

BÖLÜM 10

KAS YARALANMALARI

İsmail Hakan AKBULUT¹
Bilinç DOĞRUÖZ KARATEKİN²

Giriş

Kaslar, kontraktiliteleri (kasılmaları) nedeniyle nefes alma, çalışma, ulaşım, spor da hareket ve fiziksel aktivite gibi insanın hayatı fonksiyonlarının yanı sıra denge ve pozisyon için gereklidir.

Kas yaralanmaları spor hekimliğindeki tüm yaralanmaların en yaygınları arasındadır, ancak aynı zamanda en yaygın yaralanmalar olmalarına rağmen çoğu zaman yanlış yorumlanırlar ve yetersiz tedavi görürler. Çoğu sporcu yaralanma anından kısa bir süre sonra günlük aktivitelerine devam edebildiğinden, yaralanmanın boyutunu hafife almak kolaydır. Çoğu sporda kasların tüm yaralanmaların %10-30'unu oluşturduğunu gösteren çalışmalar vardır (1, 2). Ayrıca futbol maçları sırasında meydana gelen tüm yaralanmaların %30'dan fazlasının kas yaralanmaları olduğu bulunmuştur (3).

Kas yaralanmaları ani ve direkt travma veya kasın gerilme direncini aşan yüksek bir kuvvete maruz kalması gibi indirekt bir travma sonucu gelişebileceği gibi iskemi ve nörolojik disfonksiyonlara bağlı olarak da ortaya çıkabilir (2).

Travmaya bağlı olarak kas lifi, bazal lamina ve fasyanın bütünlüğü bozulduğu kontüzyon, strain ve laserasyon tarzındaki yaralanmalar veya bazal lamina ve bağ doku kılıfının sağlam olup, hücre içinde nekrozun geliştiği yaralanmalar şeklinde

1 Dr., İstanbul Medeniyet Üniversitesi, Göztepe Prof. Dr. Süleyman Yalçın Şehir Hastanesi, Fizik Tedavi ve Rehabilitasyon Kliniği, hakan_akkbulut@hotmail.com

2 Uzm. Dr., İstanbul Medeniyet Üniversitesi, Göztepe Prof. Dr. Süleyman Yalçın Şehir Hastanesi, Fizik Tedavi ve Rehabilitasyon Kliniği, bilinccdogruoz@hotmail.com

gibi) teknik hareketler yapılmalıdır. Vücutun ve kasların ısınması performans için önemlidir (76).

Germe egzersizlerinin farklı çalışmalarda çelişkili sonuçları da görülmüştür. Bunun sebebi farklı spor türlerinde farklı aktivitelerin ve farklı hedeflerin olması ile ilgili olabilir. Patlayıcılığın ön planda olduğu sporlarda yüksek miktarda enerjiyi depolama ve kullanma kapasitesine sahip kas tendon ünitesi gereklidir. Germe ile tendonların kompliansı ve enerji absorbe etme kapasitesi artabilir ve kas yaralanmaları profilaksisinde önemli olabilir. Daha yavaş yapılan bisiklet gibi sporlarda tendonun absorbe edeceği enerji daha az olacağı için kompliansın çok yüksek olmasına patlayıcı sporlar kadar gerek olmayabilir (77).

Kuvvetlendirme programları da kas yaralanmalarını önlemede önemlidir.

Hamstring yaralanmalarında Nordic Hamstring egzersiz programı, normal önlemler ile karşılaşıldığında %45-65 arasında bir risk azalması sağlamıştır. Kasık yaralanmalarında da normal önlemler ile karşılaşıldığında FİFA 11+ programı ve Copenhagen Adduktor Güçlendirme programı %41 daha etkili bulunmuştur (78).

Kas yaralanmalarının önlenmesinde **doğru koruyucu ekipman** ve spor türüne özgü olacak şekilde uygun ayakkabı, eldiven vb. ekipmanlar da etkilidir (79).

Antrenman programı sporcuya özgü planlanmalıdır, aksi halde antrenmandan alınan verim azalacaktır, aşırı yüklenme gibi problemler ortaya çıkabilir.

