Rehabilitation and Prevention of Shin Splints: A Literature Review

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ABSTRACT

Objective: The purpose of this literature review is to compare the current literature on the pathophysiology, diagnosis, treatment, and prevention strategies for shin splints. This review is not a fully comprehensive review in that it did not include more aggressive treatment protocols for serious cases such as drug therapy and surgery.

Data Collection: The resources utilized included peer-reviewed journal articles, reference and textbooks. EBSCOhost and PUBMED were the primary databases used to find journal articles and publications related to the topic of shin splints and rehabilitation. The resource center for this search was the Learning Resource Center at the Logan College of Chiropractic library.

Results: The keyword search for shin splints followed by rehabilitation and management developed approximately 70 results, 30 of which were acceptable for this review. The results included peer-reviewed journal articles and case studies. Further searches were made for the keywords, stress fractures and compartment syndromes. This information was necessary for the development of a differential diagnosis.

Conclusion: While many sources still argue over the cause, treatment strategies, and even the name of shin splints, the intent of this review was to compile the most agreed upon literature. The literature did clearly agree upon certain facts: a proper diagnosis must be made ruling out stress fractures and compartment syndromes and that improper training techniques and appliances are the most common cause of an overuse injury. A rehabilitation program based on rest, ice, stretching and strengthening exercises, orthotics, and patient counseling appear to be the best management strategy for shin splints.

Key Words: Shin splints, rehabilitation, stress fractures, compartment syndrome

INTRODUCTION

The increase in popularity of recreational running and jogging has also seen an increase in the number of injuries associated with such activity. Many of these injuries are classified primarily as overuse injuries. The most common exercise-induced symptom of the lower extremity is shin pain (1).

The term "shin splints" has been used as a general term to describe general shin pain since the 1960's (2). In 1966 the American Medical Association defined shin splints as "pain and discomfort in the leg from repetitive activity on hard surfaces, or due to forceful, excessive use of foot flexors. The diagnosis should be limited to musculoskeletal inflammations, excluding stress fractures or ischemic disorders" (4). Shin splints refer to a wide variety of lower extremity injuries, especially tibial stress injuries. These injuries can then be differentiated by as stress fractures, medial tibial stress syndromes, and compartment syndromes (2). Stress fractures mainly include those to the tibia and fibula and are classified as type 1. Medial Tibial Stress Syndromes include musculotendinous strains, tendonitis, interosseous membrane pain, or periostitis and are classified as type 2. Compartment Syndromes include nervous and/or vascular compression to the anterior or posterior compartment of the lower limb and are classified as type 3 (2, 3).

The ambiguity of the term "shin splints" can be confusing. This leads to a difficulty of proper diagnosis, intervention, and prevention of the condition. What is clear is that exercise induced shin pain accounts for 10-20 percent of all injuries to runners and 60 percent of all overuse injuries of the lower limb (1). They were also the most common injury reported by ballet dancers and military studies have found that 4 to

10 percent of new recruits were diagnosed with shin splints during their 8 to 12 week basic training (4).

There is also controversy in the use of the term medial tibial stress syndromes for "shin splints." The majority of the material reviewed for this paper used the terms interchangeably. However one source described a definitive difference between the two terms. Shin splints refer shin pain as the result of exercise and that it is not a specific diagnosis. Medial tibial stress syndromes have the specific clinical presentation of stress reaction within the bone, with abnormal bone remodeling (1).

There is no specific cause of shin splints, however many factors are believed to contribute to the cause of shin splints. These factors can typically be modified to provide relief and prevention of future injury. The cause of the shin splints can be from both intrinsic and extrinsic factors concerning the patient. Extrinsic factors include the individuals training schedule, duration of training sessions, training surfaces, and the footwear of the individual. The intrinsic factors that lead to injury are unique to the individual athlete. These include previous injury, anatomic misalignment, poor technique, muscle strength and flexibility, and a low bone mineral density (1).

