

AYAK VE AYAK BİLEĞİNDEKİ STRES KIRIKLARINA YAKLAŞIM

Ahmet ŞENEL¹

GİRİŞ

Stres kırıkları, patofizyolojisi gereği sinsi başlangıçlı olduğundan erken dönemde gözden kolaylıkla kaçabilen iskelet patolojilerinden biridir. İlk olarak 19. yüzyıl ortalarında askerlerde tanımlanmıştır (1). Sporculardaki stres kırığı ise Devas tarafından 1958 yılında yayınlanarak literatürdeki yerini almıştır (2).

Tekrarlayıcı, submaksimal enerji yüklenmeleri sonucu meydana gelmesi nedeniyle stres kırıkları çoğunlukla sporcularda (özellikle koşucu), dansçı ve askeri personellerde görülmektedir (3,4).

Stres kırıkları, spor yaralanmalarının %1 ile %7'sini oluşturmaktadır. Kadınlarda daha sıktır. Alt ekstremitede vücudun diğer bölgelerine göre daha fazla görülmektedir. Tibia (%49,1), tarsal (%25,3) ve metatarsal kemikler stres kırıklarının en fazla saptandığı kemiklerdir (5-9).

PATOFİZYOLOJİ VE RİSK FAKTÖRLERİ

Stres kırıklarının altında yatan temel mekanizma tekrarlayan, maksimal olmayan yüklenmelerdir. Beraberinde bulunan kemik rezorpsiyonu ve yapımı arasındaki dengesizlik mikrokırığa neden olur (5,10,11). Kemik hasarının ilk evresi stres reaksiyonudur ve bu dönemde hastalar semptomatiktir. Stres reaksiyonu evresinde, gerçek bir kırık hattı olmaması nedeniyle röntgen görüntüleri tanı için yetersizdir. Onun yerine, manyetik rezonans görüntüleme (MRG) ile saptanan ödem veya kemik sintigrafisinde tutulum olması, ke-

¹ Uzm. Dr. Ahmet ŞENEL, Yıldırım Beyazıt Üniversitesi Yenimahalle Eğitim ve Araştırma Hastanesi, Ortopedi ve Travmatoloji AD., Ankara, drahmetsenel@yahoo.com

namama ve stres kırığı üzerine etkisi olduğu düşünülmektedir (86,87). Leal ve ark., konservatif tedavilere zayıf yanıt veren hastalarda uygulanmasını önermektedir (88). ESWT için daha fazla yüksek katımlı çalışmaya ihtiyaç vardır.

KAYNAKLAR

1. Breithaupt MD. Zur pathologie des menschlichen fusses. Tothe pathology of the human foot. *Med Zeitung*. 1855;24:169.
2. Devas MB. Stress fractures of the tibia in athletes or shin soreness. *J Bone Joint Surg Br*. 1958;40-B(2):227-239. doi:10.1302/0301-620X.40B2.227
3. Cosman F, Ruffing J, Zion M, et al. Determinants of stress fracture risk in United States Military Academy cadets. *Bone*. 2013;55(2):359-366. doi:10.1016/j.bone.2013.04.011
4. Bennell KL, Malcolm SA, Thomas SA, et al. The incidence and distribution of stress fractures in competitive track and field athletes. A twelve-month prospective study. *Am J Sports Med*. 1996;24(2):211-217. doi:10.1177/036354659602400217
5. Boden BP, Osbahr DC. High-risk stress fractures: evaluation and treatment. *J Am Acad Orthop Surg*. 2000;8(6):344-353. doi:10.5435/00124635-200011000-00002
6. Gehrmann RM, Renard RL. Current concepts review: Stress fractures of the foot. *Foot Ankle Int*. 2006;27(9):750-757. doi:10.1177/107110070602700919
7. Changstrom BG, Brou L, Khodae M, et al. Epidemiology of stress fracture injuries among US high school athletes, 2005-2006 through 2012-2013. *Am J Sports Med*. 2015;43(1):26-33. doi:10.1177/0363546514562739
8. Shaffer RA, Rauh MJ, Brodine SK, et al. Predictors of stress fracture susceptibility in young female recruits. *Am J Sports Med*. 2006;34(1):108-115. doi:10.1177/0363546505278703
9. Matheson GO, Clement DB, McKenzie DC, et al. Stress fractures in athletes. A study of 320 cases. *Am J Sports Med*. 1987;15(1):46-58. doi:10.1177/036354658701500107
10. Boden BP, Osbahr DC, Jimenez C. Low-risk stress fractures. *Am J Sports Med*. 2001;29(1):100-111. doi:10.1177/03635465010290010201
11. Pegrum J, Crisp T, Padhiar N. Diagnosis and management of bone stress injuries of the lower limb in athletes. *BMJ*. 2012;344:e2511. Published 2012 Apr 24. doi:10.1136/bmj.e2511
12. Sofka CM. Imaging of stress fractures. *Clin Sports Med*. 2006;25(1):53-viii. doi:10.1016/j.csm.2005.08.009
13. Cosman F, Ruffing J, Zion M, et al. Determinants of stress fracture risk in United States Military Academy cadets. *Bone*. 2013;55(2):359-366. doi:10.1016/j.bone.2013.04.011
14. Korpelainen R, Orava S, Karpakka J, et al. Risk factors for recurrent stress fractures in athletes. *Am J Sports Med*. 2001;29(3):304-310. doi:10.1177/03635465010290030901
15. Raasch WG, Hergan DJ. Treatment of stress fractures: the fundamentals. *Clin Sports Med*. 2006;25(1):29-vii. doi:10.1016/j.csm.2005.08.013
16. Joy EA, Campbell D. Stress fractures in the female athlete. *Curr Sports Med Rep*. 2005;4(6):323-328. doi:10.1097/01.csmr.0000306294.72578.a8
17. Nattiv A. Stress fractures and bone health in track and field athletes. *J Sci Med*