Kaynaklar

1. Kirkendall DT, Garrett WEJ. Clinical Perspectives Regarding Eccentric Muscle Injury. *Clinical Orthopaedics and Related Research*. 2002;403:S81-S9.
2. Järvinen TA, Järvinen TL, Kääriäinen M, Kalimo H, Järvinen M. Muscle injuries: biology and treatment. *The American journal of sports medicine*. 2005;33 (5):745-64. doi:10.1177/0363546505274714.
3. Woods C, Hawkins RD, Maltby S, Hulse M, Thomas A, Hodson A. The Football Association Medical Research Programme: an audit of injuries in professional football--analysis of hamstring injuries. *British journal of sports medicine*. 2004;38 (1):36-41. doi:10.1136/bjsm.2002.002352.
4. Harris AJ, Duxson MJ, Butler JE, Hodges PW, Taylor JL, Gandevia SC. Muscle fiber and motor unit behavior in the longest human skeletal muscle. *The Journal of neuroscience : the official journal of the Society for Neuroscience*. 2005;25 (37):8528-33. doi:10.1523/jneurosci.0923-05.2005.
5. Peterson L, Renström P. Sports Injuries: Prevention, Treatment and Rehabilitation. CRC Press, Taylor & Francis Group; 2017.
6. Takala TE, Virtanen P. Biochemical composition of muscle extracellular matrix: the effect of loading. *Scandinavian journal of medicine & science in sports*. 2000;10 (6):321-5. doi:10.1034/j.1600-0838.2000.010006321.x.
7. Jakobsen JR, Krosgaard MR. The Myotendinous Junction-A Vulnerable Companion in Sports. A Narrative Review. *Frontiers in physiology*. 2021;12:635561. doi:10.3389/fphys.2021.635561.
8. Tidball JG. Mechanisms of muscle injury, repair, and regeneration. *Comprehensive Physiology*.

- 2011;1 (4):2029-62. doi:10.1002/cphy.c100092.
9. Toumi H, Best TM. The inflammatory response: friend or enemy for muscle injury? *British journal of sports medicine*. 2003;37 (4):284-6. doi:10.1136/bjsm.37.4.284.
 10. Relaix F, Zammit PS. Satellite cells are essential for skeletal muscle regeneration: the cell on the edge returns centre stage. *Development (Cambridge, England)*. 2012;139 (16):2845-56. doi:10.1242/dev.069088.
 11. Darby IA, Zakuani N, Billet F, Desmoulière A. The myofibroblast, a key cell in normal and pathological tissue repair. *Cellular and molecular life sciences : CMLS*. 2016;73 (6):1145-57. doi:10.1007/s00018-015-2110-0.
 12. Mann CJ, Perdigero E, Kharraz Y, Aguilar S, Pessina P, Serrano AL et al. Aberrant repair and fibrosis development in skeletal muscle. *Skeletal muscle*. 2011;1 (1):21. doi:10.1186/2044-5040-1-21.
 13. Best TM, Gharaibeh B, Huard J. Stem cells, angiogenesis and muscle healing: a potential role in massage therapies? *British journal of sports medicine*. 2013;47 (9):556-60. doi:10.1136/bjsports-2012-091685.
 14. Frey SP, Jansen H, Raschke MJ, Meffert RH, Ochman S. VEGF improves skeletal muscle regeneration after acute trauma and reconstruction of the limb in a rabbit model. *Clinical orthopaedics and related research*. 2012;470 (12):3607-14. doi:10.1007/s11999-012-2456-7.
