudden pain in the sole of the foot. The sole of the shoe was checked to be intact, and no foreign body was seen on the ground. Since the process of the foreign body piercing into the sole of the foot and its retention are both concealed, and as the dermis layer rich in blood vessels and nerves was not pierced, there was no infection or bleeding, and no scar could be seen after healing. The pain in the sole of the foot only manifested during exercise, and it was mistakenly thought to be plantar fasciitis. The symptoms are highly similar to those of plantar fasciitis, and the pain will be aggravated when the dermis layer is stimulated by external factors such as friction and pulling. Therefore, it is very easy to think that it is an attack of plantar fasciitis and delay the treatment. The discovery of the foreign body was also accidental. Two weeks after the foot pain occurred and the symptoms did not subside after two weeks of rest, the patient began to check the sole of his foot. A diagnostic needle probing was carried out on a black spot on the sole of the foot, and a foreign body about 2mm in size was found. The pain in the sole of the foot disappeared immediately after the foreign body was removed.

The pairing of acral skin with a scalpel blade is a common procedure. This technique can be used to remove a foreign body from any physician's office. The use of this method reduces pain and complications with foreign body removal and encourages patients to seek professional assistance sooner. This is an efficient, effective, and acceptable method that is simple and less intimidating to patients. There is no numbing or incising involved, reducing stress on the physician and the patient. Patient satisfaction is high with this procedure. Foreign bodies of acral skin are very common, and this method proves to be simple and effective^[19]. The diagnostic needle probing used by the author of this article is very effective. The principle is the same, and it is suitable for use in the office, at home, especially outdoors.

Conclusion

Doctors and patients pay great attention to the history of penetrating injuries caused by large foreign bodies, often ignoring the possibility of stabbing by tiny foreign bodies. For patients with "plantar pain"

who show no clinical improvement after a long period of conservative treatment, or those with sudden onset during running, hiking, etc., there should be a high degree of suspicion regarding the possibility of tiny foreign bodies remaining in the superficial skin layer of the sole of the foot. It is necessary to check in a timely manner whether there are any abnormal changes in the skin, determine the location, and after disinfection, needle probing treatment can be carried out without anesthesia. Everyone can perform this treatment, which is very simple, safe, convenient, quick, and effective. It is especially suitable for those who hike in the wild, quickly relieving foot pain and functional limitations. The management of tiny metal scraps in society should be strengthened.

Statements and Declarations

The patient provided written informed consent for the publication of this case report, including images.

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