

SELF-MİYOFASYAL RAHATLAMA TEKNİĞİNİN KAS HASARI ÜZERİNE ETKİSİ

Dr. Fatma Beyza BİLGİÇ



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*Bu Kitap, Doç. Dr. Armağan ŞAHİN KAFKAS'ın danışmanlığında yürütölen Fatma Beyza BİLGİÇ'e ait "Self-Miyofasyal Rahatlama Tekniğinin Kas Hasarı Üzerine Etkisi" adlı doktora tezinden türetilmiştir.

ISBN 978-625-399-526-3	Yayın Koordinatörü Yasin DİLMEN
Kitap Adı Self-Miyofasyal Rahatlama Tekniğinin Kas Hasarı Üzerine Etkisi	Sayfa ve Kapak Tasarımı Akademişyen Dizgi Ünitesi
Yazar Fatma Beyza BİLGİÇ ORCID id: 0009-0000-0971-8818	Yayıncı Sertifika No 47518
Editör Doç. Dr. Armağan ŞAHİN KAFKAS ORCID id: 0000-0002-7276-0020	Baskı ve Cilt Vadi Matbaacılık
	Bisac Code SPO000000
	DOI 10.37609/akya.2943

**Kütüphane Kimlik Kartı
Bilgiç, Fatma Beyza.**

Self-Miyofasyal Rahatlama Tekniğinin Kas Hasarı Üzerine Etkisi / Fatma Beyza Bilgiç,
edt : Armağan Şahin Kafkas.
Ankara : Akademişyen Yayınevi Kitabevi, 2023.
116 s. : şekil, tablo. ; 135x210 mm.
Kaynakça var.
ISBN 9786253995263
1. Spor.

GENEL DAĞITIM
Akademişyen Kitabevi A.Ş.

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Yenişehir / Ankara
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TEŐEKKÜR

Doktora tezimin gerekleřtirilmesi aŐamasında, araŐtırmanın tespiti, planlanması, yürütülmesi ve yazımında bilgisini, ilgisini, önerilerini, yardımlarını esirgmeden akademik hayatta olduĐu kadar insani ilişkilerde de her daim sonsuz desteklerini esirgemeyen bana yön veren tez danışmanım sayın Do. Dr. ArmaĐan ŐAHİN KAFKAS'a;

Lisansüstü eĐitimim boyunca deĐerli bilgilerinden istifade ettiĐim, bilgisi, tecrübesi ile yanımda olan, akademik duruŐu, bilime farklı bakıŐ açısıyla örnek aldıĐım ve tezimin alıŐma tasarımı, hazırlanması ile düzenlenmesi aŐamasında, Prof. Dr. Muhammed Emin KAFKAS'a;

İstatistik analiz, tablo ve grafiklerin düzenlenmesi sonuçlarının deĐerlendirilmesine katkı saĐlayan Prof.Dr.Mustafa ÖZDAL'a;

EĐitim hayatım boyunca dersini aldıĐım ve tecrübelerinden faydalandıĐım bütün hocalarıma;

Tezimin biyokimyasal analizlerinin yapılmasında desteklerini esirgemeyen İsmail KAUİK hocamıza, kan alımında bize yardımcı olan Yıldız ALPASLAN hemŐireye;

Verilerin toplanmasına gönüllü olarak destek veren, uygulamalar sırasında hiçbir menfaat beklemeden uygulamalara ve testlere katılan ok kıymetli Batman Üniversitesi Beden EĐitimi ve Spor Yüksekokulu öĐrencilerine, ayrıca ölçümlerde yardım eden fitness antrenörleri Ferhat ERBAŐ'a ve Abdullah AY'a;

Hayatımın her anında bana destek olan canım annem, babam ve ablama;

Desteğini her an yanımda hissettiğim, her zaman daha iyiye, güzele yönlendiren, yol arkadaşım, hayattaki en büyük şanslarım Hüseyin Çınar, Atlas ve Kuzey'in babası Murat BİLGİÇ'e teşekkür ederim.

Fatma Beyza BİLGİÇ

SİMGELER VE KISALTMALAR DİZİNİ

ACSM	: American College Of Sports Medicine
ALT	: alanin aminotransferaz
ANP	: atrial natriüretik peptit
AST	: aspartad aminotransferaz
ATP	: adenzin trifosfat
BATÜBESYO	: Batman Üniversitesi Beden Eğitimi ve Spor Yüksekokulu
BNP	: beyin natriüretik peptit
CK-KK	: kreatin kinaz
cm	: santimetre
CPK	: kreatin fosfokinaz
CRP	: c-reaktif protein
DOMS	: delayed onset muscle sorenes
EMS	: elektro myo stimülasyon
GAS	: görsel analog skala
GKA	: gecikmiş kas ağrısı
IL	: interlökin
Kg	: kilogram
LDH	: laktad dehidrogenaz
m	: metre
MT	: maksimum tekrar
NEH	: normal eklem hareketi