 15. Wu H, Xiong WC, Mei L. To build a synapse: signaling pathways in neuromuscular junction assembly. *Development (Cambridge, England)*. 2010;137 (7):1017-33. doi:10.1242/dev.038711.
 16. Gharaibeh B, Deasy B, Lavasani M, Cummins JH, Li Y, Huard J. Chapter 62 - Musculoskeletal Tissue Injury and Repair: Role of Stem Cells, Their Differentiation, and Paracrine Effects. In: Hill JA, Olson EN, editors. *Muscle*. Boston/Waltham: Academic Press; 2012. p. 881-97.
 17. Orchard JW. Intrinsic and extrinsic risk factors for muscle strains in Australian football. *The American journal of sports medicine*. 2001;29 (3):300-3. doi:10.1177/03635465010290030801.
 18. Ekstrand J, Häggblund M, Waldén M. Epidemiology of muscle injuries in professional football (soccer). *The American journal of sports medicine*. 2011;39 (6):1226-32. doi:10.1177/0363546510395879.
 19. Freckleton G, Pizzari T. Risk factors for hamstring muscle strain injury in sport: a systematic review and meta-analysis. *British journal of sports medicine*. 2013;47 (6):351-8. doi:10.1136/bjsports-2011-090664.
 20. Häggblund M, Waldén M, Ekstrand J. Risk factors for lower extremity muscle injury in professional soccer: the UEFA Injury Study. *The American journal of sports medicine*. 2013;41 (2):327-35. doi:10.1177/0363546512470634.
 21. Woods K, Bishop P, Jones E. Warm-Up and Stretching in the Prevention of Muscular Injury. *Sports Medicine*. 2007;37 (12):1089-99. doi:10.2165/00007256-200737120-00006.
 22. Askling CM, Tengvar M, Tarassova O, Thorstensson A. Acute hamstring injuries in Swedish elite sprinters and jumpers: a prospective randomised controlled clinical trial comparing two rehabilitation protocols. *British journal of sports medicine*. 2014;48 (7):532-9. doi:10.1136/bjsports-2013-093214.
 23. Bryan Dixon J. Gastrocnemius vs. soleus strain: how to differentiate and deal with calf muscle injuries. *Current reviews in musculoskeletal medicine*. 2009;2 (2):74-7. doi:10.1007/s12178-009-9045-8.
 24. Grassi A, Quaglia A, Canata GL, Zaffagnini S. An update on the grading of muscle injuries: a narrative review from clinical to comprehensive systems. *Joints*. 2016;4 (1):39-46. doi:10.11138/jts/2016.4.1.039.
 25. Cross TM, Gibbs N, Houang MT, Cameron M. Acute quadriceps muscle strains: magnetic resonance imaging features and prognosis. *The American journal of sports medicine*. 2004;32 (3):710-9. doi:10.1177/0363546503261734.
 26. Verrall GM, Slavotinek JP, Barnes PG, Fon GT. Diagnostic and prognostic value of clinical findings in 83 athletes with posterior thigh injury: comparison of clinical findings with magnetic resonance imaging documentation of hamstring muscle strain. *The American journal of sports medicine*. 2003;31 (6):969-73. doi:10.1177/03635465030310063701.
 27. Blankenbaker D, Smet A. MR imaging of muscle injuries. *Applied Radiology*. 2004;33:14-26.

