

Medial Tibial Stress Syndrome
(MTSS) References
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HISTORY

- Hutchins CP: Explanation of spike soreness in runners. *Am Phys Ed Rev* 18:31-35, 1913
- Devas MB: Stress fractures of the tibia in athletes or "shin soreness." *J Bone Joint Surg* 40B(2):227-239, 1958
- Slocum DB: The shin splint syndrome- medical aspects and differential diagnosis. *Am J Surg* 114:875-881, 1967
- Clement DB: Tibial stress syndrome in athletes. *J Sports Med* 2:81-85, 1974
- Puranen J: The medial tibial syndrome- exercise ischaemia in the medial fascial compartment of the leg. *J Bone Joint Surg* 56B(4):712-715, 1974
- Mubarak SJ, Gould RN, Lee YF, et al.: The medial tibial stress syndrome- a cause of shin splints. *Am J Sports Med* 10(4):201-205, 1982
- Michael RH, Holder LE: The soleus syndrome- a cause of medial tibial stress (shin splints). *Am J Sports Med* 13(2):87-94, 1985

GENERAL REVIEW

- Batt ME: Shin splints- a review of terminology. *Clin J Sports Med* 5(1):53-57, 1995
- Kortebein P, Kaufman K, Basford J, et al.: Medial tibial stress syndrome. *Med Sci Sports Exerc* 32(3 suppl):S27-S33, 2000
- Moen MH, Tol JL, Weir A, et al.: Medial tibial stress syndrome- a critical review. *Sports Med* 39(7):523-546, 2009

PATHOMECHANICS

- Lanyon LE, Hampson WGJ, Goodship AE, et al.: Bone deformation recorded in vivo from strain gauges attached to the human tibial shaft. *Acta Orthop Scand* 46:256, 1975
- Milgrom C, Giladi M, Simkin A, et al.: The area moment of inertia of the tibia: a risk factor for stress fractures. *J Biomech* 22:1243, 1989
- Richie DH, DeVries HV, Endo CK: Shin muscle activity and floor surfaces in dance exercise: an electromyographic study. *J Am Pod Amer Med Assoc* 83:181-187, 1993
- Gross TS, Edwards J, McLeod KJ, et al.: Strain gradients correlate with sites of periosteal bone formation. *J Bone Min Res* 12(6):982-988, 1997
- Beck BR: Tibial stress injuries: an aetiological review for the purposes of guiding management. *Sports Med* 26(4):265-279, 1998
- Milgrom C, Radeva-Petrova DR, Finestone A: The effect of muscle fatigue on *in vivo* tibial strains. *J Biomech* 40(4):845-850, 2007
- Bouché RT, Johnson CH: Medial tibial stress syndrome (tibial fasciitis)- a proposed pathomechanical model involving fascial traction. *J Am Pod Med Assoc* 97(1):31-36, 2007
- Frankly M, Oakes B, Field B, et al.: Section modulus is the optimum geometric predictor for stress fractures and medial tibial stress syndrome in both male and female athletes. *Am J Sports Med* 36(6): 1179-1189, 2010

ANATOMY

- Gerlach UJ, Lierse W: Functional construction of the superficial and deep fascia system of the lower limb in man. *Acta Anat* 139:11-25, 1990
- Beck BR, Osternig LR: Medial tibial stress syndrome- the location of muscles in the leg in relation to symptoms. *J Bone Joint Surg* 76A: 1057-1061, 1994

-Stickley CD, Hetzler RK, Kimura IF, et al.: Crural fascia and muscle origins related to medial tibial stress syndrome symptom location. *Med Sci Sports Exerc* 41(11):1991-1996, 2009

PATHOLOGY

-Johnell O, Rausing A, Wendeberg B, et al.: Morphological bone changes in shin splints. *Clin Orthop Rel Res* 167:180-184, 1982

-Bhatt R, Lauder I, Finlay DB, et al.: Correlation of bone scintigraphy & histological findings in med. tibial syndrome. *Br J Sports Med* 34:49-53, 2000

PREDISPOSING FACTORS (for MTSS)

-Kaufman KR, Brodine SK, Shaffer RA, et al.: The effect of foot structure and range of motion on musculoskeletal overuse injuries. *Am J Sports Med* 27(5):585-595, 1999