NOa	: nitrik oksit
OMNIREs	: algılanan zorluk düzeyi ölçümü
SMR	: self-miyofasyal rahatlama tekniđi
SMR-1	: self-miyofasyal rahatlama tekniđi-1 protokolü
SMR-2	: self-miyofasyal rahatlama tekniđi-1 protokolü
SMR-3	: self-miyofasyal rahatlama tekniđi-1 protokolü
ROM	: eklem hareket açıklığı
sn	: saniye
TNF-α	: tümör nekroz faktör-alfa
VAS	: visual analog scale
vb	: ve bezeri
VEGF	: Vascular endothelial growth factor
VKI	: vücut kütle indeksi
VYO	: vücut yağ oranı
YDA	: yabancı dil ağırlıklı

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1. Ocak Y, Buğdayıcı S. Futsal (Salon Futbolu). 1.Baskı, İstanbul, Bedray Basın Yayıncılık, 2012:54.
2. Akın Ş, Demirel H. İskelet kası uydu hücreleri ve kas rejenerasyonundaki yeri. *Türkiye Klinikleri J Sports Med-Special Topics* 2017, 3(3): 227-32.
3. Smith LL, Miles MP. Exercise-induced muscle injury and information. *ESSR J* 2000, (401):163-73
4. Clarkson PM, Hubal MJ. Exercise-induced muscle damage in humans. *Am J Phys Med Rehabil* 2002, 81:52-69.
5. Newham DJ, Jones DA, Edwards RH. Plasma creatine kinase changes after eccentric and concentric contractions. *Muscle nerve* 1986, 9(1):59-63.
6. Nosaka K, Clarkson PM. Influence of previous concentric exercise on eccentric exercise-induced muscle damage. *J Sport Sci* 1997, 15(5):477-83.
7. Brown S, Day S, Donnelly A. Indirect evidence of human skeletal muscle damage and collagen breakdown after eccentric muscle action. *J Sport Science* 1999, 17(5):397-402.
8. Kocağa T. Egzersize Bağlı Kas Hasarının Denge Performansına Etkisi. Sağlık Bilimleri Enstitüsü, Antrenörlük Eğitimi Anabilim Dalı, Yüksek Lisans Tezi, Bolu:Abant İzzet Baysal Üniversitesi, 2014.
9. Epstein Y. Clinical significance of serum creatine phosphokinase activity levels following exercise. *Isr J Med Sci* 1995, 31:698-9.
10. Hilbert JE, Sforzo GA, Swensen T. The effects of massage on delayed onset muscle soreness. *Br J Sports Med.* 2003, 37(1):72-4.
11. Kuipers H. Exercise induced muscle damage international, *Sport Medicine* 1994,15(3):132-5.
12. Roth SM, Martel GF, Ivey FM, Lemmer JT, Metter EJ, Hurley BF, Rogers MA. High- volume, heavy-resistance strength training and muscle damage in young and older women. *J Appl Physiol* 2000, 88(3):1112-8.
13. Korkmaz SG. Sporcularda Uzun Süreli Yorgunluğun Kas Hasarıyla İlişkisi. Sağlık Bilimleri Enstitüsü, Beden Eğitimi ve Spor Anabilim Dalı, Doktora Tezi, Adana: Çukurova Üniversitesi, 2010.
14. Murray RK, Granner DK, Mayes PA, Rodwel VW. *Harper'in Biyokimyası*, Barış Kitabevi, 1998: 24-68.

15. Hazar S. Egzersize bağlı iskelet ve kalp kası hasarı. *Sportmetre* 2004, 2(3):119-26.
16. Evans WJ, Canon JG. The metabolic effects of exercise-induced muscle damage, *ESSR J.* 1991, 19:99-125.
17. Sorichter S, Puschendorf B, Mair J. Skeletal muscle injury induced by eccentric muscle action muscle proteins as markers of muscle fiber injury. *Exerc Immunol Rev.*1999, 5:5-21.
18. Harbili S, Gencer E, Ersöz G, Demirel HA. Orta şiddetli eksantrik egzersiz diğer hasar belirteçlerini etkilemeksizin plazma keratin kinaza düzeyini artırır. *SÜ Bes Bilim Dergisi* 2008, 10(1):21-31.
19. İpek D, Özkaya Ö, Sözen H, Tekat A. Pasif germe hareketlerinin sedanterlerde oluşturulan gecikmiş kas ağrıları üzerine etkileri. *Sportmetre* 2009, 7(1):37-40.
20. Heiss R, Lutter C, Freiwald J, Hoppe MW, Grim C, Poettgen K, Forst R, Bloch W, Hüttel M, Hotfiel T. Advances in Delayed-Onset Muscle Soreness (DOMS)-Part II: Treatment and Prevention. *Sportverletzung Sportschaden* 2019, 33(01): 21-9.
21. Barnett A. Using recovery modalities between training sessions in elite athletes does it help? *Sports Med.* 2006, 36(9):781-96.
22. Nédélec M, McCall A, Carling C, Legall F, Berthoin S, Dupont G. Recovery in soccer. *Spor Med.* 2012, 42(12): 997-1015.
23. Cheung K, Hume PA, Maxwell L. Delayed onset muscle soreness: treatment strategies and performance factors. *Sports Med.* 2003, 33(2):145-64.
24. Robson-Ansley PJ, Gleeson M, Ansley L. Fatiguemanagementinthe preparation of Olympic athletes. *J Sports Sci* 2009, 27(13): 1409-20.
25. Lee YS, Bae SH, Hwang JA, Kim KY. The effects of kinesio taping on architecture, strength and pain of muscles in delayed onset muscle soreness of biceps brachii. *J Phys Sci* 2015, 27(2): 457-9.
26. Hotfiel T, Freiwald J, Hoppe MW, Lutter C, Forst R, Grim C, Bloch W, Hüttel M, Heiss R. Advances in delayed-onset muscle soreness (DOMS): Part I: Pathogenesis and diagnostics. *Sportverletzung Sportschaden* 2018, 32(04): 243-50.
27. Drinkwater EJ, Latella C, Wilmore C, Bird S, Skein M. Foam rolling as a recovery tool following eccentric exercise: Potential mechanisms underpinning changes in jump performance. *Front Physiol* 2019, 10: 768-78.
28. Schroeder AN, Best TM. Is self myofascial release an effective pre-exercise and recovery strategy? A literature review. *Cur Sports Med Rep.* 2015, 14(3): 200-8.

