

Case Report

A Case of Chronic Bilateral Tibial Stress Fractures Treated with Intramedullary Nailing

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Abstract

Introduction: Stress fractures are a type of overuse injury that frequently affects athletes, military personnel and individuals with endocrine disorders. Research has indicated that cases of anterior tibial stress fractures that do not respond to conservative treatment can be successfully treated using intramedullary nailing. To date, there has been a single documented case of patients with both tibial stress fractures treated with bilateral intramedullary nailing and all of them were professional athletes. This report examines the case of an individual who did not participate in sports and had persistent stress fractures in their lower legs, which were effectively treated by inserting two nails into the bone.

Case Report: A 23-year-old male student who was a full-time student came to the clinic with persistent pain in both of his shins that had been bothering him for about five years. He had experimented with different conservative treatments, but none of them had provided any relief from his symptoms. The diagnosis of chronic bilateral tibial stress fractures was established by examining the patient's medical records, performing a physical assessment and employing imaging methods. The patient received sequential intramedullary nailing for both of their tibiae. Even though both tibiae exhibited valgus alignment, it did not impact the placement of the nails. As the nails were inserted into the sclerotic canals, they adapted to the existing deformity, aligning themselves accordingly. The postoperative assessment revealed a successful fusion of the tibiae, providing significant relief from the patient's symptoms.

Conclusion: Overall, the application of intramedullary nailing offers a promising solution for managing chronic bilateral stress fractures, providing a viable option for patients who may otherwise face prolonged recovery times or persistent pain. By expanding the indications for this surgical technique, healthcare providers can improve outcomes for a broader patient population, ultimately enhancing their ability to return to normal activities and improving their overall quality of life.

Keywords: Intramedullary Nailing; Tibial Stress Fracture

Introduction

Stress fractures are overuse injuries that are most frequently observed in athletes, endocrine problems and military recruits [1-5]. They most commonly affect the lower extremity's weight-bearing bones, with the tibia accounting for 18.9% to 63.0% of instances that have been recorded [5-7]. The anterior cortex is home to a subgroup of tibial stress fractures. This region is more susceptible to delayed union, nonunion or total fracture because to tensile pressures and inadequate vascularity [3]. Intramedullary nailing has been shown to be effective in treating chronic cases of anterior tibial stress fractures that are not amenable to conservative treatment [1,2,6,8]. As far as we are aware, there is just one published report on patients who received bilateral intramedullary nailing for bilateral tibial stress fractures [6]. Every patient in the series was a professional athlete [6]. We describe a non-athletic patient who underwent effective treatment with bilateral intramedullary nails for chronic bilateral tibial stress fractures and related deformities.

Case Report

A 23-year-old male, who is currently pursuing a full-time education, sought medical attention for persistent pain in both of his shins that has lasted for around five years. He has undergone an extensive conservative treatment plan, which included orthotic insoles, non-steroidal anti-inflammatory drugs (nsaids), vitamin d supplementation, continuous physical therapy and corticosteroid injections, all of which have not provided relief. Furthermore, he underwent a bilateral compartment release at another facility due to suspected exertional compartment syndrome, but unfortunately, it did not alleviate his symptoms. Following a trial of spinal cord stimulation that did not yield positive results, he was referred to our institute for a more comprehensive evaluation of his tibiae. The patient reported a persistent, intense pain that ranged from 7 to 9 on a scale of 10, affecting the area from the knee to the mid-tibia. His discomfort was primarily localized to the front of his leg and intensified when he stood up from a seated position, stood for extended periods or engaged in walking. He mentioned that he did not experience any discomfort in his back, hips, knees or ankles. His mobility was limited to 13 minutes and he could only walk a quarter of a mile.

During the assessment of the lower limbs, a noticeable difference in alignment between the tibiae was observed. Evaluations of both active and passive movement for the lower back, hips, knees and ankles demonstrated unrestricted motion. There were fully healed surgical cuts measuring 12 cm in a direction parallel to the spine along the upper part of the shinbone. A mild bruise was noticed on the tibial crest, which felt warm to the touch and was tender when gently pressed. Experienced moderate pain when resisting knee bending and pointing the toes downwards on both sides of the mid-tibia. The manual muscle testing indicated a strength rating of 5/5 in the muscles of the upper leg and 5-/5 in the ankle joints when tested on both sides. The patient's walking pattern exhibited a slightly reduced stride length, but it was consistent, balanced and without any noticeable signs of discomfort. Radiographs taken before surgery (Fig. 1,2) of the bilateral tibiae exhibited cortical thickening and a reduction in the width of the medullary canal, with the left side being more severely impacted. The anteroposterior (ap) views revealed a valgus bowing of the tibiae, measuring 7.5° on the left and 6° on the right. The lateral images showed a rotation of 4° on the left and 5.5° on the right. The bone scan showed a slight increase in uptake on the left side of the tibia, specifically in the middle area. An MRI of the lower extremities showed postsurgical changes in the midsection of the lower legs, characterized by hyperintense fluid, edema and cortical thickening along the anteromedial border of the mid-tibiae bilaterally (Fig. 3). As a result, it was determined that the patient had a chronic condition affecting both of their tibial stress fractures.