- doi:10.37549/AR1235.
28. Gyftopoulos S, Rosenberg ZS, Schweitzer ME, Bordalo-Rodrigues M. Normal anatomy and strains of the deep musculotendinous junction of the proximal rectus femoris: MRI features. *AJR American journal of roentgenology*. 2008;190 (3):W182-6. doi:10.2214/ajr.07.2947.
 29. Ekstrand J, Healy JC, Waldén M, Lee JC, English B, Hägglund M. Hamstring muscle injuries in professional football: the correlation of MRI findings with return to play. *British journal of sports medicine*. 2012;46 (2):112-7. doi:10.1136/bjsports-2011-090155.
 30. Takebayashi S, Takasawa H, Banzai Y, Miki H, Sasaki R, Itoh Y et al. Sonographic findings in muscle strain injury: clinical and MR imaging correlation. *Journal of Ultrasound in Medicine*. 1995;14 (12):899-905. doi:<https://doi.org/10.7863/jum.1995.14.12.899>.
 31. Peetrons P. Ultrasound of muscles. *European radiology*. 2002;12 (1):35-43. doi:10.1007/s00330-001-1164-6.
 32. Lee JC, Healy J. Sonography of lower limb muscle injury. *AJR American journal of roentgenology*. 2004;182 (2):341-51. doi:10.2214/ajr.182.2.1820341.
 33. Chan O, Del Buono A, Best TM, Maffulli N. Acute muscle strain injuries: a proposed new classification system. *Knee Surgery, Sports Traumatology, Arthroscopy*. 2012;20 (11):2356-62. doi:10.1007/s00167-012-2118-z.
 34. Hotfiel T, Seil R, Bily W, Bloch W, Gokeler A, Krifter RM et al. Nonoperative treatment of muscle injuries - recommendations from the GOTS expert meeting. *Journal of experimental orthopaedics*. 2018;5 (1):24. doi:10.1186/s40634-018-0139-3.
 35. Ward SR, Eng CM, Smallwood LH, Lieber RL. Are current measurements of lower extremity muscle architecture accurate? *Clinical orthopaedics and related research*. 2009;467 (4):1074-82. doi:10.1007/s11999-008-0594-8.
 36. Deal DN, Tipton J, Rosencrance E, Curl WW, Smith TL. Ice reduces edema. A study of microvascular permeability in rats. *The Journal of bone and joint surgery American volume*. 2002;84 (9):1573-8.
 37. Bleakley CM, Glasgow P, Webb MJ. Cooling an acute muscle injury: can basic scientific theory translate into the clinical setting? *British journal of sports medicine*. 2012;46 (4):296-8. doi:10.1136/bjsm.2011.086116.
 38. Breger Stanton D, Lazaro R, Macdermid J. A Systematic Review of the Effectiveness of Contrast Baths. *Journal of hand therapy : official journal of the American Society of Hand Therapists*. 2008;22:57-69; quiz 70. doi:10.1016/j.jht.2008.08.001.
 39. Ziltener JL, Leal S, Fournier PE. Non-steroidal anti-inflammatory drugs for athletes: An update. *Annals of Physical and Rehabilitation Medicine*. 2010;53 (4):278-88. doi:<https://doi.org/10.1016/j.rehab.2010.03.001>.
 40. Orchard JW, Best TM, Mueller-Wohlfahrt HW, Hunter G, Hamilton BH, Webborn N et al. The early management of muscle strains in the elite athlete: best practice in a world with a limited evidence basis. *British journal of sports medicine*. 2008;42 (3):158-9. doi:10.1136/bjsm.2008.046722.
 41. Wernbom M, Augustsson J, Raastad T. Ischemic strength training: a low-load alternative to heavy resistance exercise? *Scandinavian journal of medicine & science in sports*. 2008;18 (4):401-16. doi:10.1111/j.1600-0838.2008.00788.x.
 42. LaStayo PC, Woolf JM, Lewek MD, Snyder-Mackler L, Reich T, Lindstedt SL. Eccentric muscle contractions: their contribution to injury, prevention, rehabilitation, and sport. *The Journal of orthopaedic and sports physical therapy*. 2003;33 (10):557-71. doi:10.2519/jospt.2003.33.10.557.
 43. Thorborg K. Why hamstring eccentrics are hamstring essentials. *British journal of sports medicine*. 2012;46 (7):463-5. doi:10.1136/bjsports-2011-090962.
 44. Sherry MA, Best TM. A comparison of 2 rehabilitation programs in the treatment of acute hamstring strains. *The Journal of orthopaedic and sports physical therapy*. 2004;34 (3):116-25. doi:10.2519/jospt.2004.34.3.116.
 45. Kim K, Monroe JC, Gavin TP, Roseguini BT. Local Heat Therapy to Accelerate Recovery After Exercise-Induced Muscle Damage. *Exercise and sport sciences reviews*. 2020;48 (4):163-9.

