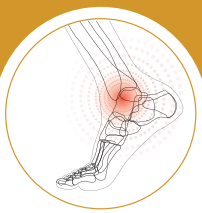
BÖLÜM 7.2



Eklem-İçi Kalkaneus Kırıkları

Serdar TOY[1]

GİRİŞ

Kalkaneus kırıkları, tarsal kemik kırıkları arasında en sık görülen kırıklardır (1-3). Kalkaneus kırıkları, erişkin kemik kırıklarının %1 ile %4'ünü oluşturmaktadır (1-3). Bu kırıkların kabaca %75'i eklem içi kırıklardır (2, 4, 5). Bu kırıklar çoğunlukla genç erkekleri etkilemektedir (1).

Eklem-içi kalkaneus kırıkları ilk olarak 1843 yılında Malgaigne tarafından tanımlanmıştır (1, 6). Radyoloji alanındaki gelişmeler ile birlikte bu kırıkları anlamamız kolaylaşmıştır (1). Eklem-içi kalkaneus kırıkları, yüksekten düşme veya trafik kazaları sonrasında meydana gelen aksiyel yüklenme sonucunda meydana gelmektedir (2, 5). Eklem-içi kalkaneus kırıklarında iki kırık hattı vardır. Kalkaneusu sagital planda anteromedial ve posterolateral olarak ikiye ayıran makaslama kuvveti ile oluşan kırık bir kırık hattıdır. Tibianın aksiyel yüklenmesi sonucunda talusun lateral çıkıntısının Gissane açısının tepe noktasına çarpmasıyla posterior eklem yüzende meydana gelen ve kalkaneusu koronal planda ön ve arka olmak üzere iki parçaya ayıran kompresif kuvvetlerin etkisi ile oluşan kırık bir diğer kırık hattıdır (7-10). Eklem-içi kalkaneus kırıklarında yukarıda bahsettiğimiz iki temel kırık hattı dışında travmaya neden olan kuvvetin büyüklüğü ve travma anında ayağın duruş şekli ilave kırıklarda görülebilir (9, 10). Genellikle, eklem-içi kalkaneus kırıklarında, kırık parçanın veya parçaların deplasmanı, kalkaneusta yükseklik kaybı ve kırık parçaların birbirlerinde ayrılmasına bağlı olarak topukta genişleme meydana gelir (9, 10).

[1] Uzm. Dr., Başakşehir Çam ve Sakura Şehir Hastanesi, Ortopedi ve Travmatoloji Kliniği, serdartoy737@gmail.com

düksiyon ve internal tespit uygulanan hastalara, kendi kliniğimizde mutlaka negatif basınçlı dren uyguluyoruz. Bu drende gelen sıvı günde 10 ml'nin altına düştüğünde çekiyoruz (31, 73). Hastaların ameliyat sonrasında 6. haftada kısmi yük vererek basmasına izin verilir ve 12. haftasında tam yük vererek basmasına izin verilir (31, 69, 73, 88).

SONUÇ

Eklem-içi kalkaneus kırıkları, yüksek enerjili travmalardan sonra meydana gelen ağır yaralanmalardır. Tedavi stratejisi ister konservatif olsun ister cerrahi olsun ciddi komplikasyonlarla birliktelik göstermektedir. Sanders Tip I kırıkların tedavisinde konservatif yöntemlerin başarılı olduğu konusunda dünya çapında görüş birliği mevcuttur (2). Sanders Tip IV veya çok parçalı eklem-içi kalkaneus kırıklarda ise ARİT veya subtalar artrodez seçenekleri mevcuttur (3). Eklem-içi kalkaneus kırıkları tedavisinde, yumuşak doku nekrozu sıklıkla karşılaşılan bir komplikasyondur. Bu konuda dikkatli olmak gerekir. Cerrahi zamanlama için ödemin veya bülün geçmesi mutlaka beklenmeli ve cilt kırışıklık testinin pozitif olması gerekir. Hastaların ameliyat sonrasında 12. haftaya kadar tam yük vermemesi teşvik edilmelidir.