After considering various treatment options, which encompassed both non-surgical and surgical methods, the patient ultimately decided to undergo intramedullary nail stabilization for the left tibia. During the surgical procedure, it was observed that the intramedullary canal displayed substantial sclerosis, requiring an initial reaming with a 6 mm reamer, which was gradually increased in 0.5 mm increments up to 11 mm. It is important to note that the intramedullary nail became distorted during its insertion. The left tibia was angled towards the outside of the leg at 7.5°, but when the nail was inserted into the bone, it adjusted to match the angle of the tibia. The nail was firmly attached at the proximal end using a single screw that could move and at the distal end with two screws that stayed in place. The patient was given the green light to bear weight at their own pace and was referred for physical therapy sessions outside of the hospital. After three months, he reported that his symptoms had completely disappeared in the left leg. Despite experiencing persistent pain in his other leg, he made the decision to undergo surgical fixation of the right tibia, employing intramedullary nailing in a manner similar to the previous procedure. Once more, the intramedullary nail curved to fit the 6° valgus angle of the right tibia as it entered the sclerotic canal.

After the stabilization of his right and left tibial stress fractures using intramedullary nails, the patient was able to walk on his own and reported only mild, occasional pain while jogging. His walking style seemed typical, without any indications of an antalgic pattern. When the doctor touched the knees or tibiae, there was little to no pain felt. The flexibility of the knees was assessed and it was found to range from 0 to 130 degrees on both sides, without any signs of instability. The patient showed no signs of neurological impairment and the surgical wounds had completely recovered. Radiographic examinations, which included anteroposterior and lateral views of both tibiae, did not show any fractures and confirmed that the hardware was intact (Fig. 4,5). The patient experienced a positive outcome from the bilateral intramedullary nailing procedure and was given the go-ahead to resume his usual activities, based on his own assessment of his abilities. It is important to note that the slight to moderate misalignment of the tibia did not hinder the tibial nailing process, as the smaller nails used were capable of accommodating the valgus alignment of the tibia during insertion.



Figure 1: Anterior posterior and lateral view X-rays of left tibia.



Figure 2: Anterior posterior and lateral view X-rays of Right tibia.



Figure 3: Coronal view of MRI showing edema and cortical thickening along the anteromedial border on both sides.



Figure 4: Anterior posterior and lateral view X-rays of left tibia one year post op.



Figure 5: Anterior posterior and lateral view X-rays of right tibia one year post op.

Discussion

Briethaupt was the first to identify stress fractures in 1855, marking a significant milestone in the understanding of these injuries [9]. Stress fractures are particularly prevalent among specific populations, including individuals with endocrine or nutritional disorders, athletes engaged in high-impact sports and military personnel who often undergo rigorous training regimens [1,3,4,10]. The underlying mechanism of stress fractures is primarily attributed to dynamic cyclic loading, which refers to the repeated application of forces that are less than the maximum load the bone can withstand [1,10,13]. Over time, this repeated submaximal loading can disrupt the delicate balance between bone formation and resorption. In a healthy bone, osteoblasts (the cells responsible for bone formation) and osteoclasts (the cells responsible for bone resorption) work in harmony to maintain bone density and integrity. However, with the continuous application of stress, osteoclastic activity may begin to outpace osteoblastic activity. This imbalance leads to an increase in bone resorption, weakening the bone structure and making it more susceptible to fractures [1]. This phenomenon is particularly concerning in the context of stress fractures occurring in the anterior midtibia. The anterior aspect of the tibia, which experiences tensile forces during activities such as running and jumping, is notably different from the posteromedial cortex of the bone. One of the critical factors contributing to the vulnerability of the anterior midtibia is its relatively lower blood supply compared to other regions of the tibia. This reduced vascularization means that the area has a diminished capacity for healing and recovery after sustaining repeated stress. Additionally, the anterior midtibia has less musculotendinous support, which further exacerbates its susceptibility to injury. Consequently, this poorly vascularized region may struggle to recover adequately from the cumulative effects of repeated stress, leading to an increased risk of developing stress fractures before the bone has had a chance to heal properly [3,5]. This makes the fracture more likely to be resistant to conservative treatment and it may develop into a focal bone infarct, non-union or total fracture [3,6]. Patients frequently arrive with a subtle beginning of pain in the mid-shaft of their tibia that develops over two to three weeks [3,5,6]. Activity exacerbates the pain, while rest alleviates it [5,6]. They might explain a recent rise in sports or a modification to footwear or gear [3,6]. A physical examination usually shows palpable periosteal thickening, local swelling, point tenderness over the afflicted bone or functional testing that replicates discomfort [3,5]. A disparity in limb length or muscle imbalance may be revealed by biomechanics evaluation [3].