- doi:10.1249/jes.0000000000000230.
46. Doyle AT, Cheatham CC, Miller MG, Michael TJ, Baker RJ, Spitsbergen JM. Effects of Dexamethasone Iontophoresis: Acute Muscle Injury of the Biceps Brachii. *Athletic Training & Sports Health Care*. 2011;3 (6):260-70. doi:doi:10.3928/19425864-20110317-02.
 47. da Rocha FR, Haupenthal D, Zaccaron RP, Corrêa M, Tramontin NDS, Fonseca JP et al. Therapeutic effects of iontophoresis with gold nanoparticles in the repair of traumatic muscle injury. *Journal of drug targeting*. 2020;28 (3):307-19. doi:10.1080/1061186x.2019.1652617.
 48. Ogura M, Paliwal S, Mitragotri S. Low-frequency sonophoresis: current status and future prospects. *Advanced drug delivery reviews*. 2008;60 (10):1218-23. doi:10.1016/j.addr.2008.03.006.
 49. dos Santos Haupenthal DP, Zortea D, Zaccaron RP, de Bem Silveira G, Corrêa MEAB, Mendes C et al. Effects of phonophoresis with diclofenac linked gold nanoparticles in model of traumatic muscle injury. *Materials Science and Engineering: C*. 2020;110:110681. doi:<https://doi.org/10.1016/j.msec.2020.110681>.
 50. Torres R, Ribeiro F, Alberto Duarte J, Cabri JM. Evidence of the physiotherapeutic interventions used currently after exercise-induced muscle damage: systematic review and meta-analysis. *Physical therapy in sport : official journal of the Association of Chartered Physiotherapists in Sports Medicine*. 2012;13 (2):101-14. doi:10.1016/j.ptsp.2011.07.005.
 51. Thelen M, Dauber J, Stoneman P. The Clinical Efficacy of Kinesio Tape for Shoulder Pain: A Randomized, Double-Blinded, Clinical Trial. *The Journal of orthopaedic and sports physical therapy*. 2008;38:389-95. doi:10.2519/jospt.2008.2791.
 52. Alexander CM, Stynes S, Thomas A, Lewis J, Harrison PJ. Does tape facilitate or inhibit the lower fibres of trapezius? *Manual therapy*. 2003;8 (1):37-41. doi:10.1054/math.2002.0485.
 53. Zanella P, Willey S, Seibel S, Hughes C. The Effect of Scapular Taping on Shoulder Joint Repositioning. *Journal of Sport Rehabilitation*. 2001;10:113-23. doi:10.1123/jsr.10.2.113.
 54. Callaghan MJ, Selfe J, Bagley PJ, Oldham JA. The Effects of Patellar Taping on Knee Joint Proprioception. *J Athl Train*. 2002;37 (1):19-24.
 55. Morris D, Jones D, Ryan H, Ryan CG. The clinical effects of Kinesio® Tex taping: A systematic review. *Physiotherapy theory and practice*. 2013;29 (4):259-70. doi:10.3109/09593985.2012.731675.
 56. Alessandrino F, Balconi G. Complications of muscle injuries. *Journal of ultrasound*. 2013;16 (4):215-22. doi:10.1007/s40477-013-0010-4.
 57. Andia I, Maffulli N. Muscle and tendon injuries: the role of biological interventions to promote and assist healing and recovery. *Arthroscopy : the journal of arthroscopic & related surgery : official publication of the Arthroscopy Association of North America and the International Arthroscopy Association*. 2015;31 (5):999-1015. doi:10.1016/j.arthro.2014.11.024.
 58. Dimauro I, Grasso L, Fittipaldi S, Fantini C, Mercatelli N, Racca S et al. Platelet-rich plasma and skeletal muscle healing: a molecular analysis of the early phases of the regeneration process in an experimental animal model. *PloS one*. 2014;9 (7):e102993. doi:10.1371/journal.pone.0102993.
 59. Miroshnychenko O, Chang WT, Dragoo JL. The Use of Platelet-Rich and Platelet-Poor Plasma to Enhance Differentiation of Skeletal Myoblasts: Implications for the Use of Autologous Blood Products for Muscle Regeneration. *The American journal of sports medicine*. 2017;45 (4):945-53. doi:10.1177/0363546516677547.
 60. Guillodo Y, Madouas G, Simon T, Le Dauphin H, Saraux A. Platelet-rich plasma (PRP) treatment of sports-related severe acute hamstring injuries. *Muscles, ligaments and tendons journal*. 2015;5 (4):284-8. doi:10.11138/mltj/2015.5.4.284.
 61. Moraes VY, Lenza M, Tamaoki MJ, Faloppa F, Bellotti JC. Platelet-rich therapies for musculoskeletal soft tissue injuries. *The Cochrane database of systematic reviews*. 2013 (12):Cd010071. doi:10.1002/14651858.CD010071.pub2.
 62. Evans CH. Platelet-rich plasma à la carte: commentary on an article by Satoshi Terada, MD, et al.: “use of an antifibrotic agent improves the effect of platelet-rich plasma on muscle healing after injury”. *The Journal of bone and joint surgery American volume*. 2013;95 (11):e801-2.