-Bennett JE, Reinking MF, Pluemer B, et al.: Factors contributing to the development of medial tibial stress syndrome in high school runners. *J Orthop Sports Phys Ther* 31(9):504-510, 2001

-Yates B, White S: The incidence and risk factors in the development of medial tibial stress syndrome among naval recruits. *Am J Sports Med* 32(3):772-780, 2004

-Plisky MS, Rauh MJ, Heiderscheit B, et al.: Medial tibial stress syndrome in high school cross-county runners: incidence and risk factors. *J Orthop Sports Phys Ther* 37(2):40-47, 2007

-Bandholm T, Boysen L, Haugaard S, et al.: Foot medial longitudinal-arch deformation during quiet standing and gait in subjects with medial tibial stress syndrome. *J Foot Ankle Surg* 47(2):89-95, 2008

-Hubbard TJ, Carpenter EM, Cordova ML: Contributing factors to medial tibial stress syndrome: a prospective investigation. *Med Sci Sports Exerc* 41(3):490-496, 2009

-Raissi RD, Safar Cherati AD, Mansoori KD, et al.: The relationship between lower extremity alignment and medial tibial stress syndrome among non-professional athletes. *Sports Med Arthrosc Rehabil Ther Technol* 1(1):11-18, 2009

-Moen MH, Bongers T, Bakker EW, et al.: Risk factors and prognostic indicators for medial tibial stress syndrome. *Scand J Med Sci Sports*, June 18 (Epub ahead of print), 2010

PREDISPOSING FACTORS (for ERLP & Tibial Pain)

-Burne SG, Khan KM, Boudville PB, et al.: Risk factors associated with exertional tibial pain: a twelve month prospective study. *Br J Sports Med* 38(4):441-445, 2004

-Reinking MF, Hayes AM: Intrinsic factors associated with exercise-related leg pain in collegiate cross-country runners. *Clin J Sports Med* 16(1):10-14, 2006

-Reinking MF: Exercise-related leg pain in female collegiate athletes- the influence of intrinsic and extrinsic factors. *Am J Sports Med* 34(9):1500-1507, 2006

-Reinking MF, Austin TM, Hayes AM: Exercise-related leg pain in collegiate cross-country athletes: extrinsic and intrinsic risk factors. *J Orthop Sports Phys Ther* 37(11):670-678, 2007

-Reinking MF, Austin TM, Hayes AM: Risk factors for self-reported exercise-related leg pain in high school cross-country athletes. *J Athletic Training* 45(1):51-57, 2010

DIAGNOSTIC IMAGING

-Holder LE, Michael RH: The specific scintigraphic pattern of "shin splint in the lower leg": concise communication. *J Nucl Med* 25:865-869, 1984

-Allen MI, O'Dwyer FG, Barnes MR, et al.: The value of bone scans in young patients with exercise-induced leg pain. *Nucl Med Communications* 16:88-91, 1995

-Fredrickson M, Bergman AG, Hoffman KL, et al.: Tibial stress reaction in runners- correlation of clinical symptoms and scintigraphy with a new magnetic resonance imaging grading system. *Am J Sports Med* 23(4):472-481, 1996

-Anderson MW, Ugalde V, Batt M, et al.: Shin splints: MR appearance in a preliminary study. *Radiology* 204:177-180, 1997

- Batt ME, Ugalde V, Anderson MW, et al.: A prospective controlled study of diagnostic imaging for acute shin splints. *Med Sci Sports Exerc* 30(11):1564-1571, 1998
- Magnusson HI, Westlin NE, Nyqvist F, et al.: Abnormally decreased regional bone density in athletes with medial tibial stress syndrome. *Am J Sports Med* 29(6):712-715, 2001
- Ishibashi Y, Okamura Y, Otsuka H, et al.: Comparison of scintigraphy and magnetic resonance imaging for stress injuries of bone. *Clin J Sports Med* 12:79-84, 2002
- Magnusson HI, Ahlborg HG, Karlsson C, et al.: Low regional tibial bone density in athletes normalizes after recovery from symptoms. *Am J Sports Med* 31(4):596-600, 2003
- Aoki Y, Yasuda K, Tohyama H, et al.: Magnetic resonance imaging in stress fractures and shin splints. *Clin Orthop Rel Res* 421:260-267, 2004
- Gaeta M, Minutoli F, Scibano E, et al.: CT and MR imaging findings in athletes with early tibial stress injuries: comparison with bone scintigraphy findings and emphasis on cortical abnormalities. *Radiology* 235:553-561, 2005
- Gaeta M, Minutoli F, Vinci S, et al.: High-resolution CT grading of tibial stress reactions in distance runners. *Am J Radiol* 187:789-793, 2006