KAYNAKLAR

1. Epstein N, Chandran S, Chou L. Current concepts review: intra-articular fractures of the calcaneus. *Foot Ankle Int*. 2012;33(1):79-86.
2. Allegra PR, Rivera S, Desai SS, et al. Intra-articular calcaneus fractures: Current concepts review. *Foot Ankle Orthop*. 2020;5(3):2473011420927334.
3. Wei N, Zhou Y, Chang W, et al. Displaced intra-articular calcaneal fractures: classification and treatment. *Orthopedics*. 2017;40(6):e921-e929.
4. Nosewicz T, Knupp M, Barg A, et al. Mini-open sinus tarsi approach with percutaneous screw fixation of displaced calcaneal fractures: a prospective computed tomography–based study. *Foot Ankle Int*. 2012;33(11):925-933.
5. Tejwani NC, Soohoo NF. Foot Trauma. In: Lieberman JR, editor. AAOS Comprehensive Orthopaedic Review 3. vol. 2. Illinois: American Academy of Orthopaedic Surgeons: Lippincott Williams & Wilkins; 2019. p. 2624-2630.
6. Malgaigne J-F. Die Knochenbrüche und Verrenkungen: Rieger; 1856.
7. Rak V, Ira D, Masek M. Operative treatment of intra-articular calcaneal fractures with calcaneal plates and its complications. *Indian J Orthop*. 2009;43(3):271.
8. Carr JB. Mechanism and pathoanatomy of the intraarticular calcaneal fracture. *Clin Orthop Relat Res*. 1993(290):36-40.
9. Çırpar M, Ekşioğlu MF. Fractures of calcaneus. *J TOTBİD*. 2013;12(2):168-176.
10. Daftary A, Haims AH, Baumgaertner MR. Fractures of the calcaneus: a review with emp-

hasis on CT. *Radiographics*. 2005;25(5):1215-1226.
11. Rowe CR, Sakellarides HT, Freeman PA, et al. Fractures of the os calcis: a long-term follow-up study of 146 patients. *J Am Med Assoc*. 1963;184(12):920-923.
12. Thordarson DB, Krieger LE. Operative vs. nonoperative treatment of intra-articular fractures of the calcaneus: a prospective randomized trial. *Foot Ankle Int*. 1996;17(1):2-9.
13. Swanson SA, Clare MP, Sanders RW. Management of intra-articular fractures of the calcaneus. *Foot Ankle Clin*. 2008;13(4):659-678.
14. Stapleton JJ, Kolodenker G, Zgonis T. Internal and external fixation approaches to the surgical management of calcaneal fractures. *Clin Podiatr Med Surg*. 2010;27(3):381-392.
15. van Tetering EA, Buckley RE. Functional outcome (SF-36) of patients with displaced calcaneal fractures compared to SF-36 normative data. *Foot Ankle Int*. 2004;25(10):733-738.
16. Buckley R TS, McCormack R, Pate G, Leighton R, Petrie D, Galpin R. . Operative compared with nonoperative treatment of displaced intra-articular calcaneal fractures: a prospective, randomized, controlled multicenter trial. *J Bone Joint Surg Am*. 2002;84(10):1733-1744.