29. Armstrong R. Mechanisms of exercise-induced delayed onset muscular soreness: a brief review. *Med. Sci. Sports Exerc.* 1984, 16(6): 529-38.
30. MacIntyre DL, Sorichter S, Mair J, Berg A, McKenzie DC. Markers of inflammation and myofibrillar proteins following eccentric exercise in humans. *Eur J Appl Physiol.* 2001, 84(3): 180-6.
31. Ernst E. Does post-exercise massage treatment reduce delayed onset muscle soreness? A systematic review. *Br J Sports Med* 1998, 32(3): 212-4.
32. Cheatham SW, Kolber MJ, Cain M, Lee M. The effects of self-myofascial release using a foam roll or roller massager on joint range of motion, muscle recovery, and performance: a systematic review. *International Journal of Sports Physical Therapy* 2015, 10: 827-38
33. Laffaye G, Da Silva DT, Delafontaine A. Self-myofascial release effect with foam rolling on recovery after high-intensity interval training. *Front Physiol* , 2019, 10:1287-92.
34. Medeiros FVA, Bottaro M, Martins WR, Ribeiro DLF, Marinho EBA, Viana RB, Ferreira-Junior JB, Carmo JC. The effects of one session of roller massage on recovery from exercise-induced muscle damage: A randomized controlled trial. *J Exerc Sci Fit* 2020, 18(3): 148-54.
35. Junker DH, Stöggl TL. The foam roll as a tool to improve hamstring flexibility. *J Strength Cond Res.*, 2015, 29(12):3480-5.
36. Junker DH, Stöggl TL. The training effects of foam rolling on core strength endurance, balance, muscle performance and range of motion: A randomized controlled trial. *J Sports Sci Med.*, 2019, 18(2): 229-38.
37. Lim JH, Park CB. The immediate effects of foam roller with vibration on hamstring flexibility and jump performance in healthy adults. *J Exerc Rehabil.* 2019, 15(1):50-4
38. Çolak M, Çetin E. Bayanlara uygulanan farklı ısınma protokollerinin eklem hareket genişliği ve esneklik üzerine etkileri. *Fırat üniversitesi sağlık bilimleri tıp dergisi* 2010, 24(1):1-8.
39. Hough T. Ergographic studies in muscular fatigue and soreness. *J Boston Soc Med Sci* 1900, 5:81-92.
40. Proske U, Morgan DL. Muscle Damage from Eccentric Exercise: Mechanism, Mechanical Signs, Adaptation and Clinical Applications. *J Physiol* 2001, 537(2): 333-45.
41. McHugh MP, Connolly DA, Eston RG, Kremenec IJ, Gleim GW. neural factors associated with exercise-induced muscle damage. *Med. Sci. Sports Exerc.* 1998, 30(5):157-70

42. Tiidus PM. *Skeletal Muscle Damage and Repair*. Human Kinetics, 2008: 41-2
43. Parolin ML, Spriet LL, Hultman E, Matsos MP, Hollidge-Horvat MG, Jones NL, Heigenhauser GJ. Effects of PDH activation by dichloroacetate in human skeletal muscle during exercise in hypoxia. *Am J Physiol Endocrinol Metab.*, 2010, 279(4): 752-61.
44. Tesch PA. Aspects on muscle properties and use in competitive alpine skiing. *Med Sci Sports Exerc.*, 1995, 27(3): 310-14.
45. Morgan DL. new insights into the behavior of muscle during active-lengthening. *Biophysic J*, 1990, 57:209-21.
46. Talbot JA, Morgan DL. The effects of stretch parameters on eccentric exercise-induced damage to toad skeletal muscle. *J Muscle Res Cell Motil.* 1998, 19:237-45.
47. Friden J, Lieber RL. Eccentric exercise-induced injuries to contractile and cytoskeletal muscle fibre components. *Acta Physiol Scand*, 2001, 171: 321-6.
48. Raastad T, Owe SG, Paulsen G, Enns D, Overgaard K, Crameri R, Kiil S, Belcastro A, Bergersen L, Hallen J. Changes in calpain activity, muscle structure, and function after eccentric exercise. *Med Sci Sports Exerc.*, 2010, 42: 86-95.
49. Rattray B, Caillaud C, Ruell PA, Thompson MW. Heat exposure does not alter eccentric exercise-induced increases in mitochondrial calcium and respiratory dysfunction. *Eur J Appl Physiol.* 2011, 111:2813-21.
50. Rattray B, Thompson M, Ruell P, Caillaud C. Specific training improves skeletal muscle mitochondrial calcium homeostasis after eccentric exercise. *Eur J Appl Physiol*, 2013, 113:427-36.
51. Tee JC, Bosch AN, Lambert MI. Metabolic consequences of exercise-induced muscle damage. *Sports Med*, 2007, 37:27-36.
52. Nosaka K, Clarkson PM, Apple FS. Time course of serum protein changes after strenuous exercise of the forearm flexors. *J Lab Clin Med*, 1992, 119(2): 183-8.
53. Rawson ES, Gunn B, Clarkson PM. The effects of creatine supplementation on exercise induced muscle damage. *J Strength Cond Res*, 2001, 15(2): 178-84.
54. Eston R, Byrne C, Twist C. Muscle function after exercise-induced muscle damage: considerations for athletic performance in children and adults. *J Exerc Sci Fit*, 2003, 1(2): 85-96.
55. Lavender AP, Nosaka K. Comparison between old and young men for changes in markers of muscle damage following voluntary ec-