The actual etiology is also not well defined. Some research has described shin splints as a periostitis of the tibia and/or fibula. Morphologic bone changes are also attributed to shin splints. The pain is believed to originate from stress microfractures within the bone. Others relate the pain to originate from the either the origin or insertion of the tibialis posterior or soleus muscle.

The purpose of this paper will be to review current literature on shin splints and related syndromes, describing the most common diagnosis, treatment, and preventative

measures. This paper will primarily focus on the treatment of current cases as well as the prevention of future injury. It will also focus management plans provided in chiropractic literature.

DISCUSSION

Diagnosis

The chief complaint of a patient with shin splints is pain along the medial aspect of the distal third of the tibia. Generally the individual will first notice the pain and discomfort at the beginning of their workout; the pain will then decrease during the workout only to return after the workout (5). When the condition becomes more chronic the patient will notice that the pain will gradually last a greater amount of time until it persists throughout the entire exercise period and into other daily activities.

It is also necessary to obtain a thorough history from the patient. This can determine what factors contributed to the injury and therefore what can be modified for treatment and future prevention. Information must be gathered in regards to the patient's physical characteristics, training habits, and running environment. Areas to note for the patient's physical characteristics are the patient's age, gender, body build, and foot alignment. The patients training habits should include distance, speed, form, and stretching. The patient's running environment should include terrain, weather, time of day, and type of shoes worn (5).

A thorough physical exam of the patient is the next step in diagnosis. A patient presenting with a chief complaint of shin splints will have an area of tenderness several centimeters square over the posterior medial edge of the patient's distal tibia. The physical exam will likely reveal tenderness and no other physical findings. Findings others than tenderness, especially localized pain on the tibia may indicate a stress fracture.

The differential diagnosis of an individual with shin pain not only includes shin splints but also tibial stress fractures, periostitis, and various forms of compartment syndromes.

An individual presenting with shin pain may in fact have a tibial stress fracture. The pain that is experienced by the individual will be very similar to that of shin splints. It will be along the posteromedial aspect of the tibia; however it will often be more focal in nature and will be more likely along the anterolateral aspect of the tibia. The symptoms will also begin much the same way as the shin splints, it will often progress with further training, but will then last throughout the day and even during the evening (1). These stress fractures tend not to be dangerous to the patient however should they continue to train with the fracture more serious injury may develop.

Initially the clinician may chose plain film radiography to visualize the lesion in question, however this will most likely present as normal because tibial stress fractures tend not to be displaced. What may be visualized on plain film will be cortical widening to the shaft of the tibia.

Triple phase bone scintigraphy is a reliable method to differentiate shin splints and tibial stress fracture. Stress fractures will present with a more focal uptake on a technetium bone scan (6). Shin splints will present with a much more diffuse tracer uptake. The tracer uptake will be longitudinally orientated and only visible on delayed-phase images (1). Bone scan will often be positive within 3 days of symptom onset and can remain positive for as long as 12 months (1). In the event that the plain film exam is still negative after a positive bone scan further imaging using CT scans or tomograms may be warranted (6).

MRI is another imaging modality utilized to differentiate shin splints from tibial stress fractures. MRI has been found to have a similar sensitivity to that of triple phase bone but also has other advantages. MRI adds anatomic visualization of the structures in question, may cost less than bone scan, and delivers no radiation to the patient (1).

Shin splints may also be confused with compartment syndromes. Compartment syndromes vary in severity depending on the type of syndrome. They can be differentiated as acute or chronic (which can considered exercised induced or exertional). Compartment syndromes typically affect the anterior compartment of the lower limb, primarily affecting the anterior tibialis muscle.

The mechanism of injury with a compartment syndrome is as follows. During exercise the increased metabolic activity of the muscles in question demand a greater blood supply. The increase blood supply causes the muscle to swell. This is perfectly normal for most individuals however for a patient with anterior compartment syndrome the fascial layers surrounding the muscle are unusually restrictive. The pressure in the anterior compartment can rise to a point were nervous and vascular tissues may become compromised. At this point a compartment syndrome becomes a medical emergency that is treated by fasciotomy (6).