- Sport*. 2000;3(3):268-279. doi:10.1016/s1440-2440(00)80036-5
18. Maitra RS, Johnson DL. Stress fractures. Clinical history and physical examination. *Clin Sports Med*. 1997;16(2):259-274. doi:10.1016/s0278-5919(05)70021-1
 19. Barrack MT, Gibbs JC, De Souza MJ, et al. Higher incidence of bone stress injuries with increasing female athlete triad-related risk factors: a prospective multisite study of exercising girls and women. *Am J Sports Med*. 2014;42(4):949-958. doi:10.1177/0363546513520295
 20. Voss LA, Fadale PD, Hulstyn MJ. Exercise-induced loss of bone density in athletes. *J Am Acad Orthop Surg*. 1998;6(6):349-357. doi:10.5435/00124635-199811000-00003
 21. Mayer SW, Joyner PW, Almekinders LC, et al. Stress fractures of the foot and ankle in athletes. *Sports health*, 6(6), 481–491. doi:10.1177/1941738113486588
 22. McInnis KC, Ramey LN. High-Risk Stress Fractures: Diagnosis and Management. *PM R*. 2016;8(3 Suppl):S113-S124. doi:10.1016/j.pmrj.2015.09.019
 23. Diehl JJ, Best TM, Kaeding CC. Classification and return-to-play considerations for stress fractures. *Clin Sports Med*. 2006;25(1):17-vii. doi:10.1016/j.csm.2005.08.012
 24. Mallee WH, Weel H, van Dijk CN, et al. Surgical versus conservative treatment for high-risk stress fractures of the lower leg (anterior tibial cortex, navicular and fifth metatarsal base): a systematic review. *Br J Sports Med*. 2015;49(6):370-376. doi:10.1136/bjsports-2013-093246
 25. Yavuz U, Özkan NK. Sporcularda ayak stres kırıkları. *Totbid Dergisi*, 2018, 17: 88-97. doi:10.14292/totbid.dergisi.2018.11
 26. Barrow GW, Saha S. Menstrual irregularity and stress fractures in collegiate female distance runners. *Am J Sports Med*. 1988;16(3):209-216. doi:10.1177/036354658801600302
 27. Bennell KL, Malcolm SA, Thomas SA, et al. Risk factors for stress fractures in track and field athletes. A twelve-month prospective study. *Am J Sports Med*. 1996;24(6):810-818. doi:10.1177/036354659602400617
 28. Spitz DJ, Newberg AH. Imaging of stress fractures in the athlete. *Radiol Clin North Am*. 2002;40(2):313-331. doi:10.1016/s0033-8389(02)00010-6
 29. Greaser MC. Foot and Ankle Stress Fractures in Athletes. *Orthop Clin North Am*. 2016;47(4):809-822. doi:10.1016/j.ocl.2016.05.016
 30. Arendt EA, Griffiths HJ. The use of MR imaging in the assessment and clinical management of stress reactions of bone in high-performance athletes. *Clin Sports Med*. 1997;16(2):291-306. doi:10.1016/s0278-5919(05)70023-5
 31. Fredericson 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*. 1995;23(4):472-481. doi:10.1177/036354659502300418
 32. Rodeo SA, Warren RF, O'Brien SJ, et al. Diastasis of bipartite sesamoids of the first metatarsophalangeal joint. *Foot Ankle*. 1993;14(8):425-434. doi:10.1177/107110079301400801
 33. Brukner P, Bradshaw C, Khan KM, et al. Stress fractures: a review of 180 cases. *Clin J Sport Med*. 1996;6(2):85-89.
 34. Brockwell J, Yeung Y, Griffith JF. Stress fractures of the foot and ankle. *Sports Med Arthrosc Rev*. 2009;17(3):149-159. doi:10.1097/JSA.0b013e3181b12727
 35. Meurman KOA. Less common stress fractures in the foot. *Br J Radiol*. 1981;54(637):1-7. doi:10.1259/0007-1285-54-637-1
 36. Meurman KOA, Elfving S. Stress fracture of the cuneiform bones. *Br J Radiol*. 1980;53(626):157-160. doi:10.1259/0007-1285-53-626-157