- centric exercise of the elbowflexors. *ApplPhysiol Nutr Metab*, 2006, 31:218-25.
56. Hazar S, Erol E, Gökdemir K. Kuvvet antrenmanı sonrası oluşan kas ağrısının kas hasarıyla ilişkisi. *Gazi Beden Eğitimi ve Spor Bilimleri Dergisi*, 2006, 11(3): 49-58.
 57. Karlı U. Impact of exercise induced muscle damage on target shooting performance. *LifeSci J*, 2013, 10(1):3386-92.
 58. Yanagisawa O, Sakuma J, Kawakami Y, Suzuki K, Fukubayashi T. Effect of exercise-induced muscle damage on muscle hardness evaluated by ultrasoundreal-time tissue elastography. *SpringerPlus*, 2015, 4: 308-17.
 59. Obh T, Ebata S, Haro H. Comparision of serum markers for muscle damage, surgical bloodloss, postoperative recovery, and surgical site pain after extreme lateral interbody fusionwith percutaneous pedicle screws or traditional open posterior lumbar interbody fusion. *BMC Musculoskeletal Disorders*, 2017, 18 (415): 1-7.
 60. Lippi G, Schena F, Salvagno GL, Montagnana M, Gelati M, Tarperi C, Banfi G, Guidi GC. Acute variation of biochemical markers of muscle damage following a 21-km, half- marathon run. *Scand J Clin Lab Invest*, 2008, 68(7): 667-72.
 61. Nie J, Tong TK, George K, Fu FH, Lin H, Shi Q. Resting and post-exercise serum biomarkers of cardiac and skeletal muscle damage in adolescent runners.*Scand. J Med SciSports*, 2011, 21: 625-9.
 62. Kanda K, Sugama K, Sakuma J, Kawakami Y, Suzuki K. Evaluation of serum leakingenzymes and investigation into new biomarkers for exercise-induced muscle damage. *ExercImmuno Review*, 2014, 20: 39-54
 63. Brown D, Chevalier G, Hill M. Pilot study on the effect of grounding on delayed-onset muscle soreness. *J Altern Complement Med*. 2010, 16(3): 265-73.
 64. Guilhem G, Cornu C, Guével A. Neuromuscular and muscle-tendon system adaptations to isotonic and isokinetic eccentric exercise. *Ann Phys Rehabil Med*. 2010, 53(5): 319-41.
 65. Isner-Horobeti ME, Dufour SP, Vautravers P, Geny B, Coudeyre E, Richard R. Eccentric exercise training: modalities, applications and perspectives. *Sports Medicine*, 2013, 43(6): 483-512.
 66. Lieber RL, Fridén J. Morphologic and mechanical basis of delayed-onset muscle soreness. *J Am Acad Orthop Surg* 2002, 10(1): 67-73.
 67. McHugh MP, Tetro DT. Changes in the relationship between joint angle and torque production associated with the repeated bout effect. *J Sports Sci* 2003, 21(11): 927-32.