CONSERVATIVE TREATMENT

- Andrish JT, Bergfeld JA, Waldheim J: A prospective study on the management of shin splints. *J Bone Joint Surg* 56A(8):1697-1700, 1974
- Eickhoff CA, Hossain SA, Slawski DP: Effects of prescribed foot orthoses on medial tibial stress syndrome in collegiate cross-country runners. *Clin Kines* 54:76-80, 2000
- Herring K: A plyometric training model used to augment rehabilitation for tibial fasciitis. *Curr Sports Med Rep* 5(3):147-154, 2006
- Madeley LT, Munteanu SE, Bonanno DR: Endurance of the ankle joint plantar flexor muscles in athletes with medial tibial stress syndrome: a case-control study. *J Sci & Med in Sport* 10:356-362, 2007

- Galbraith RM, Lavallee ME: Medial tibial stress syndrome: conservative treatment options. *Curr Rev Musculoskeletal Med* 2(3):127-133, 2009
- Craig DI: Current developments concerning medial tibial stress syndrome. *Phys Sportsmed* 37(4):39-44, 2009
- Loudon JK, Dolphino MR: Use of foot orthoses and calf stretching for individuals with medial tibial stress syndrome. *Foot & Ankle Specialist* 3(1):15-20, 2010
- Moen MH, Bongers T, Bakker EWP, et al.: The additional value of a pneumatic leg brace in the treatment of recruits with medial tibial stress syndrome; a randomized study. *JR Army Med Corps* 156(4):36-240, 2010
- Rompe JD, Cacchio A, Furia JP, et al.: Low-energy extracorporeal shock wave therapy as a treatment for medial tibial stress syndrome. *Am J Sports Med* 38(1):125-132, 2010
- Moen MH, Rayer S, Schipper M, et al.: Shockwave treatment for medial tibial stress syndrome in athletes; a prospective study. *Br J Sports Med* , March 9 (EPub ahead of print), 2011

SURGICAL TREATMENT

- Detmer DE: Chronic shin splints- classification and management of medial tibial stress syndrome. *Sports Med* 3:436-446, 1986
- Abramowitz AJ, Schepsis A, McArthur C: The medial tibial syndrome. The role of surgery. *Orthop Rev* 23:875-881, 1994
- Holen KJ, Engenbretsen L, Grøntvedt T, et al.: Surgical treatment of medial tibial stress syndrome (shin splint) by fasciotomy of the superficial posterior compartment of the leg. *Scand J Med Sci Sports* 5:40-43, 1995
- Yates B, Allen MJ, Barnes MR: Outcome of surgical treatment of medial tibial stress syndrome. *J Bone Joint Surg* 85A:1974-1980, 2003

PREVENTION

- Andrish JT, Bergfeld JA, Waldheim J: A prospective study on the management of shin splints. *J Bone Joint Surg* 56A(8):1697-1700, 1974
- Schwellnus MP, Jordaan G, Noakes TD: Prevention of common overuse injuries by the use of shock absorbing insoles. *Am J Sports Med* 18(6): 636-641, 1990
- Larsen K, Weidech F, LeBoeuf-Yde C: Can custom-made biomechanic shoe orthoses prevent problems in the back and lower extremities? *J Manipulative Physiol Ther* 25(5):326-331, 2002
- Yeung SS, Yeung EW, Gillespie LD: Interventions for preventing lower limb soft-tissue running injuries. *Cochrane Database of Systemic Reviews*, Issue 7, 2011
- Crowell HP, Davis IS: Gait retraining to reduce lower extremity loading in runners. *Clin Biomech* 26(1):78-83, 2011
- Milgrom C, Miligram M, Simkin A, et al.: A home exercise program for tibial bone strengthening based on *in vivo* strain measurements. *Am J Phys Med Rehabil* 80(6):433-438, 2001

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