While plain radiographs are typically the initial imaging choice for diagnosing stress fractures, it is crucial to understand that the radiographic changes associated with these injuries may not be immediately visible. In many cases, these changes can take time to manifest, often appearing two to three months after the onset of clinical symptoms. This delay in detection can pose a significant challenge for clinicians, as timely diagnosis is essential for effective management and treatment [5-7]. Research indicates that approximately 50% of stress fractures are overlooked in follow-up radiographs, highlighting the difficulty in identifying these injuries even after initial imaging. The detection rate is particularly concerning during the initial imaging phase, where it can drop to as much as 85%. This underscores the importance of clinical suspicion and the need for careful evaluation of symptoms and patient history [7]. The earliest signs of stress fractures on radiographs are often subtle and can include the presence of radiolucencies—areas that appear darker on the X-ray due to decreased bone density or an indistinct cortical outline, which may suggest underlying bone pathology. As the condition progresses, additional imaging may reveal more pronounced changes, such as the formation of new periosteal bone, which is indicative of the body's attempt to heal the fracture. Endosteal thickening, which refers to the thickening of the inner layer of the bone, may also be observed, accompanied by sclerosis, a process where bone becomes denser and harder [7, 8]. A particularly notable feature in the imaging of stress fractures is the "dreaded black line". This term describes a lucent line that can be seen in the thickened anterior cortex of the bone, serving as a critical indicator of a stress fracture. The presence of this line can significantly aid in the diagnosis, as it is often associated with more advanced stages of the injury. In cases where a stress fracture is suspected but initial radiographs do not provide conclusive evidence, it is advisable to conduct repeat imaging approximately two weeks later. This follow-up imaging can often yield clearer evidence of the fracture, as the changes in the bone may become more pronounced over time. By allowing for this additional time, clinicians can improve their chances of accurately diagnosing the injury and implementing appropriate treatment strategies to facilitate healing and prevent further complications [8-10].

If ordinary film proves to be inconclusive, technetium-99 m-labeled diphosphonate bone scintigraphy is a great alternative. Within 6-72 hours of the onset of symptoms, it is usually abnormal [10]. Specificity is not as high as sensitivity, which has been reported to be close to 100% [5,11,14]. Twenty to forty percent of lesions observed on bone scintigraphy were reportedly asymptomatic [10]. Discrete, confined and occasionally linear regions of enhanced uptake on all three scan phases are indicative of acute stress fractures [5]. Although MRI, CT and ultrasound have been successfully utilized to diagnose stress fractures, they are usually saved for situations where bone scintigraphy and plain films provide unclear results.

Rest, moderation of activity and correction of biomechanical abnormalities can aid the majority of tibial stress fractures. Furthermore, intrinsic factors such as hormonal or nutritional imbalances should be assessed and addressed [1-4,10]. Conversely, mid-anterior tibial stress fractures are recognized as a distinct category of tibial stress fractures, showing variable results with non-operative treatment [1,2,4,11,12]. Notably, in Beals and Cook's study, only eight out of twenty patients were able to return to sports with rest alone [11]. In addition, five of eight patients who were allowed full range of motion underwent complete bone grafting. These data suggest that stress fractures of the medial tibia are more likely to result in complete fracture, delayed fusion or instability. Therefore, they often require more intensive treatment after attempting nonoperative treatment. The use of tibial intramedullary nails has been described [6,8,12]. Bilateral tibial nailing as a treatment for bilateral tibial stress fractures has only been reported by Varner, et al. [6]. Four patients with bilateral tibial stress fractures were successfully treated, according to their description. Remed intramedullary nailing was used to treat 11 chronic anterior midtibial stress fractures in 7 collegiate athletes in their cohort. Patients received non-operative treatment for at least four months and the average duration of symptoms was twelve months. This cohort's stress fractures were observed to union at 2.7 months subjectively and 3 months radiographically after surgery. Every patient was able to resume their sporting activities and expressed pleasure with the operation. In our instance, the patient had a five-year course before receiving conclusive treatment and was not a professional athlete.

Conclusion

Bilateral tibial stress fractures that do not respond to conservative treatment may be effectively addressed through the use of bilateral intramedullary nail fixation. The placement of these intramedullary nails is feasible even when mild to moderate tibial malalignment is present, yielding favorable clinical outcomes.

Conflict of Interest

The authors declare that they have no conflict of interest in this paper.

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Authors' Contributions

All authors contributed equally in this paper.

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