17. Benirschke SK, Kramer PA. Wound healing complications in closed and open calcaneal fractures. *J Orthop Trauma*. 2004;18(1):1-6.
18. Agren P-H, Wretenberg P, Sayed-Noor AS. Operative versus nonoperative treatment of displaced intra-articular calcaneal fractures: a prospective, randomized, controlled multicenter trial. *J Bone Joint Surg Am*. 2013;95(15):1351-1357.
19. Basile A. Operative versus nonoperative treatment of displaced intra-articular calcaneal fractures in elderly patients. *J Foot Ankle Surg*. 2010;49(1):25-32.
20. Buckley RE, Tough S. Displaced intra-articular calcaneal fractures. *J Am Acad Orthop Surg*. 2004;12(3):172-178.
21. Gougoulias N, Khanna A, McBride DJ, et al. Management of calcaneal fractures: systematic review of randomized trials. *Br Med Bull*. 2009;92(1):153-167.
22. Luo X, Li Q, He S, et al. Operative versus nonoperative treatment for displaced intra-articular calcaneal fractures: a meta-analysis of randomized controlled trials. *J Foot Ankle Surg*. 2016;55(4):821-828.
23. Zhang W, Lin F, Chen E, et al. Operative versus nonoperative treatment of displaced intra-articular calcaneal fractures: a meta-analysis of randomized controlled trials. *J Orthop Trauma*. 2016;30(3):e75-e81.
24. Llusá M, Merí À, Ruano D. Surgical atlas of the musculoskeletal system: Am Acad Orthop Surg; 2008.
25. Miller MD, Thompson SR. Miller's Review of Orthopaedics E-Book. 8th ed. Philadelphia, PA: Elsevier Health Sciences; 2019.
26. Seyahi A, Uludag S, KOYUNCU L, et al. The calcaneal angles in the Turkish population. *Acta Orthop Traumatol Turc*. 2009;43(5):406-411.
27. Knight JR, Gross EA, Bradley GH, et al. Boehler's angle and the critical angle of Gissane are of limited use in diagnosing calcaneus fractures in the ED. *Am J Emerg Med*. 2006;24(4):423-427.
28. Harris R, Beath T. Etiology of peroneal spastic flat foot. *J Bone Joint Surg Br*. 1948;30(4):624-634.
29. Dhillon MS, Bali K, Prabhakar S. Controversies in calcaneus fracture management: a systematic review of the literature. *Musculoskelet Surg*. 2011;95(3):171-181.
30. Gupta A, Ghalambor N, Nihal A, et al. The modified Palmer lateral approach for calcaneal fractures: wound healing and postoperative computed tomographic evaluation of fracture reduction. *Foot Ankle Int*. 2003;24(10):744-753.
31. YÜCE A. Deplase Eklem İçi Kalkaneus Kırıkları. In: ŞAHNA E, AKGÜL H, editors. Sağlık Bilimlerinde Güncel Araştırmalar-II. Çankaya / Ankara / TR: Yaşar Hız; 2022. p. 67-78.