68. Gruber M, Linnamo V, Strojnik V, Rantalainen T, Avela J. Excitability at the motoneuron pool and motor cortex is specifically modulated in lengthening compared to isometric contractions. *J Neurophysiol* 2009, 101(4): 2030-40.
69. Proske U, Allen TJ. Damage to skeletal muscle from eccentric exercise. *Exerc Sport Sci* 2005, 33(2): 98-104.
70. Newton MJ, Morgan GT, Sacco P, Chapman DW, Nosaka K. Comparison of responses to strenuous eccentric exercise of the elbow flexors between resistance-trained and untrained men. *J Strength Cond Res.* 2008, 22(2): 597-607.
71. Connolly DA, Sayers SP, McHugh MP. Treatment and prevention of delayed onset muscle soreness. *J Strength Cond Res.* 2003, 17(1): 197-208.
72. Nosaka K, Newton M. Concentric or eccentric training effect on eccentric exercise-induced muscle damage. *Med. Sci. Sports Exerc.* 2002, 34(1): 63-9.
73. Hody S, Croisier JL, Bury T, Rogister B, Leprince P. Eccentric muscle contractions: risks and benefits. *Front Physiol* 2019, 10:536-43
74. Sonkodi B, Berkes I, Koltai E. Have we looked in the wrong direction for more than 100 years? delayed onset muscle soreness is, in fact, neural microdamage rather than muscle damage. *Antioxidants*, 2020, 9(3): 212-21.
75. Gulick DT, Kimura IF, Sitler M, Paolone A, Kelly JD. Various treatment techniques on signs and symptoms of delayed onset muscle soreness. *J Athl Train* 1996, 31(2): 145-57.
76. Murase S, Terazawa E, Queme F, Ota H, Matsuda T, Hirate K, Kozaki Y, Katanosaka K, Taguchi T, Urai H. Bradykinin and nerve growth factor play pivotal roles in muscular mechanical hyperalgesia after exercise (delayed-onset muscle soreness). *J Neurosci* 2010, 30(10): 3752-61.
77. Cazorla G, Petibois C, Bosquet L, Léger L. Lactate et exercice: mythes et realites. *Grenoble*, 2001, 22(54): 63-76.
78. De Vries HA. Electromyographic observations of the effects of static stretching upon muscular distress. *Research Quarterly* 1961, 32(4): 468-79.
79. Cleak M, Eston R. Delayed onset muscle soreness: mechanisms and management. *J Sports Sci* 1992, 10(4): 325-41.
80. Newham D, Jones D, Edwards R. Large delayed plasma creatine kinase changes after stepping exercise. *Muscle Nerve* 1983, 6(5): 380-5.
81. Abraham WM. Factors in delayed muscle soreness. *Med Sci Sports* 1997, 9(1): 11-20.

82. Tomasek JJ, Gabbiani G, Hinz B, Chaponnier C, Brown RA. Myofibroblasts and mechano-regulation of connective tissue remodeling. *Nat Rev Mol Cell Biol* 2002, 3(5): 349-63.
83. Vickers AJ. Time course of muscle soreness following different types of exercise. *BMC Musculoskelet Disord* 2001, 2(1): 5-12.
84. Francis K, Hoobler T. Effects of aspirin on delayed muscle soreness. *J Sports Med Phys Fitness* 1987, 27(3): 333-7
85. Hasson SM, Daniels JC, Divine JG, Niebuhr BR, Richmond S, Stein PG, Williams JH. Effect of ibuprofen use on muscle soreness, damage, and performance: a preliminary investigation. *Med. Sci. Sports Exerc.* 1993, 25(1): 9-17.
86. Smith LL. Acute inflammation: the underlying mechanism in delayed onset muscle soreness? *Med. Sci. Sports Exerc.* 1991, 23(5): 542-51.
87. Friden J, Sfikianos P, Hargens A. Muscle soreness and intramuscular fluid pressure: comparison between eccentric and concentric load. *J Appl Physiol* 1986, 61(6): 2175-9.
88. Lightfoot JT, Char D, McDermott J, Goya C. Immediate postexercise massage does not attenuate delayed onset muscle soreness. *J Strength Cond Res.* 1997, 11(2): 119-24.
89. Armstrong R. Initial events in exercise-induced muscular injury. *Med. Sci. Sports Exerc.* 1990, 22(4): 429-38.
90. Colón A, Guo X, Akanda N, Cai Y, Hickman J. Functional analysis of human intrafusal fiber innervation by human γ -motoneurons. *Sci Rep* 2017, 7(1): 1-11.
91. Enoka RM. Eccentric contractions require unique activation strategies by the nervous system. *J Appl Physiol* 1996, 81(6): 2339-46.
92. Brentano, M., and Martins Krueel, L. A review on strength exercise-induced muscle damage: applications, adaptation mechanisms and limitations. *J Sports Med Phys Fitness* 2011, 51(1): 1-10.
93. Douglas J, Pearson S, Ross A, McGuigan M. Eccentric exercise: physiological characteristics and acute responses. *Sports Med.* 2017, 47(4): 663-75.
94. Paulsen G, Ramer Mikkelsen U, Raastad T, Peake JM. Leucocytes, cytokines and satellite cells: what role do they play in muscle damage and regeneration following eccentric exercise? *Exerc Immunol Rev.* 2012, 18: 42-97
95. Hirose L, Nosaka K, Newton M, Laveder A, Kano M, Peake J, Suzuki K. Changes in inflammatory mediators following eccentric exercise of the elbow flexors. *Exerc Immunol Rev.* 2004, 10: 75-90.

