How to identify, treat and prevent medial tibial stress syndrome

1. Background

Pain in the shin region is a common problem for runners (both long distance and sprinters). Around 10-15% of all running injuries are located in this region (3).

The term “Shin splints” is often used by physicians, athletes and coaches to describe pain along the tibia. In the literature there are several different conditions with different pathologies that can manifest this region. It is therefore of significance to make a correct diagnosis in order to treat and prevent the symptoms at hand. It is proposed that shin splints should be used only to describe symptoms in a certain location when not related to stress fractures, compartment syndrome and muscle hernia. However, this term is not a diagnostic term and should not be used by health professionals. Rather should they examine the cause of the pain and name the outcome according to the actual pathophysiology (1). A term that is often used in the literature is medial tibial stress syndrome (MTSS). However, this term has also been criticized because the lack of exact descriptive pathology. A more descriptive term that accounts for the inflammatory, traction event on the tibial aspect of the leg common in runners is medial tibial traction periostitis or just medial tibial periostitis (inflammation of the periosteum, the thin layer of connective tissue surrounding the bone).

There are 5 different pathological processes that can occur in regards to shin pain (2):

- Bone stress
- Vascular insufficiency
- Inflammation
- Raised intracompartmental pressure
- Nerve entrapment
It’s possible to have more than one of these conditions at the same time. This could be one reason why people continue having problems after treatment. Usually only one condition is treated. However, this report will be focused on medial tibial traction periostitis and how to identify, treat and prevent this.

1.1 What is causing the pain?

How an athlete move biomechanically can predispose them to pain on the anterior or medial border of the tibia. Both supination and pronation of the foot can lead to shin pain in athletes (2). Furthermore, overuse and muscle fatigue can also be linked to development of pain in this region as well as environmental factors like training errors, shoe design and surface type.

The bone reacts to overuse and stress by remodeling itself to try and replace the week regions. During long periods of continuous stress the remodeling process do not have sufficient time to make the bone stronger and it may fracture (stress fracture) (3). Athletes can show other features before a stress fracture is present, these include periostitis, cortical demineralization and cortical hypertrophy.

Moreover, it is important to distinguish between compartment syndrome and medial tibial periostitis. Compartment syndrome can develop due to raised pressure in the fascial compartment. During exercise the muscle retains more fluid and increases bulk. This causes the fascial compartment pressure to increase and block blood supply to the muscle causing ischemia (2). This may also compress nerves and cause referred distal symptoms. Intracompartmental pressure can be measured with a catheter and a transducer (3). Treatment and deeper investigation for this goes beyond the scope of this report since its main focus is on medial tibial traction periostitis or more general on MTSS.

1.2 Muscles involved

Tight calf muscles will restrict ankle dorsiflexion and can lead to excessive pronation of the foot. Pronation of the foot leads to lengthening of soleus (superficial compartment), tibialis posterior, flexor hallucis longus and flexor digitorum longus (deep compartment). This means that when the heel strikes the ground in running these muscles have to contract eccentrically harder and longer to resist the pronation. When finishing the step from the toe-off position these muscles contract concentrically over a greater length to complete the transition to a supinated foot. However, when fatigued these muscles do not have enough force to provide the shock absorption needed. If this happens during a long period of time medial tibial periostitis can occur as a result of traction at the origins of the muscles. Moreover, chronic medial tibial periostitis can also lead to stress fractures and deep compartment syndrome (2).

This report is aims to elucidate how to identify treat and prevent medial tibial traction periostitis. This will be done through a Medline search on relevant articles.
2. Methods

The search for relevant articles was conducted in Medline using keywords: “medial tibial periostitis”, “medial tibial traction periostitis”, “shin splints”, “medial tibial stress syndrome” and “shin pain”. Other limitation to search criteria: Only human studies, no articles older than 1980, accepted language was English. This resulted in 9 articles which will be summarized and analyzed below. The background for this report is based on reviews and a textbook (see reference list).

