Tibial Stress Fractures / Medial Tibial Stress Syndrome

Saint Louis University – SSM Health Physical Therapy Orthopedic Residency
in Collaboration with SLUCare Physician Group

Physician Referral for Physical Therapy

Patient Name: **Date:**

Referring DX: Medial Tibial Stress Syndrome

Recommended Frequency: 1 – 3 visits/ wk **Total Duration: ~8 months**

These guidelines, treatments, and milestones have been established to assist in guiding rehabilitation based on the most current available evidence. They are not intended to be substitute for sound clinical judgement with consideration of the individual contextual features of the patient and the demands of various functions/sports.

Overview:

Treatment for MTSS is contingent upon both severity of stress injury, relative risk, and stage of injury at diagnosis. Recovery timelines can vary from 2 weeks to 4 months based on grade of injury, time to diagnosis, and patient compliance. No definitive literature exists to suggest any specific, time-based intervention series for MTSS.[1]

Rehabilitation Progression

Stage 1: Offload Involved Extremity (~2 weeks)

Criteria for Advancement: Pain-free daily walking without WB restriction

Recommended Interventions: Immediate cessation of aggravating activity, utilize one crutch, two crutches, immobilization boot, air casting or rigid casting based on symptom presence and patient compliance.[2-5] Identify patient risk factors (see below). Cryotherapy to manage pain and limb inflammation.[6]

Avoid: Over-stretching triceps surae musculature[7]

Stage 2: Graded Return to Activity / Exercise

Criteria for Advancement: Pain-free progression through graded exercise without symptom recurrence or regression in aerobic capacity.

Recommended Interventions: Address risk factors, unweighted cardiovascular activity (water running, arm bike, swimming, or biking),[3] walk/jog progression,[8] initiate triceps surae flexibility.

Stage 3: Return to Sport / Full Function

Criteria for Advancement: Pain-free sport specific, activity specific, and plyometric training without symptom recurrence or regression in aerobic capacity.

Recommended Interventions: Sport specific retraining, plyometrics, and running progression.[9]

Consider the following categories of interventions throughout the period of care:

Risk Factor Modification

Identification/Classification: Female sex, increased weight, higher navicular drop, previous running injury, and greater hip external rotation with the hip in flexion are risk factors for the development of MTSS.[10] It has been recommended to address all risk factors that may be contributing to the development, prolonging, or recurrence of MTSS.

Stratification of Risk: It is imperative to differentiate anterior tibial stress injury (high risk stress fracture) and posterior medial tibial stress injury (low risk stress fracture) due to notable differences in recovery timelines.[11]

Running Retraining

Step Rate: Avoid over striding.[8] Increase step frequency by 10-20% greater than "preferred step frequency" at baseline which may alter foot strike pattern and reduce over striding, tibial loading, and rate of pronation.[12]

Step Width: Avoid crossover pattern by providing verbal cues to "widen stance". Consider implementation of running with visual spacer between feet. [8,13]

Reduce Impact Loading Variables (reduce tibial acceleration): Correct over pronation or over supination, depending on patient presentation.

Graded Running Program: Start at 50% of pre-injury intensity, increase 10-15% each week and reference soreness rules[28] to guide progressions.[3,7] Another suggested return to running protocol suggests alternating "on" and "off" days with 5 minute interval progressions of running time until 45 minutes of pain-free running is achieved.[14]

It has been reported that there is no significant effect of a graded running program with compression stockings versus graded running program with stretching and strengthening of the calves.[15]

Orthotic Fabrication / Utilization

Shock Absorbing Insoles/Vacuum Molded Orthotics: Limited evidence suggests employing shock absorbing insoles to reduce rate of tibial loading and reduce incidence of developing stress fracture.[16] Men may respond more favorably to orthotic insert.[17]

Pneumatic Leg Brace (PLB): Mixed evidence recommends application of shin orthoses via PLB to reduce return to activity timelines. The initial study on this orthotic has been unsuccessfully replicated.[18,19] And it has been demonstrated that there was no significant effect of days to complete rehabilitation with addition of PLB.[4]

Adjunct Therapies

ESWT + Generalized Exercise: Consider employing ESWT + lower extremity stretching, joint mobilization, and strengthening as well as coupled with a graded running program.[20-22] ESWT application varied between studies, ranging from 1000-1500 shocks, 0.1 - 0.3 mj/mm,^{2} and 2.5 - 5 Hz.

