[Orthopaedic Surgery]

The Treatment and Outcomes of Medial Malleolar Stress Fractures: A Systematic Review of the Literature

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Context: The medial malleolus is considered a high-risk stress fracture and can be debilitating to the highly active or athletic populations. A range of treatment methods have been described with varying outcomes. Currently, there is no gold standard treatment option with optimal results described.

Objective: A systematic search of the literature to determine treatment options and outcomes in medial malleolus stress fractures.

Data Sources: OVID/Medline, EMBASE, and the Cochrane Library from 1950 to September 2013.

Study Selection: Included studies mentioned treatment and outcomes of medial malleolus stress fractures.

Study Design: Systematic review.

Level of Evidence: Level 4.

Data Extraction: The searches used combinations of the terms *stress fracture, medial malleolus, management*, and *treatment*. Two authors independently reviewed the selected articles and created individual tables, which were later compiled into a master table for final analysis.

Results: Six retrospective case series were identified (n = 31 patients). Eighty percent (25/31) of patients were men, with an average age of 24.5 years. Ninety percent (28/31) of patients were at least involved in recreational athletics. All patients were able to return to sport. Complications were seen in both groups ranging from minor stiffness to nonunion requiring open reduction internal fixation.

Conclusion: Nonoperative and operative interventions have proven to be successful with regard to healing and return to play for medial malleolar stress fractures in the recreational and competitive athlete. However, early operative intervention can possibly create a higher likelihood of early healing, decrease in symptoms, and return to play.

Keywords: medial malleolus; stress fracture; outcomes; nonunion; operative care

Stress fractures of the lower extremity are a common occurrence in athletic and military populations.[1,3,7,8] This is because of the repetitive nature of their activities. Stress fractures result from excessive, repetitive, submaximal loads on bone that cause an imbalance between bone resorption and formation.[2] This creates propagation of microfractures in bone beyond the body's ability to repair, eventually coalescing into a clinically symptomatic fracture.[4-9] The etiology is multifactorial, with intrinsic and extrinsic factors playing a role. Stress fractures have been broadly classified as high or low risk,[2] with high-risk stress fractures having a predilection for progression to complete fracture, delayed union, or nonunion.[2] They are often found in areas of high shear stresses or poor vascular supply.

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Of the reported high-risk stress fractures, this review focuses on the medial malleolus. These injuries present with gradually increasing pain and swelling over the medial ankle. The symptoms are aggravated by activity and usually relieved with rest. Although relatively uncommon and found almost exclusively in athletes performing repetitive running and jumping, medial malleolar stress fractures can be debilitating and disabling. A delay in diagnosis or inadequate treatment of a high-risk stress fracture may result in extended loss of playing time or progression to a possible career-ending injury.[5] Because of a low index of suspicion by clinicians, the athlete often continues to compete, delaying treatment and creating potential complications such as delayed union, nonunion, or those mentioned previously.[12]

The aim of this study was to determine if a gold standard for treatment exists for this entity that would optimize treatment outcomes.

METHODS

This systematic review was conducted using OVID/Medline, EMBASE, and the Cochrane Library from 1950 to September 2013, following the guidelines of Wright et al.[16] The inclusion criteria were human subjects, English language, medial malleolus stress fracture, management of medial malleolus stress fracture, treatment of medial malleolus stress fracture, fatigue fracture to the medial malleolus, and articles of at least level 4 evidence. Exclusion criteria included review papers, case reports of 1 patient only, acute traumatic injury to the medial malleolus, pathologic fractures, and failure to mention treatment within the body of the article. The searches used combinations of the terms *stress fracture, medial malleolus, management*, and *treatment*. These patients had an acute injury in the face of a chronic problem related to a stress-like reaction in the medial malleolus.

Data were extracted independently from each of the selected articles by 2 reviewers. Any discrepancies were resolved by mutual agreement between the reviewers. If an agreement was unable to be mutually reached, then a third reviewer was available to resolve the conflict.

RESULTS

A final list of 6 publications[3,6,10,11,13,14] was produced (Figure 1). All the articles were retrospective case series. Years of publication ranged from 1988 to 2008.

Patient Demographics

A total of 31 patients were analyzed. There were 25 men and 6 women, with ages ranging from 16 to 60 years.

Clinical Presentation

All patients had at least 1 or more of the following symptoms: generalized ankle pain, swelling, or point tenderness over the medial malleolus. Pain was present with weightbearing or high-impact activities along with range of motion, and more specifically dorsiflexion. The length of symptoms prior to clinical presentation varied, ranging from 5 days to 1 year. Of those participating in high school athletics (n = 14), 11 had a period of soreness with acute increase in pain from sport participation leading to presentation to the physician.