37. Bui-Mansfield LT, Thomas WR. Magnetic resonance imaging of stress injury of the cuneiform bones in patients with plantar fasciitis. *J Comput Assist Tomogr.* 2009;33(4):593-596. doi:10.1097/RCT.0b013e31818af248
38. Childress HM. March fractures of the lower extremity. Report of a case of March fracture of a cuneiform bone. *War Medicine.* 1943;4:152-160.
39. Pegrum J, Dixit V, Padhiar N, et al. The pathophysiology, diagnosis, and management of foot stress fractures. *Phys Sportsmed.* 2014;42(4):87-99. doi:10.3810/psm.2014.11.2095
40. Hullinger CW. Insufficiency fractures of the calcaneus. *J Bone Joint Surg.* 1944;26:751-7.
41. Sormaala MJ, Niva MH, Kiuru MJ, et al. Stress injuries of the calcaneus detected with magnetic resonance imaging in military recruits. *J Bone Joint Surg Am.* 2006;88(10):2237-2242. doi:10.2106/JBJS. E.01447
42. Leabhart JW. Stress fractures of the calcaneus. *J Bone Joint Surg Am.* 1959;41-A:1285-1290.
43. Biedert R, Hintermann B. Stress fractures of the medial great toe sesamoids in athletes. *Foot Ankle Int.* 2003;24(2):137-141. doi:10.1177/107110070302400207
44. Pagenstert GI, Valderrabano V, Hintermann B. Medial sesamoid nonunion combined with hallux valgus in athletes: a report of two cases. *Foot Ankle Int.* 2006;27(2):135-140. doi:10.1177/107110070602700212
45. Anderson RB, McBryde AM Jr. Autogenous bone grafting of hallux sesamoid nonunions. *Foot Ankle Int.* 1997;18(5):293-296. doi:10.1177/107110079701800509
46. Torg JS, Balduini FC, Zelko RR, et al. Fractures of the base of the fifth metatarsal distal to the tuberosity. Classification and guidelines for non-surgical and surgical management. *J Bone Joint Surg Am.* 1984;66(2):209-214.
47. DeLee JC, Evans JP, Julian J. Stress fracture of the fifth metatarsal. *Am J Sports Med.* 1983;11(5):349-353. doi:10.1177/036354658301100513
48. Zogby RG, Baker BE. A review of nonoperative treatment of Jones' fracture. *Am J Sports Med.* 1987;15(4):304-307. doi:10.1177/036354658701500402
49. Lee KT, Park YU, Jegal H, et al. Prognostic classification of fifth metatarsal stress fracture using plantar gap. *Foot Ankle Int.* 2013;34(5):691-696. doi:10.1177/1071100713475349
50. Lee KT, Park YU, Young KW, et al. Surgical results of 5th metatarsal stress fracture using modified tension band wiring. *Knee Surg Sports Traumatol Arthrosc.* 2011;19(5):853-857. doi:10.1007/s00167-011-1406-3
51. Fitch KD, Blackwell JB, Gilmour WN. Operation for non-union of stress fracture of the tarsal navicular. *J Bone Joint Surg Br.* 1989;71(1):105-110. doi:10.1302/0301-620X.71B1.2644288
52. Khan KM, Brukner PD, Kearney C, et al. Tarsal navicular stress fracture in athletes. *Sports Med.* 1994;17(1):65-76. doi:10.2165/00007256-199417010-00006
53. Torg JS, Pavlov H, Cooley LH. Stress fractures of the tarsal navicular. A retrospective review of twenty-one cases. *J Bone Joint Surg Am.* 1982;64(5):700-712.
54. Khan KM, Fuller PJ, Brukner PD, et al. Outcome of conservative and surgical management of navicular stress fracture in athletes. Eighty-six cases proven with computerized tomography. *Am J Sports Med.* 1992;20(6):657-666. doi:10.1177/036354659202000606
55. Burne SG, Mahoney CM, Forster BB, et al. Tarsal navicular stress injury: long-term outcome and clinoradiological correlation using both computed tomography and magnetic resonance imaging. *Am J Sports Med.* 2005;33(12):1875-1881. doi:10.1177/0363546505278253
56. Lee S, Anderson RB. Stress fractures of the tarsal navicular. *Foot Ankle Clin.*