3. Results

3.1 Prevention

There seem to be no consensus on how to prevent MTSS in the literature. There are still many theories on best practice and since there are few clinical studies on athletes it is hard to extrapolate existing data to find a conclusion. Yates and White along with Viitasalo and Kvist suggests that training on hard surfaces or uneven terrain, improper training techniques, increasing training intensity too quickly, changes in footwear, muscle imbalances or inflexibility, and biomechanical abnormalities are all variables that can contribute to medial tibial stress syndrome (4, 5).

Gudas found that concrete and grass are too hard and too soft, respectively, for the human leg mechanics to handle long-term. If patients have a limb-length discrepancy of 2 cm or more, they should consider a shoe lift; in addition, if their shoes show evidence of hyperpronation, a shoe insert could be helpful (6).

Couture and Karlson found that the mileage on a running shoe may have important effects on shock absorption. Running shoes should be replaced when worn between 300 and 600 miles, depending on a multitude of factors, including body weight, running style, and training surface (7).

3.2 Identification

Yates and White found that an over pronated foot (in standing position) was correlated with medial tibial stress syndrome (4). They also saw a greater incidence in women for this problem. However, a limitation to their study is that they did not look at the foot position during walking and running only in standing position. The patterns may not have been the same in these conditions.
Hubbard, Carpenter and Cordova showed in a prospective investigation in NCAA division I and II athletes that subjects with MTSS had significantly increased plantarflexion range of motion and less years of running history. Additionally, athletes who had a previous history of MTSS and stress fracture were significantly more likely to develop MTSS again. Furthermore, athletes who developed MTSS were significantly more likely to wear orthotics than athletes that did not develop MTSS (8).

In one study training errors were the cause of MTSS in nearly 60% of participants. Training errors include an abrupt increase in intensity, duration or frequency of training (measured as an increase of more than 30% of initial training mileage within 1 year), hill training, and a change in running surface to a harder or tilted type (9).

### 3.3 Treatment

In one study, 16 of 41 collegiate cross-country runners were prescribed orthotics; 14 (88%) reported relief or improvement in their symptoms and return to running within 4 weeks (10).  

The other survey, of long-distance runners, found that 70% who had used or were using orthotics for a presumed diagnosis of MTSS reported complete relief or great improvement (11).

Contrary, in one study the only method that had some evidence (not statistically significant) for preventing MTSS was training program alterations—reduction in the distance, frequency, and duration of running bouts. Other methods they tried were stretching, use of insoles and footwear modifications none of which were more effective than altering the way they trained (12).

Below is a table summarizing the results of the different studies considered in this report.
Table 1: Summery of the studies analyzed in this report.