96. Howatson G, McHugh MP, Hill J, Brouner J, Jewell A, Van Someren KA, Shave R, Howatson S. Influence of tart cherry juice on indices of recovery following marathon running. *Med Sci Sports* 2010, 20(6): 843-52.
97. Cleary MA, Kimura IF, Sitler MR, Kendrick ZV. Temporal pattern of the repeated bout effect of eccentric exercise on delayed-onset muscle soreness. *J Athl Train*. 2002, 37(1): 32-41
98. Nosaka K, Clarkson PM. Muscle damage following repeated bouts of high force eccentric exercise. *Med. Sci. Sports Exerc*. 1995, 27(9): 1263-9.
99. Friden J, Sjöström M, Ekblom B. Myofibrillar damage following intense eccentric exercise in man. *Int J Sports Med*. 1983, 4(3): 170-6.
100. Erdoğan M. Farklı Isı Koşullarında Uygulanan Maksimal Aerobik Yüklemenin Kas Hasarı ve Performans Üzerine Etkileri. Sağlık Bilimleri Enstitüsü, Beden Eğitimi ve Spor Anabilim Dalı, Doktora Tezi, Ankara:Gazi Üniversitesi, 2009.
101. Burtis CA, Ashwood ER. *Tietz Textbook of Clinical Chemistry*. Philadelphia, ABD, 1999: 42.
102. Black HR, Quallich H, Gareleck CB. Racial differences in serum creatine kinase levels. *Am J Med*. 1986, 81(3): 479-87.
103. Moat SJ, Korpimäki T, Furu P, Hakala H, Polari H, Meriö L, Mäkinen P, Weeks I. Characterization of a blood spot creatine kinase skeletal muscle isoform immunoassay for high-throughput newborn screening of Duchenne muscular dystrophy. *Clin Chem* 2017, 63(4): 908-14.
104. Kılıç T. Basketbol Turnuvasının Kas Hasarı ve Toparlanma Süresine Etkileri. Sağlık Bilimleri Enstitüsü, Beden Eğitimi ve Spor Anabilim Dalı, Doktora Tezi, Ankara:Gazi Üniversitesi, 2010
105. Vural S, Çetin ET, Tuzlacı U, Dağ T. *Klinik Teşhiste Laboratuvar(1. baskı)*. İstanbul, 1986, 15.
106. Bernard JH. *Clinical Diagnosis and Management by Laboratory Methods*. 20th Ed., Philadelphia: W. B. Saunders Company, 2001.
107. Rumley A, Pettigrew A, Colgan M, Taylor R, Grant S, Manzie A, Findlay I, Dargie H, Elliott A. Serum lactate dehydrogenase and creatine kinase during marathon training. *Br J Sports Med* 1985, 19(3): 152-5.
108. O'Connor R, Hurley DA. The effectiveness of physiotherapeutic interventions in the management of delayed onset muscle soreness: a systematic review. *Phys Ther* 2003, 8(4): 177-95.
109. Craig JA, Barron J, Walsh DM, Baxter GD. Lack of effect of combined low intensity laser therapy/phototherapy (CLILT) on delayed

- onset muscle soreness in humans. *Lasers Surg Med* 1999, 24(3): 223-30.
- 1 1 0. Edwards R, Hill D, Jones D, Merton P. Fatigue of long duration in human skeletal muscle after exercise. *J Physiol* 1977, 272(3): 769-78.
- 1 1 1. Eston RG, Finney S, Baker S, Baltzopoulos V. Muscle tenderness and peak torque changes after downhill running following a prior bout of isokinetic eccentric exercise. *J Sports Sci* 1996, 14(4): 291-9.
- 1 1 2. Mizrahi J, Verbitsky O, Isakov E. .Fatigue-induced changes in decline running. *Clin Biomech* 2001, 16(3): 207-12.
- 1 1 3. Warren GL, Lowe DA, Armstrong RB. Measurement tools used in the study of eccentric contraction-induced injury. *Sports Med.* 1999, 27(1): 43-59.
- 1 1 4. Fridén J. Changes in human skeletal muscle induced by long-term eccentric exercise. *Cell Tissue Res.* 1984, 236(2): 365-72.
- 1 1 5. Lott JA, Stang JM. Serum enzymes and isoenzymes in the diagnosis and differential diagnosis of myocardial ischemia and necrosis. *Clin Chem* 1980, 26(9): 1241-50.
- 1 1 6. Kurt G. Sağlıklı Gönüllülerde Gecikmiş Kas Ağrısında Farklı Fizyoterapi Yöntemlerinin Etkisi. Lisansüstü Eğitim Enstitüsü, Fizyoterapi ve Rehabilitasyon Anabilim Dalı, Doktora Tezi, Kütahya: Kütahya Sağlık Bilimleri Üniversitesi, 2020
- 1 1 7. Vaidya V, Gangwal A, Dabadghav R, Shyam A, Sancheti P. Comparison between neurodynamic therapy and foam rolling in cool-down sessions for delayed onset muscle soreness in healthy individuals. *J Bodyw Mov Ther* 2021, 26: 492-00.
- 1 1 8. Robson-Ansley PJ, Gleeson M, Ansley L. Fatigue management in the preparation of Olympic athletes. *J Sports Sci.* 2009, 27:1409-20
- 1 1 9. Dupont G, Moalla W, Matran R, Berthoin S. Effect of short recovery intensities on the performance during two wingate tests. *Med Sci Sports Exerc* 2007, 39(7): 1170-6.
- 1 2 0. Bogdanis GC, Nevill ME, Lakomy HK, Graham CM, Louis G. Effects of active recovery on power output during repeated maximal sprint cycling. *Eur J Appl Physiol* 1996, 74(5): 461-9.
- 1 2 1. Toubekis AG, Smilios I, Bogdanis GC, Mavridis G, Tokmakidis SP. Effect of different intensities of active recovery on sprint swimming performance. *Appl Physiol Nutr Metab* 2006, 31(6): 709-16.
- 1 2 2. Baldari C, Videira M, Madeira F, Sergio J, Guidetti L. Blood lactate removal during recovery at various intensities below the individual anaerobic threshold in triathletes. *J Sports Med Phys Fitness* 2005, 45(4): 460-72.