Iontophoresis, Phonophoresis, Ultrasound: Consider utilization of US treatment to focal areas of irritation during treatment of MTSS.[21]

Ice Massage: Consider utilization of ice massage to manage acute symptoms during treatment of MTSS.[21]

Periosteal Pecking: Consider utilization of periosteal pecking technique as a supplemental modality to accelerate healing timelines.[21]

Kinesio-Taping

Medial Tibial "Y" Technique: Consider utilizing kinesiotape to support navicular medial malleolus to reduce the rate of tibial loading. The suggested location is a "A single Y-strip.. applied with the base at the supero-medial tibia traveling anterior and posterior to the medial malleolus to the arch of the foot."[23]

General Anti-Pronation Taping: Anti-pronation taping may assist with muscular activity and bio-mechanical factors to reduce pain response early in rehabilitation.[24]

Preventative Intervention

Stretching: Consider implementing a stretching program including standardized warmup with stretching to gastrocnemius, soleus, hamstrings.[25] As noted above, do not implement stretching prior to cessation of patient pain symptoms with daily WB activity.

Criteria Based Intervention/Grading

Tibial Stress Fractures / Medial Tibial Stress Syndrome

Saint Louis University – SSM Health Physical Therapy Orthopedic Residency
in Collaboration with SLUCare Physician Group

Fredericson Criteria: Provides treatment recommendations based on tibial stress injury as indicated on bone scan and MRI.[26,27] This study attempted to correlate patient symptoms to grades of bone injury.

For questions regarding the patient's medical care, new orders, or insurance questions: please contact your physician's office directly
For additional questions, comments, or concerns regarding the implementation of these physical therapy guidelines, please contact Chris Sebelski, PT, DPT, PhD, OCS, Director of the SLU – SSM Health Physical Therapy Residency @ 314 977 8724 OR chris.sebelski@health.slu.edu

Please respond to our anonymous survey regarding these guidelines to assist in improving patient care and advocacy. https://slu.az1.qualtrics.com/jfe/form/SV_bpX7Z9AaVTzGblj

Appendices of referenced assessments[26,28]

MRI Grading of Tibial Stress Injuries Adapted from Fredericson et al. 1995		
Grade	MRI Findings	Patient Symptoms and Treatment
Grade 1	Periosteal edema on fat-fat-suppressed T2 images (shin splints)	- Diffuse tenderness along medial posterior tibial border. - Return to running in as short at 2-4 weeks
Grade 2	Grade 1 + marrow edema on fat-suppressed T2 images	- Diffuse tenderness along medial posterior tibial border. - Return to running suggested in 4-6 weeks
Grade 3	Grade 2 + marrow edema on T1 images	- Localized tenderness on the medial tibial diaphysis with increased pain on direct percussion of the tibia. - Pain with daily ambulation. - May experience pain with indirect percussion of the tibia. - Return to impact activity suggested 6-9 weeks
Grade 4	Grade 3 + clearly visible fracture line	- Localized tenderness on the medial tibial diaphysis with increased pain on direct percussion of the tibia. - Pain with daily ambulation. - May experience pain with indirect percussion to tibia. - Recommends casting for 6 weeks and return to impact activity after additional 6 weeks.

Soreness Rules Adapted from Fees et al. 1998	
Criterion	**Action**
1. Soreness during warm-up that continues	2 days off, drop down 1 step
2. Soreness during warm-up that goes away	Stay at step that led to soreness
3. Soreness during warm-up that goes away from redevelops during session	2 days off, drop down 1 step
4. Soreness the day after lifting (not muscle soreness)	1 day off, do not advance program to the next step
5. No soreness	Advance 1 step per week or as instructed by healthcare professional

Bibliography

1. Moen MH, Tol JL, Weir A, Steunebrink M, De Winter TC. Medial tibial stress syndrome: a critical review. *Sports Medicine.* 2009;39(7):523-546.

2. Beck BR. Tibial stress injuries. An aetiological review for the purposes of guiding management. *Sports Medicine.* 1998;26(4):265-279.

3. Craig DI. Current developments concerning medial tibial stress syndrome. *The Physician and sportsmedicine.* 2009;37(4):39-44.

4. Moen MH, Bongers T, Bakker EW, et al. The additional value of a pneumatic leg brace in the treatment of recruits with medial tibial stress syndrome; a randomized study. *Journal of the Royal Army Medical Corps.* 2010;156(4):236-240.

5. Barton CJ, Bonanno DR, Carr J, et al. Running retraining to treat lower limb injuries: a mixed-methods study of current evidence synthesised with expert opinion. *British journal of sports medicine.* 2016;50(9):513-526.

6. Johnston E, Flynn T, Bean M, et al. A randomized controlled trial of a leg orthosis versus traditional treatment for soldiers with shin splints: A pilot study. *Military Medicine.* 2006;171(1):40-44.