32. Juliano P, Nguyen H-V. Fractures of the calcaneus. *Orthop Clin North Am*. 2001;32(1):35-51.
33. Richman JD, Barre PS. The plantar ecchymosis sign in fractures of the calcaneus. *Clin Orthop Relat Res*. 1986(207):122-125.
34. Rubino R, Valderrabano V, Martin Sutter P, et al. Prognostic value of four classifications of calcaneal fractures. *Foot Ankle Int*. 2009;30(3):229-238.
35. Thermann H, Krettek C, Hüfner T, et al. Management of calcaneal fractures in adults: conservative versus operative treatment. *Clin Orthop*. 1998;353:107-124.
36. Essex-Lopresti P. Mechanism, reduction technique, and results in fractures of the os calcis. *Lancet*. 1942;2:175.
37. AssociationFracture OT, Compendium D. Orthopaedic Trauma Association Committee for Coding and Classification. *J Orthop Trauma*. 1996;10:1-154.
38. Regazzoni P. Behandlung von Kalkaneusfrakturen. *Basler Beiträge Chir*. 1991;3:49-62.
39. Rosenberg ZS, Feldman F, Singson RD. Intra-articular calcaneal fractures: computed tomographic analysis. *Skeletal Radiol*. 1987;16(2):105-113.
40. Sanders R, Fortin P, DiPasquale T, et al. Operative treatment in 120 displaced intraarticular calcaneal fractures. Results using a prognostic computed tomography scan classification. *Clin Orthop Relat Res*. 1993(290):87-95.
41. Sanders R. Current concepts review-displaced intra-articular fractures of the calcaneus. *J Bone Joint Surg*. 2000;82(2):225-250.
42. Gardner MJ, Nork SE, Barei DP, et al. Secondary soft tissue compromise in tongue-type calcaneus fractures. *J Orthop Trauma*. 2008;22(7):439-445.
43. Snoap T, Jaykel M, Williams C, et al. Calcaneus fractures: a possible musculoskeletal emergency. *J Emerg Med*. 2017;52(1):28-33.
44. Taylor MA LA, Sanders DW. Calcaneus Fractures. In: Tornetta P 3rd RW, Ostrum RF MM, McKee MD, Court-Brown CM, editors. Rockwood and Green's fractures in adults. 2. 9th ed. Philadelphia: Wolters Kluwer; 2020. p. 4688-4749.
45. Mcbride DJ, Ramamurthy C, Laing P. (ii) The hindfoot: Calcaneal and talar fractures and dislocations—Part I: Fractures of the calcaneum. *Curr Orthop*. 2005;19(2):94-100.
46. Sanders R, Vaupel ZM, Erdogan M, et al. Operative treatment of displaced intraarticular calcaneal fractures: long-term (10–20 years) results in 108 fractures using a prognostic CT classification. *J Orthop Trauma*. 2014;28(10):551-563.
47. Agren P-H, Wretenberg P, Sayed-Noor AS. Operative versus nonoperative treatment of displaced intra-articular calcaneal fractures: a prospective, randomized, controlled multicenter trial. *J Bone Joint Surg Am*. 2013;95(15):1351-1357.
48. Griffin D, Parsons N, Shaw E, et al. Operative versus non-operative treatment for closed, displaced, intra-articular fractures of the calcaneus: randomised controlled trial. *Brit Med J*. 2014;349.
49. Jiang N, Lin Q-r, Diao X-c, et al. Surgical versus nonsurgical treatment of displaced intra-articular calcaneal fracture: a meta-analysis of current evidence base. *Int Orthop*. 2012;36(8):1615-1622.
50. Randle JA, Kreder HJ, Stephen D, et al. Should calcaneal fractures be treated surgically?: a metaanalysis. *Clin Orthop Relat Res*. 2000;377:217-227.
51. Thordarson DB, Krieger LE. Operative vs. nonoperative treatment of intra-articular fractures of the calcaneus: a prospective randomized trial. *Foot Ankle Int*. 1996;17(1):2-9.
52. Watson TS. Soft tissue complications following calcaneal fractures. *Foot Ankle Clin*. 2007;12(1):107-123.
53. Clare MP, Lee III WE, Sanders RW. Intermediate to long-term results of a treatment protocol for calcaneal fracture malunions. *J Bone Joint Surg Am*. 2005;87(5):963-973.