- 1 2 3 . Casanova N, Reis JF, Vaz JR, Machado R, Mendes B, Button DC, Freitas SR. Effects of roller massager on muscle recovery after exercise-induced muscle damage. *J Sports Sci* , 2018, 36(1): 56-63.
- 1 2 4 . Pearcey GE, Bradbury-Squires DJ, Kawamoto JE, Drinkwater EJ, Behm DG, Button DC. Foam rolling for delayed-onset muscle soreness and recovery of dynamic performance measures. *J Athl Train*. 2015, 50(1):5-13.
- 1 2 5 . MacDonald GZ, Penney MD, Mullaley ME, Cuconato AL, Drake CD, Behm DG, Button DC. An acute bout of self-myofascial release increases range of motion without a subsequent decrease in muscle activation or force. *J Strength Cond Res* 2013, 27(3): 812-21.
- 1 2 6 . Schleip R, Baker A. (Eds.) *Fascia in Sport and Movement*. Handspring Publishing, 2015.
- 1 2 7 . Bordoni B, Zanier E. Clinical and symptomatological reflections: the fascial system. *J Multidiscip Healthc* 2014, 7: 401-11.
- 1 2 8 . Cohen JH, Gibbons RW, Raymond L, Nimmo and the evolution of trigger point therapy. *J manipulative physiol ther* . 1998, 21(3): 167-72.
- 1 2 9 . Dommerholt J, Bron C, Franssen J. Myofascial trigger points: an evidence-informed review. *J Manual Manipulativ* 2006, 14(4): 203-21.
- 1 3 0 . Wilke J, Krause F, Vogt L, Banzer W. What is evidence-based about myofascial chains: a systematic review. *Arch Phys Med Rehabil* 2016, 97(3), 454-61.
- 1 3 1 . Boehme R, Boehme J. *Myofascial Release and Its Application to Neuro- Developmental Treatment*. Paperback, 1991, 5-8.
- 1 3 2 . Beardsley C, Škarabot J. Effects of self-myofascial release: a systematic review. *J Bodyw Mov Ther* 2015, 19(4): 747-58.
- 1 3 3 . McKenney K, Elder AS, Elder C, Hutchins A. Myofascial release as a treatment for orthopaedic conditions: a systematic review. *J Athl Train*. 2013, 48(4): 522-7.
- 1 3 4 . Swann E, Graner SJ. Uses of manual-therapy techniques in pain management. *IJATT* 2002, 7(4): 14-7.
- 1 3 5 . Barnes MF. The basic science of myofascial release: morphologic change in connective tissue; *J Bodyw Mov Ther* 1997, 1(4): 231-8
- 1 3 6 . Curran PF, Fiore rd crisco jj a comparison of the pressure exerted on soft tissue by 2 myofascial rollers. *J sport rehabil*. 2008;17: 432-42.
- 1 3 7 . AjiMsha MS, Al-Mudahka NR, Al-Madzhar JA. Effectiveness of myofascial release: systematic review of randomized controlled trials. *J Bodyw Mov Ther* 2015, 19(1): 102-12.

138. Paolini J. Review of myofascial release as an effective massage therapy technique. *J Ath Ther Today* 2009, 15: 30-4.
139. Behara B, Jacobson BH. Acute effects of deep tissue foam rolling and dynamic stretching on muscular strength, power, and flexibility in division I linemen. *J Strength Cond Res.* 2017, 31(4): 888-92.
140. Bailey U. Effect of Vibration Foam Rolling and Non-Vibration Foam Rolling in the Lower Extremities on Jump Height. EWU Masters Thesis Collection, Eastern Washington University, Cheney Washington, 259, 2014
141. Morey KJ, Cheatham SW, Cain M. Comparison of video-guided, live instructed, and self-guided foam roll interventions on knee joint range of motion and pressure pain threshold: A randomized controlled trial. *Int J Sports Phys Ther* 2017,12(2): 242-53.
142. Couture G, Karlik D, Glass SC, Hatzel BM. The effect of foam rolling duration on hamstring range of motion. *Open Orthop* 2015, 2(9): 450-5.
143. Sherer E. Effects of Utilizing a Myofascial Foam Roll on Hamstring Flexibility. Masters Theses, Kinesiology and Sports Studies, Eastern Illinois University, 2013.
144. Hotfiel T, Swoboda B, Krinner S, Grim C, Engelhardt M, Uder M, Heiss RU. Acute effects of lateral thigh foam rolling on arterial tissue perfusion determined by spectral doppler and power doppler ultrasound. *J Strength Cond Res.* 2017, 31(4): 893-900.
145. Baumgart C, Freiwald J, Kühnemann M, Hotfiel T, Hüttel M, Hoppe W M. Foam rolling of the calf and anterior thigh: biomechanical loads and acute effects on vertical jump height and muscle stiffness. *Sports (Basel).* 2019, 7(1): 27-34.
146. Saç A, Aktaş M, Çolak H. Foam roller uygulamasının kadın basketbolcularda eklem hareket genişliği, esneklik ve alt ekstremitte patlayıcı güç üzerine etkileri. *J Sports Perf* 2018, 9(1): 35-43.
147. Else J. The Effectiveness of Foam Rolling Treatment Versus Chiropractic Manipulative Therapy in The Management of Iliotibial Band Friction Syndrome in Runners and Cyclists. Faculty of Health Sciences Masters, University of Johannesburg, 2016.
148. Monteiro ER, Da Silva Novaes J, Cavanaugh MT, Hoogenboom BJ, Steele J, Vingren JL, Škarabot J. Quadriceps foam rolling and rolling massage increases hip flexion and extension passive range-of-motion. *J Bodyw Mov Thers* 2019, (23): 575-80.
149. Cheatham SW, Stull KR. Roller massage: Comparison of three different surface type pattern foam rollers on passive knee range of motion and pain perception. *J Bodyw Mov Thers* 2019, 23(3): 555-60.