- doi:10.2106/jbjs.m.00485.
63. Kelc R, Vogrin M. Concerns about fibrosis development after scaffolded PRP therapy of muscle injuries: commentary on an article by Sanchez et al.: "Muscle repair: platelet-rich plasma derivates as a bridge from spontaneity to intervention." *Injury*. 2015;46 (2):428. doi:10.1016/j.injury.2014.12.010.
 64. Chargé SB, Rudnicki MA. Cellular and molecular regulation of muscle regeneration. *Physiological reviews*. 2004;84 (1):209-38. doi:10.1152/physrev.00019.2003.
 65. Evans CH, Robbins PD. Genetically augmented tissue engineering of the musculoskeletal system. *Clinical orthopaedics and related research*. 1999 (367 Suppl):S410-8. doi:10.1097/00003086-199910001-00040.
 66. Hannallah D, Peng H, Young B, Usas A, Gearhart B, Huard J. Retroviral delivery of Noggin inhibits the formation of heterotopic ossification induced by BMP-4, demineralized bone matrix, and trauma in an animal model. *The Journal of bone and joint surgery American volume*. 2004;86 (1):80-91. doi:10.2106/00004623-200401000-00013.
 67. Musgrave DS, Pruchnic R, Bosch P, Ziran BH, Whalen J, Huard J. Human skeletal muscle cells in ex vivo gene therapy to deliver bone morphogenetic protein-2. *The Journal of bone and joint surgery British volume*. 2002;84 (1):120-7. doi:10.1302/0301-620x.84b1.11708.
 68. Kang R, Ghivizzani SC, Muzzoni TS, Herndon JH, Robbins PD, Evans CH. Orthopaedic Applications of Gene Therapy: From Concept to Clinic. *Clinical Orthopaedics and Related Research®*. 2000;375.
 69. Neal J, Salinas F, Choi D. Local Anesthetic-Induced Myotoxicity After Continuous Adductor Canal Block. *Regional anesthesia and pain medicine*. 2016;41. doi:10.1097/AAP.0000000000000466.
 70. Öz Gergin Ö, Yıldız K, Bayram A, Sencar L, Coşkun G, Yay A et al. Comparison of the myotoxic effects of levobupivacaine, bupivacaine, and ropivacaine: an electron microscopic study. *Ultrastructural pathology*. 2015;39 (3):169-76. doi:10.3109/01913123.2015.1014610.
 71. Beiner JM, Jokl P, Cholewicki J, Panjabi MM. The effect of anabolic steroids and corticosteroids on healing of muscle contusion injury. *The American journal of sports medicine*. 1999;27 (1):2-9. doi:10.1177/03635465990270011101.
 72. Sciorati C, Rigamonti E, Manfredi AA, Rovere-Querini P. Cell death, clearance and immunity in the skeletal muscle. *Cell death and differentiation*. 2016;23 (6):927-37. doi:10.1038/cdd.2015.171.
 73. Joyce D, Lewindon D. Sports Injury Prevention and Rehabilitation: Integrating Medicine and Science for Performance Solutions. Taylor & Francis; 2015.
 74. Meeuwisse WH, Tyreman H, Hagel B, Emery C. A dynamic model of etiology in sport injury: the recursive nature of risk and causation. *Clinical journal of sport medicine : official journal of the Canadian Academy of Sport Medicine*. 2007;17 (3):215-9. doi:10.1097/JSM.0b013e3180592a48.
 75. Lewis J. A systematic literature review of the relationship between stretching and athletic injury prevention. *Orthopedic nursing*. 2014;33 (6):312-20; quiz 21-2. doi:10.1097/nor.0000000000000097.
 76. Altavilla G, Raiola G, editors. Physiological effects of warm-up and problems related to team sports2017.
 77. Witvrouw E, Mahieu N, Danneels L, McNair P. Stretching and injury prevention: an obscure relationship. *Sports medicine (Auckland, NZ)*. 2004;34 (7):443-9. doi:10.2165/00007256-200434070-00003.
 78. Ishøi L, Krommes K, Husted RS, Juhl CB, Thorborg K. Diagnosis, prevention and treatment of common lower extremity muscle injuries in sport - grading the evidence: a statement paper commissioned by the Danish Society of Sports Physical Therapy (DSSF). *British journal of sports medicine*. 2020;54 (9):528-37. doi:10.1136/bjsports-2019-101228.
 79. Marshall SW, Loomis DP, Waller AE, Chalmers DJ, Bird YN, Quarrie KL et al. Evaluation of protective equipment for prevention of injuries in rugby union. *International journal of epidemiology*. 2005;34 (1):113-8. doi:10.1093/ije/dyh346.