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<th>Reference</th>
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<tr>
<td>Yates et al, 2004</td>
<td>To identify the incidence of medial tibial stress syndrome (MTSS) in a group of athletic recruits. Risk factors analyzed.</td>
<td>Prospektiv randomiserad</td>
<td>Anthropometric and lower limb biomechanical data were recorded at the start of the program along with injury history and previous sporting activity for 3 months prior to enlisting. Recruits were monitored during training for development of medial tibial stress syndrome and were asked to complete an exit interview at the end of the program.</td>
<td>Forty recruits (22 men and 18 women) developed MTSS. A significant relationship existed between gender and medial tibial stress syndrome (P = .012), with male recruits more likely to develop medial tibial stress syndrome than male recruits (53% vs 28%). A risk estimate revealed a relative risk of 2.03. The biomechanical results indicated a more pronated foot type (P = .002) in the medial tibial stress syndrome group when compared to the control group.</td>
<td>Identifying a pronated foot type prior to training may help reduce the incidence of medial tibial stress syndrome by early intervention to control abnormal pronation. Findings of a higher incidence of medial tibial stress syndrome among female recruits require further investigation.</td>
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<td>Viitasalo JT, 1983</td>
<td>Identify biomechanical aspects of the foot and ankle in athletes with and without shin splints</td>
<td>Case-control, icke randomiserad</td>
<td>Thirteen adult male athletes (long-distance runners and orienteers without foot problems) and 35 male athletes with shin splints were compared with respect to: 1) the position of the lower leg and the ankle while standing, 2) the passive range of mobility in the subtalar joint, and 3) the angular displacement between the calcaneus and the midline of the lower leg (Achilles tendon angle) while running with bare feet on a treadmill</td>
<td>In standing, the two groups differed statistically significantly in the Achilles tendon angle, which values were greater in the shin splint group. With respect to passive mobility, the athletes with shin splints had significantly greater (P less than 0.05-0.01) angular displacement values in inversion, eversion, and in their sum than the control group. While running, the Achilles tendon angle of the shin splint group was significantly greater (P &lt; 0.002) and the ankle/foot range of motion, tibial varum, and navicular drop before the start of their respective athletic season.</td>
<td>The results suggest structural and functional differences in the feet and ankles between healthy athletes and those with shin splints.</td>
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<td>Hubbard TJ, 2009</td>
<td>To conduct a prospective, multisite, cohort study investigating the possible risk factors for medial tibial stress syndrome (MTSS) in college athletes.</td>
<td>Prospektiv, randomiserad</td>
<td>One hundred and forty-six healthy, collegiate athletes from NCAA Division I and Division II institutions participated in the study. Subjects first completed a health history questionnaire to establish previous history of injury and underwent a physical examination to assess their ankle/foot strength, ankle/foot range of motion, tibial varum, and navicular drop before the start of their respective athletic season. Athletes were instructed to report to a certified athletic trainer if they developed pain on their tibia.</td>
<td>Twenty-nine subjects developed MTSS during this study. Athletes that had been participating in athletic activity for fewer than 5 yr were significantly more likely to develop MTSS (P = 0.002). Additionally, athletes with a previous history of MTSS (P = 0.0001), a previous history of stress fracture (P = 0.039), and the use of orthotics (P = 0.031) were more likely to develop MTSS compared with those who did not develop MTSS.</td>
<td>This study established that the factors most influencing MTSS development were previous history of MTSS and stress fracture, years of running experience, and orthotic use. These data demonstrate the importance of establishing a thorough history before the start of the season.</td>
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<td>Gross ML, 1991</td>
<td>Effectiveness of orthotic shoe inserts in the long-distance runner.</td>
<td>Case-control, icke randomiserad</td>
<td>Five hundred questionnaires were distributed to long-distance runners who had used, or who were using orthotic shoe inserts for symptomatic relief of lower extremity complaints. Three hundred forty-seven (69.4%) responded (males, 71%; females, 29%). The mean duration for use of the orthotic inserts was 23 months (range, 1 to 96). The predominant (63%) type of orthotic device used was flexible.</td>
<td>Of the runners responding, 262 (75.5%) reported complete resolution or great improvement of their symptoms. Results of treatment with orthotic shoe inserts were independent of the diagnosis or the runner’s level of participation. A high degree of overall satisfaction was demonstrated by the finding that 90% of the runners continued to use the orthotic devices even with no symptoms</td>
<td>Orthotic shoe inserts were most effective in the treatment of symptoms arising from biomechanical abnormalities. Orthotic shoe inserts may allow the athlete to continue participation in running and avoid other treatments.</td>
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4. Discussion

Although there are several theories regarding the pathogenesis of MTSS, there is no evidence-based research to support these theories. Although a hyperpronated foot has been identified as a predisposing factor in the development of MTSS, there does not seem to be any good studies on dynamic foot function and this condition. Because MTSS is an exercise-induced leg pain and, therefore, occurs during moving exercise it should be evaluated in a close to real environment.

There are very mixed results on how to effectively treat and prevent MTSS. No studies stratified subjects as much as would be appropriet. Bodyweight for example is a variable that should be considered when looking at subjects with MTSS.

An area which should be investigated more is also the role of nutrition especially in female athletes who seem to be more prone to pain in this region than men. Not only macronutrients and general nutrition status should be measured but specific nutrients like calcium, vitamin-D and bone health status is of great importance to an athlete to be able to rebuild the stress exercise induces on bone and muscles.

This area of sports injuries is clearly not fully understood. To fully understand the process that occurs future research should clearly define different physiological events that happen in the bone and muscle to be able to better understand the pathophysiology behind this event.
References