- 2004;9(1):85-104. doi:10.1016/S1083-7515(03)00151-7
57. Saxena A, Fullem B, Hannaford D. Results of treatment of 22 navicular stress fractures and a new proposed radiographic classification system. *J Foot Ankle Surg.* 2000;39(2):96-103. doi:10.1016/s1067-2516(00)80033-2
 58. Rossi F, Dragoni S. Talar body fatigue stress fractures: three cases observed in elite female gymnasts. *Skeletal Radiol.* 2005;34(7):389-394. doi:10.1007/s00256-005-0913-z
 59. Sormaala MJ, Niva MH, Kiuru MJ, et al. Bone stress injuries of the talus in military recruits. *Bone.* 2006;39(1):199-204. doi:10.1016/j.bone.2005.12.001
 60. Sormaala MJ, Niva MH, Kiuru MJ, et al. Outcomes of stress fractures of the talus. *Am J Sports Med.* 2006;34(11):1809-1814. doi:10.1177/0363546506291405
 61. Black KP, Ehlert KJ. A stress fracture of the lateral process of the talus in a runner. A case report. *J Bone Joint Surg Am.* 1994;76(3):441-443. doi:10.2106/00004623-199403000-00015
 62. Bradshaw C, Khan K, Brukner P. Stress fracture of the body of the talus in athletes demonstrated with computer tomography. *Clin J Sport Med.* 1996;6(1):48-51. doi:10.1097/00042752-199601000-00010
 63. Iwamoto J, Takeda T. Stress fractures in athletes: review of 196 cases. *J Orthop Sci.* 2003;8(3):273-278. doi:10.1007/s10776-002-0632-5
 64. Shelbourne KD, Fisher DA, Rettig AC, et al. Stress fractures of the medial malleolus. *Am J Sports Med.* 1988;16(1):60-63. doi:10.1177/036354658801600111
 65. Jowett AJ, Birks CL, Blackney MC. Medial malleolar stress fracture secondary to chronic ankle impingement. *Foot Ankle Int.* 2008;29(7):716-721. doi:10.3113/FAI.2008.0716
 66. Irion V, Miller TL, Kaeding CC. The treatment and outcomes of medial malleolar stress fractures: a systematic review of the literature. *Sports Health.* 2014;6(6):527-530. doi:10.1177/1941738114546089
 67. Shabat S, Sampson KB, Mann G, et al. Stress fractures of the medial malleolus--review of the literature and report of a 15-year-old elite gymnast. *Foot Ankle Int.* 2002;23(7):647-650. doi:10.1177/107110070202300711
 68. Kor A, Saltzman AT, Wempe PD. Medial malleolar stress fractures. Literature review, diagnosis, and treatment. *J Am Podiatr Med Assoc.* 2003;93(4):292-297. doi:10.7547/87507315-93-4-292
 69. Friedl KE, Evans RK, Moran DS. Stress fracture and military medical readiness: bridging basic and applied research. *Med Sci Sports Exerc.* 2008;40(11 Suppl):S609-S622. doi:10.1249/MSS.0b013e3181892d53
 70. Jones BH, Thacker SB, Gilchrist J, et al. Prevention of lower extremity stress fractures in athletes and soldiers: a systematic review. *Epidemiol Rev.* 2002;24(2):228-247. doi:10.1093/epirev/mxf011
 71. Moreira CA, Bilezikian JP. Stress Fractures: Concepts and Therapeutics. *J Clin Endocrinol Metab.* 2017;102(2):525-534. doi:10.1210/jc.2016-2720
 72. McCabe MP, Smyth MP, Richardson DR. Current concept review: vitamin D and stress fractures. *Foot Ankle Int.* 2012;33(6):526-533. doi:10.3113/FAI.2012.0526
 73. Bischoff-Ferrari HA, Willett WC, Wong JB, et al. Fracture prevention with vitamin D supplementation: a meta-analysis of randomized controlled trials. *JAMA.* 2005;293(18):2257-2264. doi:10.1001/jama.293.18.2257
 74. Grados F, Brazier M, Kamel S, et al. Effects on bone mineral density of calcium and vitamin D supplementation in elderly women with vitamin D deficiency. *Joint Bone Spine.* 2003;70(3):203-208. doi:10.1016/s1297-319x(03)00046-0
 75. Milgrom C, Finestone A, Novack V, et al. The effect of prophylactic treatment with risedronate on stress fracture incidence among infantry recruits. *Bone.*