The actual diagnosis of anterior compartment syndrome is made by the symptoms of extreme pain, tenderness, and swelling of the affected muscle. The skin covering the muscle may also be shiny and warm to touch. The patient may experience paresthesias in their toes and may complain of cold feet. The most objective diagnosis of anterior compartment syndrome is by wick catheter or by needle-monitoring methods. An individual with compartment syndrome may have an increase in pressure of 30-40

millimeters of mercury at which point capillary blood flow becomes compromised (5, 7). Should this pressure remain elevated for an extended period of time tissue necrosis and permanent disability will occur.

Other possible causes of shin pain are bone tumors and pes anserine bursitis. Bone tumors will produce insidiously worsening pain that is unrelated to any form of exercise. Bone tumors are also easily seen with plain film radiography. Pes anserine bursitis produces shin pain; however it produces pain over the proximal aspect of the tibia rather than the distal third (1).

Pathophysiology

Pronation

Excessive overpronation is a major cause for shin splints. Pronation is the motion of the foot once it lands. For most people the outside of the heel touches first and then the foot rolls inward. The amount of inward rotation should be between 4-6 %. Too flat of a foot or too high of an arch can bring on a number of leg and knee injuries. Once the foot lands it flattens out, and the ankle rolls inward or pronates. The tibia (shinbone) is forced to twist slightly in the opposite or outside direction, stretching on the calf muscles. Too much twisting can lead to a stress fracture of the tibia. In other words, too flat of a foot results in the foot rolling inward too much transferring much of the pounding into the inner portion of the lower leg resulting in shin splints. Research shows that females are more likely to suffer from shin splints than males because their hips, on the average, are wider than a male. Because of the wider hips, a women's foot strike the ground at a greater angle resulting in overpronation.

As stated, 4-6 % pronation is ok. More or less will lead to problems. The flatter the arch the more support is needed. If the heel tilts inward during running or if shoes appear distorted after you take them off with the heels tilted inward, *moderate* pronation occurs. If the heel counters are broken down toward the inside, *severe* overpronation occurs.

Underpronation is the action of the foot, once it lands, hardly rolls inward. This person usually has a very high arch. Again too high of an arch or too flat of a foot can lead to numerous problems such as shin, knee, hip and foot injuries. To check your arches, give yourself the wet test (see photo on next page). When you step dripping from the shower, stand normally, then step away and check your footprints. If you leave an impression of your whole foot, arch and all, you have flat feet. If what shows up is mostly ball and heel, your arches are high. If your footprint shows something in between the two extremes, with a moderate amount of arch, you're blessed with a normal foot that shouldn't cause you any problems.

Treatment

The best treatment for any injury especially for an overuse injury is rest, however for the athlete in training this is not usually an option. In conjunction with rest the following have been utilized in the treatment of shin splints, cryotherapy, microcurrent, massage, heat, trigger point therapy, orthotics, heel cord stretching, ultrasound, local heat, shoe modifications, training program alterations, taping, strengthening of the intrinsic muscles of the foot, and manipulation (7).

With an acute case of shin splints the most common and probably the best treatment is ice. The individual should freeze water in Styrofoam cups and use them for

ice massage. As the ice melts continue to peel back the cup. The patient should perform this during an acute flare-up particularly following training. The patient should perform this for no longer than 20 minutes.

In a study by Rick Morris, D.C. the application of microcurrent was found to be part of a successful treatment protocol for and individual with shin splints. The treatment protocol consisted of a 20 percent galvanic current with 80 percent medium frequency current at 50 to 100 Hz for a period of 5 to 8 min. The intensity was set at a level that the described as comfortable by the patient. The positive pad was place over the site of pain and the negative pad placed just proximal to it. The rest of the treatment protocol was very similar to those described in this paper. They included rest, taping of the arches, orthotics, ice, and a gradual re-entry into training (9).