54. Gaskill T, Schweitzer K, Nunley J. Comparison of surgical outcomes of intra-articular calcaneal fractures by age. *J Bone Joint Surg Am*. 2010;92(18):2884-2889.
55. Herscovici Jr D, Widmaier J, Scaduto JM, et al. Operative treatment of calcaneal fractures in elderly patients. *J Bone Joint Surg Am*. 2005;87(6):1260-1264.
56. Csizy M, Buckley R, Tough S, et al. Displaced intra-articular calcaneal fractures: variables predicting late subtalar fusion. *J Orthop Trauma*. 2003;17(2):106-112.
57. Radnay CS, Clare MP, Sanders RW. Subtalar fusion after displaced intra-articular calcaneal fractures: does initial operative treatment matter? *J Bone Joint Surg Am*. 2009;91(3):541-546.
58. Widén A. Fractures of the calcaneus. *Acta Chir Scand Suppl*. 1954;188:1-104.
59. Sanders R. Intra-articular fractures of the calcaneus: present state of the art. *J Orthop Trauma*. 1992;6(2):252-265.
60. DeWall M, Henderson CE, McKinley TO, et al. Percutaneous reduction and fixation of displaced intra-articular calcaneus fractures. *J Orthop Trauma*. 2010;24(8):466-472.
61. Kikuchi C, Charlton TP, Thordarson DB. Limited sinus tarsi approach for intra-articular calcaneus fractures. *Foot Ankle Int*. 2013;34(12):1689-1694.
62. Kline AJ, Anderson RB, Davis WH, et al. Minimally invasive technique versus an extensile lateral approach for intra-articular calcaneal fractures. *Foot Ankle Int*. 2013;34(6):773-780.
63. Song JH, Kang C, Hwang DS, et al. Extended sinus tarsi approach for treatment of displaced intraarticular calcaneal fractures compared to extended lateral approach. *Foot Ankle Int*. 2019;40(2):167-177.
64. Tomesen T, Biert J, Frölke J. Treatment of displaced intra-articular calcaneal fractures with closed reduction and percutaneous screw fixation. *J Bone Joint Surg Am*. 2011;93(10):920-928.
65. Wang Q, Chen W, Su Y, et al. Minimally invasive treatment of calcaneal fracture by percutaneous leverage, anatomical plate, and compression bolts—the clinical evaluation of cohort of 156 patients. *J Trauma*. 2010;69(6):1515-1522.
66. Wu Z, Su Y, Chen W, et al. Functional outcome of displaced intra-articular calcaneal fractures: a comparison between open reduction/internal fixation and a minimally invasive approach featured an anatomical plate and compression bolts. *J Trauma Acute Care Surg*. 2012;73(3):743-751.
67. Hsu AR, Anderson RB, Cohen BE. Advances in surgical management of intra-articular calcaneus fractures. *J Am Acad Orthop Surg*. 2015;23(7):399-407.
68. Schepers T. Sinus tarsi approach with screws-only fixation for displaced intra-articular calcaneal fractures. *Clin Podiatr Med Surg*. 2019;36(2):211-224.
69. Xu H, Hou R, Ju J, et al. Articular calcaneal fractures: open or minimally invasive surgery, when the medial wall reduction is obtained percutaneously from the lateral side. *Int Orthop*. 2021;45(9):2365-2373.
70. Eastwood D, Langkamer V, Atkins R. Intra-articular fractures of the calcaneum. Part II: Open reduction and internal fixation by the extended lateral transcalcaneal approach. *J Bone Joint Surg Br*. 1993;75(2):189-195.
71. Gould N, Seligson D. Technique tips: footings: lateral approach to the os calcis. *Foot Ankle*. 1984;4(4):218-220.
72. Mehta CR, An VV, Phan K, et al. Extensile lateral versus sinus tarsi approach for displaced, intra-articular calcaneal fractures: a meta-analysis. *J Orthop Surg Res*. 2018;13(1):1-6.
73. Xie W, Cui X, Zhang C, et al. Modified sinus tarsi approach with a variable-angle locking anterolateral plate for Sanders type II and III calcaneal fractures. *Foot Ankle Surg*. 2021.
74. Yüce A, Mısır A, Karslıoğlu B, et al. Does Sectioning and Then Repairing of the Calcaneofibular Ligament at Subtalar Approach Lead to Residual Lateral Ankle Instability? *Arch Bone*

