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Case Report

Stress fracture of the distal fibula in flatfoot patients: case report

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Abstract: The increase in proportional loading of the fibula with progression of hindfoot deformity would lead to high fibular loads during rapid walking, resulting in insufficiency fractures. We report an unusual mechanism of such fracture in a textile worker resulting from valgus alignment from a stage III flatfoot deformity. The stress fracture was missed initially and only confirmed by CT examination. The patient responded well to nonoperative treatment and had an excellent recovery with no residual symptoms finally. Fracture of the distal fibula caused by rigid hindfoot valgus in stage III flatfoot deformity is a previously undescribed injury. We report a patient who presented with this injury, the possible mechanisms of such injury, its management and outcome.

Keywords: Stress fracture, flatfoot, fibular loading

Stress fractures are more unusual in the fibula than in the tibia because the fibula plays a minor role concerning the axial load of the lower extremity. However, in rigid flatfoot deformity with hindfoot valgus, the loads on the fibula may have increased. We present a unique case of fibular stress fracture in a flatfoot patient, which is missed at initial presentation. To our knowledge, no cases with distal fibular stress fractures attributable to flatfoot have been reported in the English literature.

Case report

A 44-year-old female presented to our clinic for lateral distal pain in the left leg of four days duration. The patient was employed as a worker in the textile mill for 8 years and the job needed the patient to walk around to fill all the textile machinery with water repeatedly. After 2 weeks of continuous overtime work, the patient noticed a gradual swelling in her left leg just above the ankle. She was still able to stand on her leg, although with pain, and completed the work days. But four days later, she had to discontinue work because of aggravated pain and a slight limp toward the left side. Physical examination revealed localized swelling and tenderness on the distal fibula about 3 cm proximal to the lateral malleolus. Radiographs of the ankle did not reveal any abnormalities (**Figure 1**) and the patient was given nonsteroidal anti-inflammatory medications for pain relief and was placed on sick leave. Unfortunately, two weeks later the patient returned to our clinic with no improvement of the symptoms. On meticulous physical examination again, we found she had bilateral foot arch collapse with increased hindfoot valgus deformity (**Figure 2**). In contrast to the right reducible deformity, the left side showed inability to perform a single heel-rise test with a passively uncorrectable subtalar joint (**Figure 3**). In consideration of these clinical signs, we suspected it was a lateral impingement caused by calcaneal valgus and decided to do an MRI examination of the left ankle. The MRI identified an abnormal segmental signal of the distal fibula above the ankle and a cortical defect surrounded by soft-tissue swelling (**Figure 4**). According to these findings, further diagnostic protocols were ordered. Laboratory tests including routine blood tests, as well as erythrocyte sedimentation rate, C-reactive protein, all part of the blood workup were in the normal ranges. Subsequent CT with 3D reconstruction con-

Figure 1. Radiograph of the ankle revealed a preserved ankle joint with normal alignment, severe arch collapse and no evidence of fibular fracture.

firmed a homogenous thickening associated with minimal solid periosteal reaction. A linear fracture line involving the bilateral cortex was identified (**Figure 5**). Finally the diagnosis of a stress fracture of the distal fibula was established. Our treatment consisted of cast immobilization of the lower leg, and weight-bearing restriction for the duration of 2 weeks followed. At 2 weeks follow-up, she was almost symptom-free and physical examination did not reveal any abnormalities except for mild pain on deep palpation over the callus. She remained symptom-free and eventually was able to return to normal activities 2 months from her original injury. In addition, Because of the repetitive intense activities in the textile mill, she complied with our recommendation to change a new job with less physical demands. At one year follow-up, the patient responded well to non-operative management with no reoccurrence of stress fracture.

Discussion

Stress fractures generally occur as a result of repetitive, cyclic loading which exceeds the mechanical capacity of the bone. Approximately 95% of all stress fractures occur in the lower extremities, more commonly involving the tibia with only less than 20% occur in the fibula, particularly in the distal third [1-4] Biomechanical studies have found that the fibula receives between 6.4% and 17.2% of the load applied to the lower extremity with the ankle in neutral position [5-8]. However, the percentage of the axial load taken by the fibula depends to a large extent on the anatomic alignment of the limb. Wang has demonstrated that a valgus alignment of the hindfoot could be associated with a more lateral position of the force vector, which would increase fibular loading significantly [5]. Friedman has found that the flatfoot condition with valgus calcaneal deformity and consequent malalignment resulted in highly significant lateral shift in the location of both global contact area and peak pressure on the talar dome. Significant increases in mean and peak pressure were also found but were proportionately small to the relatively large decrease in contact area. A transfer of load off the talar dome to the lateral facet and fibula was then suspected [9]. This finding was supported by the work of Calhoun and colleagues who found more force was transmitted through the fibula with ankle eversion and the increased load might cause fracture which was similar to the fracture mechanisms as described by Lauge-Hansen [10]. These findings may explain the stress fractures seen in patients with late-stage adult-acquired flatfoot with associated irreducible hindfoot valgus. In current case, there are detectable abnormalities of flatfoot with valgus deformity of the subtalar joint in the standing position. According to the Johnson and Strom classification, the patient has a Stage II right flexible foot deformity which is passively correctable and a left stage III rigid deformity with fixed hindfoot valgus. As could be predicted from the above mechanical principles, a lateral shift in the line of force from the fixed valgus deformity in the

Figure 2. With the patient standing, bilateral heel valgus and medial arch collapse were recorded.