Stretching and specific exercises can be very beneficial when rehabilitating the lower extremity from shin splints. It is also recommended that prior to performing stretching and strengthening exercises moist heat is applied to the area. This should be applied for 15 minutes followed by gentle massage to the area. This will loosen tight and inflamed muscles and will increase blood flow to the area (10). Once the patient's pain has decreased by 25 percent the following stretching and exercise program may be implemented:

1. Towel stretch: Sit on a hard surface with your injured leg stretched out in front of you. Loop a towel around the ball of your foot and pull the towel toward your body keeping your knee straight. Hold this position for 15 to 30 seconds then relax. Repeat 3 times.
2. Standing calf stretch: (used after maximum benefit is reached from towel stretch) Facing a wall, put your hands against the wall at about eye level. Keep the injured leg back, the uninjured leg forward, and the heel of your injured leg on the floor. Turn your injured foot slightly inward as you slowly lean into the wall until you feel a stretch in the back of your calf. Hold for 15

to 30 seconds. Repeat 3 times. This should be performed several times per day.

3. Anterior compartment stretch: Stand with one hand against a wall or chair for balance. Bend your knee and grab the front of your foot of your injured leg. Bend the front of your foot toward your heel. You should feel a stretch in the front of your shin. Hold for 15 to 30 seconds. Repeat 3 times.
4. Resisted dorsiflexion: Sit with your injured leg out straight and your foot facing a doorway. Tie a loop in a knot in one end of a piece of stretch tubing. Put your foot through the loop so that the tubing goes around the arch of your foot. Tie a knot in the other end of the tubing and shut the knot in the door. Move backward until there is tension in the tubing. Keeping your knee straight, pull your foot toward your body, stretching the tubing. Slowly return to the starting position. Perform 3 sets of 10
5. Ankle range of motion: Sitting or lying down with your legs straight and your knee toward the ceiling, move your ankle up and down, in and out, and in circles. Only move your ankle. Do not move your leg. Repeat 10 times in each direction. Push hard in all directions.
6. Heel raises: balance yourself while standing behind a chair. Raise your body up onto your toes and hold for 5 seconds, then slowly lower yourself down. Repeat 10 times. Perform 3 sets of 10.
7. Resisted inversion: Sit with your legs out straight and cross your uninjured leg over your injured ankle. Wrap the stretch tubing around the ball of your injured foot and then loop it around your uninjured foot so that the tubing is anchored there at one end. Hold the other end of the tubing in your hand. Turn your injured foot inward and upward. This action will stretch the tubing. Return to the starting position. Perform 3 sets of 10.
8. Resisted eversion: Sit with both legs stretched out in front of you, with your feet about a shoulders width apart. Tie a loop in one end of the tubing. Put your injured foot through the loop so that the tubing goes around the arch of that foot and wraps around the outside of the uninjured foot. Hold onto the other end of the tubing with your hand to provide tension. Turn your injured foot up and out. Make sure you keep your uninjured foot still so that it will allow the tubing to stretch as you move your injured foot. Return to the starting position. Perform 3 sets of 10.
9. Standing toe raises: Stand with your feet flat on the floor, rock back onto your heels and lift your toes off the floor. Hold this for 5 seconds. Perform 3 sets of 10.
10. Static and dynamic balance exercises: Place a chair next to your non-injured leg and stand upright. Stand on your injured foot. Try to raise the arch of your foot while keeping your toes on the floor. Try to maintain this position and balance on your injured side for 30 seconds. This exercise can be made more difficult by performing it on a piece of foam or a wobble board, or with your eyes closed. Stand in the same position as above. Keep your foot in this position and reach forward in front of you with your injured side's hand, allowing your knee to bend. Repeat this 10 times while maintaining the arch height. This exercise can be made more difficult by reaching farther in front

of you. Perform 2 sets. Standing in the same position as above, while maintaining your arch height, reach the injured side's hand across your body toward the chair. The farther you reach the more challenging the exercise. Perform 2 sets of 10.