Sport Participation

Twenty-eight of 31 patients were in a specific sporting activity from recreational to highly competitive (Division I or professional) levels, including football, baseball, volleyball, basketball, track and field, cricket, gymnastics, martial arts, cross-country, running, and Australian Rules football.

Diagnostic Imaging

All patients received at least 1 radiograph; 14 (45%) were positive. Bone scans were used in 17 patients (55%), with 15 of 17 (88%) positive. Computed tomography scan was positive in 13 patients (42%), while magnetic resonance imaging was positive in 6 (19%).

Treatment Modalities

Sixteen of 31 patients (51.6%) underwent initial nonoperative therapy, while 15 patients (48.4%) underwent initial operative therapy (Table 1). Within each of these 2 groups, additional variability existed in treatment method.

Regarding nonoperative therapy, there was no standard protocol. Many utilize 1 of 2 broad treatment regimens, including strict nonweightbearing with crutches, short leg cast, and/or boot. The other allowed limited weightbearing with a boot, tape immobilization, and the RICE method (rest, ice, compression, and elevation). Length of non- or partial weightbearing ranged from 2 to 8 weeks. Additional methods included weightbearing as tolerated while curtailing or stopping training regimens and avoiding strenuous activity.

Operative therapy was slightly more uniform but showed some variability as well. Open reduction internal fixation (ORIF) was accomplished using AO, cannulated, or cancellous screws. The screw size was 4.0 mm in most that specified, and 6.5 mm cannulated in 1 patient. The number of screws used was 1, 2, or 3. Three patients underwent ORIF.[13] The fracture site was drilled with a 2.2-mm drill bit in 2 patients.[11] Bone graft was not used in any of these patients. Postoperative weightbearing ranged from as tolerated to nonweightbearing for 3 months. The majority of patients (10/15) were nonweightbearing for 1 to 3 weeks after surgery, then progressed to full weightbearing with or without the use of an Aircast, cast brace, or hinged cast brace.

Treatment Decision Making

The decision regarding nonoperative versus operative treatment was addressed in 5 studies.[3,6,10,13,14] Higher level of competition, proximity to competitive season, visibility of a fracture line on plain radiograph, and frank displacement of the fracture were indications for surgical fixation.