Figure 3. In double heel rise test (the patient placed her hands against the wall for balance), the collapsed arch and valgus deformity was still present in the left side when a medial longitudinal arch and heel inversion appeared in the right side.

left side would increase the fibular loading, which might result in stress fracture finally.

Some clinicians consider medializing calcaneal osteotomy (MCO) is beneficial in this case which aims to realign the hindfoot and normalize stress distribution. MCO results a medial shift of the calcaneal weightbearing axis, aligning it with the tibial axis, and medializing the moment arm of the Achilles tendon [11, 12]. Several studies have provided biomechanical data to support that realignment of the hindfoot corrects the pathologic contact characteristics of the ankle associated with an adult acquired flatfoot. Fairbank has stated that hindfoot valgus could adversely affect tibiotalar joint contact characteristics with a qualitative shift of pressure laterally and MCO would cause a medial shift of pressure distribution conversely [13]. Havenhill has reported that the MCO significantly decreased the mean contact pressure and corrected the lateralization of contact pressure produced by the flatfoot condition [14]. The work done by Steffensmeier and colleagues also showed the center of force within the ankle shifted in direction of the displacement osteotomy [15]. These cadaver studies support that MCO may be used clinically to partially offload focal areas of fibula and halt overload induced degeneration in a flatfoot model. However, other clinicians feel a pure medial slide of calcaneus couldn't correct arch height and midfoot subluxation adequately and is insufficient at maintaining correction over longer periods of time, rather, it inevitably influences the foot biomechanics and can thus lead to forefoot deformity progression and subsequent foot symptoms [16, 17]. Therefore, a triple arthrodesis with possible adjunctive proce-

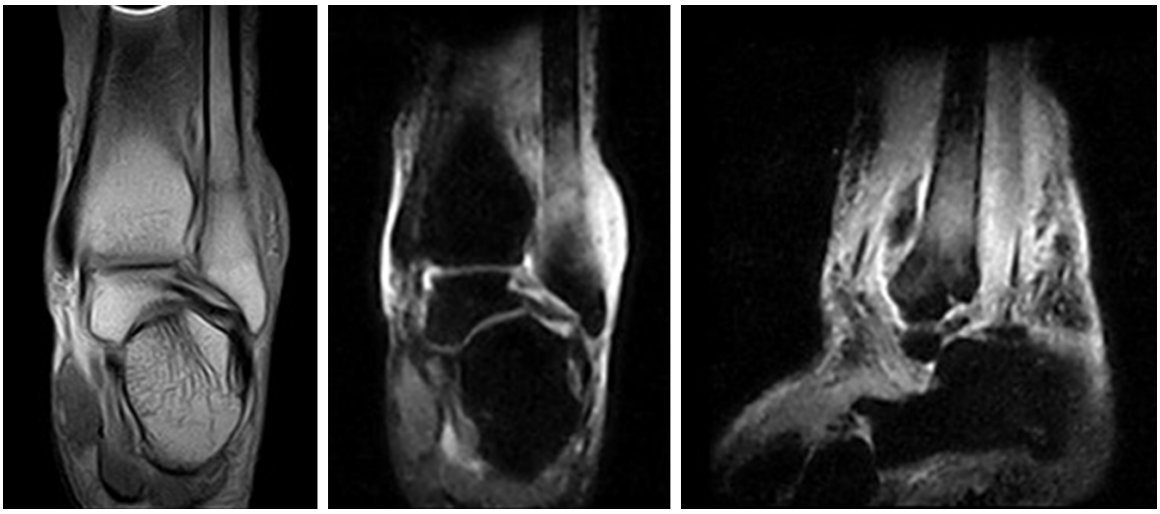

Figure 4. MRI showed extensive bone marrow edema in the distal fibula with surrounding soft tissue edema.

Figure 5. CT showed a nondisplaced transverse hairline fracture of the distal fibula with callus formation.

dures should be a better long-term procedure to achieve full correction and prevent underlying disease process. However, in the absence of symptoms in the foot, the arthrodesis seems too radical and the significant degenerative effect on adjacent joints particularly the ankle, is concerned [18, 19]. With above arguments, we finally determined to use cast immobilization as initial treatment and the patient was instructed to return if pain reoccurs. As with other stress fractures, healing occurred once the offending loading force was removed. Finally, the patient changed to a less physical-demanding job without symptoms recurrence at one year follow-up. However the long-term outcome is still uncertain.

The weight-bearing function of the fibula in flatfoot model does not seem to have been adequately studied. Neither the occurrence nor the frequency of fibular stress fracture in patients with flatfoot deformity has been documented. Also definitive studies would be necessary to assess whether treatment of the deformity reduces fibular stress and prevents overload degeneration. With these informations, it may lead to better understanding and improved treatment algorithms of this condition.

Conclusion

Stress fracture of the fibula may be related with the long-standing presence of an adult acquired flatfoot deformity. Increased proportional loading in the fibula due to lateralization of the load axis in fixed hindfoot valgus deformity is thought to contribute to this condition. However, whether it's an operative indication using calcaneal

osteotomy or even arthrodesis to reduce the fibular weight-bearing stress is still in doubt. Finally, understanding the etiology of the distal fibular pain in patients with flatfoot deformity can potentially alter the physician to the possibility of stress fracture and aid in clinical diagnosis and treatment designing.

Disclosure of conflict of interest

None.

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