11. Hip abduction (with stretch tubing): Stand sideways near a doorway with your uninjured side closest to the door. Tie elastic tubing around the ankle on your injured side. Knot the other end of the tubing and close the knot in the door. Abduct your leg, keeping your knee straight. Return to the starting position. Perform 3 sets of 10.

These stretches and exercises should all be performed bilaterally. Proper implementation of these stretches and exercises may enable the patient to recover faster from injury. Once the individual is pain free and wishes to return to training these may prevent the recurrence of shin splints (8).

Once the patient has reached a pain free state in their rehabilitation, they may begin with a gradual progression back into their training regimen. Initially they may return to training at level 50 percent of their preinjury level. They may then progress at a rate of 10 to 15 percent per week as long as they remain pain free (1, 7). Cross training may also be utilized in a patient's training program. This will allow the patient to may their level of aerobic fitness while not stressing the injured tissues. The most commonly recommended alternative training techniques are swimming, cycling and pool running (1). Pool running is highly recommended when the patient is planning to return to their normal training regimen.

Prevention

The best way to deal with shin splints is to do what it takes to prevent them in the first place. There are several preventative measures that should be practiced by every runner on every team. Purchasing the proper shoe for your foot is the first step in preventing shin splints. Knowing whether you are an overpronator or underpronator is very important. The wet test will determine this.

Below are features of a shoe for an overpronator, the more common runner type for shin splints recipients.

1. Rigid plastic collar that wraps around the shoe heel for support and to control excess pronation.
2. A firm shoe with lots of supports.
3. A rear-heel area made of solid rubber.
4. Dual density midsole with the firmer material on the inside edge. This construction is easy to spot since the midsole will usually come in different colors.
5. A "board-lasted" shoe. To tell if a shoe is board-lasted, pull out the insole, the extra strip of material that is inside the shoe. If there is no stitching between the inside and bottom of the shoe it is board lasted

A firm shoe with lots of support preventing excessive motion is needed for those who overpronate. Something to keep in mind is that the more cushioned the shoe the less stability the shoe will have.

For the **underpronator** motion of the foot is limited. The type of shoe needed would be one that is flexible. It should be a cushioned shoe with a soft midsole. Depending on the amount of pronation a runner may have will determine whether or not they would benefit from orthotics? Sometimes just a good pair of inserts found at a drug store to fit in the shoes, or a pair of anti-pronators in which you could receive through a podiatrist may do the trick, and are much more inexpensive than orthotics. In any case though a good arch support will be needed.

Many sources agree that overpronation of the foot during the gait cycle is one of, if not the most common predisposing factors of shin splints. Therefore it would seem reasonable that eliminating overpronation would reduce the occurrence of shin splints. The use of custom made orthotics is perhaps the best way to treat and prevent shin splints in these individuals (11, 12).

Another key factor in the prevention of shin splints is the running surface the individual trains on. The patient should be advised to avoid running on hard surfaces, such as pavement and especially concrete. They should avoid or minimize running up or down hills as well as avoid running on banked tracks, road shoulders, and uneven terrain (11).

As with any exercise program a proper warm up and cool down period is necessary to prevent injury. The athlete should perform a few minutes of light jogging as warm up, followed by stretching as described in the treatment section of this paper.

CONCLUSION

The etiology of shin splints can arise from a variety of sources. The key to successful treatment is find the offending tissue and focus a rehabilitation program on the tissue that has been damaged.

When a patient presents to your office with shin pain consistent with an overuse injury the first thing you must do is recommend a period of rest. Once the offending tissues have been identified and the patient's pain level has decreased by 25 percent a treatment protocol may be applied. This treatment protocol will be dependent upon many factors, such as, the severity of the condition, osseous misalignment, and previous injury.

Shin splints are a very common malady concerning not only the serious runner but also those engaged recreational jogging and other sports. Although there was no real mention of shin splints progressing into the more serious conditions of stress fracture and compartment syndromes, it appears that shin splints are in fact the initial onset of the aforementioned conditions. Without proper intervention the pathophysiology of the damaged tissues may in fact progress into more serious conditions.

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