- 2004;35(2):418-424. doi:10.1016/j.bone.2004.04.016
76. Jiang Y, Zhao J, Geusens P, et al. Femoral neck trabecular microstructure in ovariectomized ewes treated with calcitonin: MRI microscopic evaluation. *J Bone Miner Res*. 2005;20(1):125-130. doi:10.1359/JBMR.041008
 77. Li X, Luo X, Yu N, et al. Effects of salmon calcitonin on fracture healing in ovariectomized rats. *Saudi Med J*. 2007;28(1):60-64.
 78. Cobb KL, Bachrach LK, Sowers M, et al. The effect of oral contraceptives on bone mass and stress fractures in female runners. *Med Sci Sports Exerc*. 2007;39(9):1464-1473. doi:10.1249/mss.0b013e318074e532
 79. Cumming DC, Cumming CE. Estrogen replacement therapy and female athletes: current issues. *Sports Med*. 2001;31(15):1025-1031. doi:10.2165/00007256-200131150-00001
 80. Cumming DC. Exercise-associated amenorrhea, low bone density, and estrogen replacement therapy. *Arch Intern Med*. 1996;156(19):2193-2195.
 81. Brighton CT, Wang W, Seldes R, et al. Signal transduction in electrically stimulated bone cells. *J Bone Joint Surg Am*. 2001;83(10):1514-1523. doi:10.2106/00004623-200110000-00009
 82. Khan Y, Laurencin CT. Fracture repair with ultrasound: clinical and cell-based evaluation. *J Bone Joint Surg Am*. 2008;90 Suppl 1:138-144. doi:10.2106/JBJS.G.01218
 83. Beck BR, Matheson GO, Bergman G, et al. Do capacitively coupled electric fields accelerate tibial stress fracture healing? A randomized controlled trial. *Am J Sports Med*. 2008;36(3):545-553. doi:10.1177/0363546507310076
 84. Busse JW, Kaur J, Mollon B, et al. Low intensity pulsed ultrasonography for fractures: systematic review of randomised controlled trials. *BMJ*. 2009;338:b351. Published 2009 Feb 27. doi:10.1136/bmj.b351
 85. Needle AR, Kaminski TW. Effectiveness of low-intensity pulsed ultrasound, capacitively coupled electric fields, or extracorporeal shock wave therapy in accelerating stress fracture healing: a systematic review. *Athletic Training and Sports Health Care*, 2009, 1.3: 133-139. doi:10.3928/19425864-20090427-08
 86. Furia JP, Rompe JD, Cacchio A, et al. Shock wave therapy as a treatment of nonunions, avascular necrosis, and delayed healing of stress fractures. *Foot Ankle Clin*. 2010;15(4):651-662. doi:10.1016/j.fcl.2010.07.002
 87. Moretti B, Notarnicola A, Garofalo R, et al. Shock waves in the treatment of stress fractures. *Ultrasound Med Biol*. 2009;35(6):1042-1049. doi:10.1016/j.ultrasmedbio.2008.12.002
 88. Leal C, D'Agostino C, Gomez Garcia S, et al. Current concepts of shockwave therapy in stress fractures. *Int J Surg*. 2015;24(Pt B):195-200. doi:10.1016/j.ijsu.2015.07.723