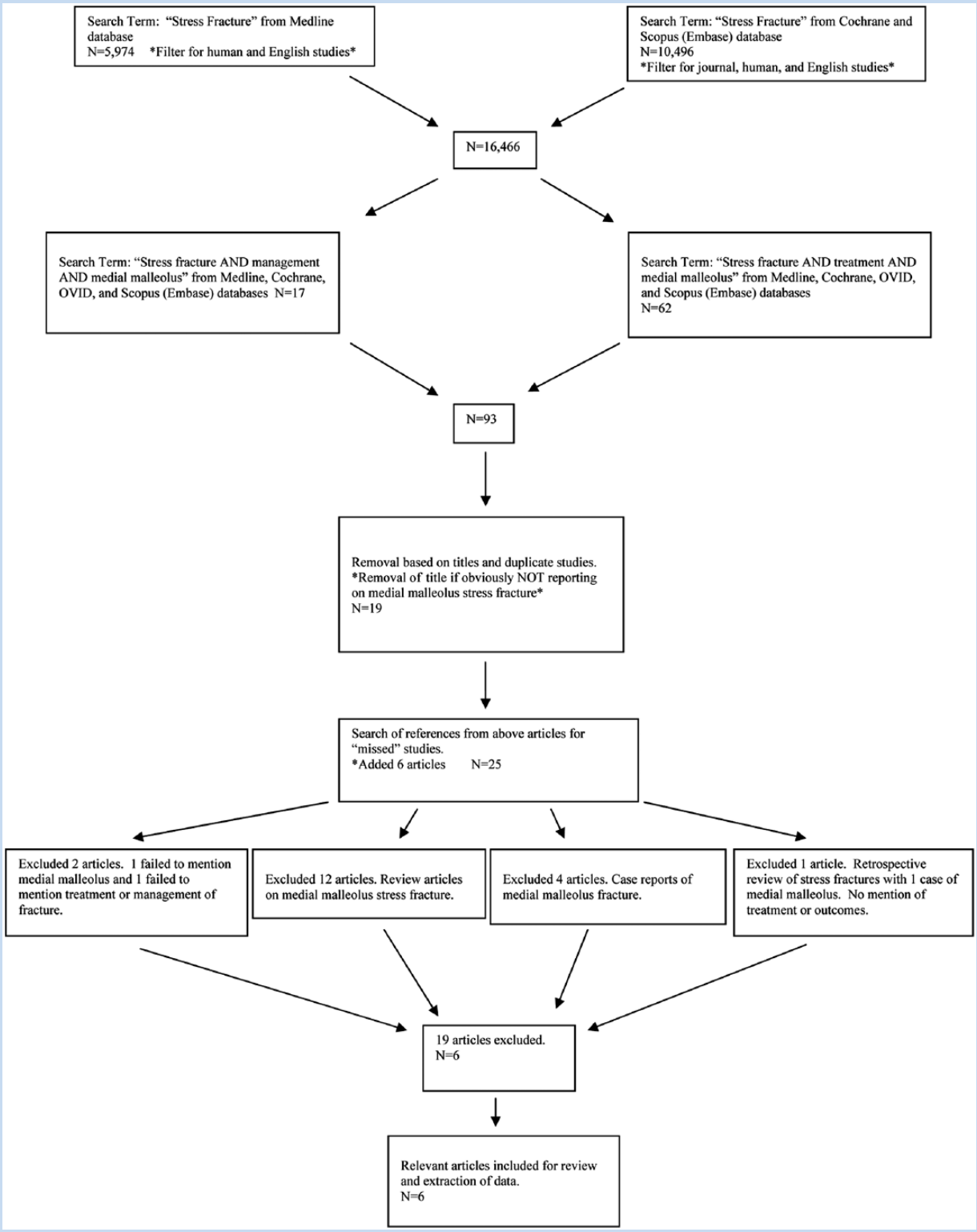

Figure 1. Flowchart detailing systematic review of the literature.

Table 1. Key differences between nonoperative and operative groups

	Nonoperative	Operative
Total patients, n	16	15
Average time to healing, weeks	14.3 (range, 5-24)	13.7 (range, 4-32)[a]
Time missed from activities, weeks	7.6 (range, 3-12)	2.4 (range, 2-4)
Complications, n (%)	0	4 (26.7)[b]

[a]Removal of an outlier patient who failed previous open reduction internal fixation would reduce the operative average time to healing to 12 weeks (range, 4-24 weeks).
[b]Three complications were simple stiffness that resolved with physical therapy and hydrotherapy.

Time From Definitive Treatment to Radiographic Healing

The average time from definitive treatment to radiographic healing was 12.9 weeks, with a range of 4 weeks to 8 months (32 weeks). The operative group showed an average time to healing of 13.7 weeks, with a range of 4 to 32 weeks. One outlier was the patient who had a failed previous ORIF that required 32 weeks to heal with revision ORIF. Without this patient, the average time to healing in the operative group decreased to 12 weeks, with a range of 4 to 24 weeks.

Return to Sport and Time Away From Sport

All patients who previously participated in sports were able to return to play. Fourteen (45%) were elite-level athletes, and all were able to resume their previous level of sport. The time missed from sporting activities with nonoperative treatment averaged 7.6 weeks, with a range of 3 to 12 weeks. Time missed from training or sporting activities in the operative group averaged 2.4 weeks, with a range of 2 to 4 weeks.

Complications

The complication rate was relatively high (4/31 patients, 13%). One patient initially treated operatively had a failed open reduction and internal fixation.[14] The other 3 complications were postoperative stiffness, which was resolved with physical therapy and hydrodilatation therapy. There were no treatment failures (nonunion) with nonoperative therapy. The incidence of nonunion for the entire group was 3% (1/31 patients).

DISCUSSION

Stress fractures of the medial malleolus are relatively uncommon but have been identified as potentially leading to significant disability in running and jumping athletes.[2,14,15] Multiple case series base their treatment on several factors such as timing within the season, pain, or presence of a fracture line on plain radiographs.[3,6,10,11,14]

A major limitation of this review is the small number of retrospective case series at level 4 evidence.

CONCLUSION

Medial malleolus stress fractures can be quite debilitating, especially for high-level running and jumping athletes. Therefore, no definitive conclusions were able to be made on the gold standard of treatment for these injuries. While both nonoperative and operative interventions have proven to be successful with regard to healing and return to play, early operative intervention could create a higher likelihood of early healing, decrease in symptoms, and return to play.

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