Jt Surg. 2022;10(4):347.
75. Igde N, Cakar M, Yuce A, et al. Functional and radiographic outcomes after surgery for displaced intraarticular calcaneal fractures: Comparison between the sinus tarsi approach and the extensile lateral approach. *Med Sci*. 2021;10(3):752-757.
76. Li S. Wound and sural nerve complications of the sinus tarsi approach for calcaneus fractures. *Foot Ankle Int*. 2018;39(9):1106-1112.
77. Femino JE, Vaseenon T, Levin DA, et al. Modification of the sinus tarsi approach for open reduction and plate fixation of intra-articular calcaneus fractures: the limits of proximal extension based upon the vascular anatomy of the lateral calcaneal artery. *Iowa Orthop J*. 2010;30:161.
78. Daws SB, Neary K, Lundeen G. Short-term radiographic outcomes of calcaneus fractures treated with 2-incision, minimally invasive approach. *Foot Ankle Int*. 2019;40(9):1060-1067.
79. Wallin KJ, Cozzetto D, Russell L, et al. Evidence-based rationale for percutaneous fixation technique of displaced intra-articular calcaneal fractures: a systematic review of clinical outcomes. *J Foot Ankle Surg*. 2014;53(6):740-743.
80. Tornetta III P. The Essex-Lopresti reduction for calcaneal fractures revisited. *J Orthop Trauma*. 1998;12(7):469-473.
81. Zwipp H, Paša L, Žilka L, et al. Introduction of a new locking nail for treatment of intraarticular calcaneal fractures. *J Orthop Trauma*. 2016;30(3):e88-e92.
82. Reinhardt S, Martin H, Ulmar B, et al. Interlocking nailing versus interlocking plating in intra-articular calcaneal fractures: a biomechanical study. *Foot Ankle Int*. 2016;37(8):891-897.
83. Falis M, Pyszel K. Treatment of Displaced Intra-articular Calcaneal Fractures by Intramedullary Nail. Preliminary Report. *Ortop Traumatol Rehabil*. 2016;18(2):141-147.
84. Barla J, Buckley R, McCormack R, et al. Displaced intraarticular calcaneal fractures: long-term outcome in women. *Foot Ankle Int*. 2004;25(12):853-856.
85. Feng Y, Yu Y, Shui X, et al. Closed reduction and percutaneous fixation of calcaneal fractures in children. *Orthopedics*. 2016;39(4):e744-e748.
86. Schepers T, Schipper IB, Vogels LM, et al. Percutaneous treatment of displaced intra-articular calcaneal fractures. *J Orthop Sci*. 2007;12(1):22-27.
87. Rammelt S, Amlang M, Barthel S, et al. Percutaneous treatment of less severe intraarticular calcaneal fractures. *Clin Orthop Relat Res*. 2010;468(4):983-990.
88. Maskill JD, Bohay DR, Anderson JG. Calcaneus fractures: a review article. *Foot Ankle Clin*. 2005;10(3):463-489.
89. Zhang G, Ding S, Ruan Z. Minimally invasive treatment of calcaneal fracture. *J Int Med Res*. 2019;47(8):3946-3954.
90. Woon CY-L, Chong K-W, Yeo W, et al. Subtalar arthroscopy and flurosocopy in percutaneous fixation of intra-articular calcaneal fractures: the best of both worlds. *J Trauma Acute Care Surg*. 2011;71(4):917-925.
91. Al-Ashhab ME. Primary ankle arthrodesis for severely comminuted tibial pilon fractures. *Orthopedics*. 2017;40(2):e378-e381.
92. Kalsi R, Dempsey A, Bunney EB. Compartment syndrome of the foot after calcaneal fracture. *J Emerg Med*. 2012;43(2):e101-e106.
93. Gurkan V, Dursun M, Orhun H, et al. Long-term results of conservative treatment of Sanders type 4 fractures of the calcaneum: a series of 64 cases. *J Bone Joint Surg Br*. 2011;93(7):975-979.
94. Myerson M, Quill Jr G. Late complications of fractures of the calcaneus. *J Bone Joint Surg Am*. 1993;75(3):331-341.

95. Myerson MS. Primary subtalar arthrodesis for the treatment of comminuted fractures of the calcaneus. *Orthop Clin North Am*. 1995;26(2):215-227.
96. Buch BD, Myerson MS, Miller SD. Primary subtalar arthrodesis for the treatment of comminuted calcaneal fractures. *Foot Ankle Int*. 1996;17(2):61-70.
97. Huefner T, Thermann H, Geerling J, et al. Primary subtalar arthrodesis of calcaneal fractures. *Foot Ankle Int*. 2001;22(1):9-14.
98. Potenza V, Caterini R, Farsetti P, et al. Primary subtalar arthrodesis for the treatment of comminuted intra-articular calcaneal fractures. *Injury*. 2010;41(7):702-706.
99. Lin J, Xie C, Chen K, et al. Comparison of sinus tarsi approach versus extensile lateral approach for displaced intra-articular calcaneal fractures Sanders type IV. *Int Orthop*. 2019;43(9):2141-2149.
100. Davis D, Seaman TJ, Newton EJ. Calcaneus fractures. StatPearls [Internet]: StatPearls Publishing; 2022.