7. Couture CJ, Karlson KA. Tibial stress injuries: Decisive diagnosis and treatment of 'shin splints'. *Physician and Sportsmedicine.* 2002;30(6):29-36.

8. Brukner P, Bennell K. Stress fractures in female athletes. Diagnosis, management and rehabilitation. *Sports medicine (Auckland, NZ).* 1997;24(6):419-429.

9. Bolthouse E, Hunt A, Mandrachia K, Monarski L, Lee K. Return to Running After a Tibial Stress Fracture: A Suggested Protocol. *Orthopaedic Physical Therapy Practice.* 2015;27(1):37-45.

10. Reinking MF, Austin TM, Richter RR, Krieger MM. Medial Tibial Stress Syndrome in Active Individuals: A Systematic Review and Meta-analysis of Risk Factors. *Sports Health: A Multidisciplinary Approach.* 2017;9(3):252-261.

11. Kaeding CC, Yu JR, Wright R, Amendola A, Spindler KP. Management and return to play of stress fractures. *Clinical journal of sport medicine : official journal of the Canadian Academy of Sport Medicine.* 2005;15(6):442-447.

12. Hobara H, Sato T, Sakaguchi M, Nakazawa K. Step Frequency and Lower Extremity Loading During Running. *International Journal of Sports Medicine.* 2012;33(4):310-313.

13. Meardon SA, Derrick TR. Effect of step width manipulation on tibial stress during running. *Journal of Biomechanics.* 2014;47(11):2738-2744.

14. Harrast MA, Colonno D. Stress fractures in runners. *Clinics in sports medicine.* 2010;29(3):399-416.

15. Moen MH, Holtslag L, Bakker E, et al. The treatment of medial tibial stress syndrome in athletes; a randomized clinical trial. *Sports Medicine, Arthroscopy, Rehabilitation, Therapy and Technology.* 2012;4(1).

16. Gillespie WJ, Grant I. Interventions for preventing and treating stress fractures and stress reactions of bone of the lower limbs in young adults. *The Cochrane database of systematic reviews.* 2000(2):Cd000450.

17. Loudon JK, Dolphino MR. Use of Foot Orthoses and Calf Stretching for Individuals With Medial Tibial Stress Syndrome. *Foot & Ankle Specialist.* 2010;3(1):15-20.

18. Swenson EJ, Jr., DeHaven KE, Sebastianelli WJ, Hanks G, Kalenak A, Lynch JM. *American Journal of Sports Medicine.* 1997;25(3):322-328.

19. Allen CS, Flynn TW, Kardouni JR, et al. The use of a pneumatic leg brace in soldiers with tibial stress fractures--a randomized clinical trial. *Military Medicine.* 2004;169(11):880-884.

20. Moen MH, Rayer S, Schipper M, et al. Shockwave treatment for medial tibial stress syndrome in athletes; a prospective controlled study. *British journal of sports medicine.* 2012;46(4):253-257.

21. Winters M, Eskes M, Weir A, Moen MH, Backx FJ, Bakker EW. Treatment of medial tibial stress syndrome: a systematic review. *Sports medicine (Auckland, NZ).* 2013;43(12):1315-1333.

22. Gomez Garcia S, Ramon Rona S, Gomez Tinoco MC, et al. Shockwave treatment for medial tibial stress syndrome in military cadets: A single-blind randomized controlled trial. *International journal of surgery (London, England).* 2017;46:102-109.

23. Griebert MC, Needle AR, McConnell J, Kaminski TW. Lower-leg Kinesio tape reduces rate of loading in participants with medial tibial stress syndrome. *Physical Therapy in Sport.* 2016;18:62-67.

24. Kachanathu SJ, Algarni FS, Nuhmani S, Alenazi AM, Hafez AR, Algarni AD. Functional outcomes of kinesio taping versus standard orthotics in the management of shin splint. *The Journal of sports medicine and physical fitness.* 2018;58(11):1666-1670.

25. Tolbert TA, Binkley HM. Treatment and prevention of shin splints. *Strength & Conditioning Journal.* 2009;31(5):69-72.

26. Fredericson M, Bergman AG, Hoffman KL, Dillingham MS. Tibial stress reaction in runners: correlation of clinical symptoms and scintigraphy with a new magnetic resonance imaging grading system. *American Journal of Sports Medicine.* 1995;23(4):472-481.

27. Rajasekaran S, Finnoff JT. Exertional Leg Pain. Physical medicine and rehabilitation clinics of North America. 2016;27(1):91-119.

28. Fees M, Decker T, Snyder-Mackler L, Axe MJ. Upper extremity weight-training modifications for the injured athlete. A clinical perspective. *The American journal of sports medicine.* 1998;26(5):732-742.