150. Monteiro ER, Corrêa Neto VG. Effect of different foam rolling volumes on knee extension fatigue. *Int J Sports Phys Ther* 2016, 11(7):1076-81.
151. De Benito AM, Valldecabres R, Ceca D, Richards J, Barrachina Igual J, Pablos A. Effect of vibration vs non-vibration foam rolling techniques on flexibility, dynamic balance and perceived joint stability after fatigue. *PeerJ.*, 2019, 7(26): 771-7.
152. Mohr AR, Long BC, Goad CL. Effect of foam rolling and static stretching on passive hipflexion range of motion. *J Sport Rehabil.*, 2014, 23(4): 296-9.
153. Brzycki M. *Assessing strength you can judge 1-RM by formula without trying risky maximum lifts.* Fitness Management 2000, 34-7.
154. Woolcott OO, Bergman RN. Relative fat mass (RFM) as a new estimator of whole-body fat percentage— A cross-sectional study in American adult individuals. *Sci Rep* 2018, 8(1): 1-11.
155. Dixon CB, Andreacci JL, Ledezma C. Effect of aerobic exercise on percent body fat using leg-to-leg and segmental bioelectrical impedance analysis in adults. *Int J Body Compos Res* 2008, 6(1): 27-34
156. Robertson E, Grace S, Wallington T, Stewart DE. Antenatal risk factors for postpartum depression: a synthesis of recent literature. *Gen Hosp Psychiatry* 2004, 26(4): 289-95.
157. Gallagher EJ, Liebman M, Bijur PE. Prospective validation of clinically important changes in pain severity measured on a visual analog scale. *Ann Emerg Med*, 2001, 38: 633-8.
158. Turna B. Futbolcularda Rutin Olarak Yapılan Kombine Performans Analizine Bağlı Maç Performans Düzeyleri Arasındaki İlişkinin Araştırılması. Sağlık Bilimleri Enstitüsü, Spor Bilimleri Anabilim Dalı, Doktora Tezi, Isparta: Süleyman Demirel Üniversitesi, 2013.
159. Kiook Baek, Jong-Tae Park, Junghee Hong, Kyeongmin Kwak. Hand grip strength for the working-age population in South Korea: Development of an estimation and evaluation model, *Int J Ind Ergonomic* 2003, 94:1-8.
160. Atan T. Farklı ısınma protokollerinin eklem hareket genişliği, sıçrama ve sprint performansına etkisi. *OPUS* 2019, 13(19): 621-35.
161. Maulder P, Cronin J. Horizontal and vertical jump assessment: reliability, symmetry, discriminative and predictive ability. *J Phys Therapy Sport*, 6(2): 74-82.
162. Güder F, Canbolat B, Günay M. 12-14 yaş taekwondocularında vücut kompozisyonu kuvvet ve esneklik ilişkisinin incelenmesi. *Akdeniz Spor Bilimleri Dergisi*, 2022, 5(1): 166-75.

163. Kahraman MZ, Balıca D, Çelik M. Acute effects of different warm-up protocols on speed, vertical jump, balance and leg strength in young male futsal players. *J ROL Sports Sci* 2023, 4(1): 229-46
164. Soslu R, Özkan A, Göktepe M. The relationship between anaerobic performances, muscle strength, hamstring/quadriceps ratio, agility, sprint ability and vertical jump in professional basketball players. *Niğde University Journal of Physical Education And Sport Sciences*, 2016, 10(2): 164-73.
165. Semenick D. The T-Test. *National Strength & Conditioning Association Journal*, 1990, 12(1): 36-7.
166. Haake SJ. The impact of technology on sporting performance in Olympic sports. *J Sports Sci*. 2009, 27(13): 1421-31.
167. Tjønndal A. Sport innovation: developing a typology. *Eur J Sport Soc*. 2017, 14(4): 291-310.
168. Bond MM, Lloyd R, Braun RA, Eldridge JA. Measurement of strength gains using a fascial system exercise program. *Int. J. Exerc. Sci*. 2019, 12: 825-38
169. Healey KC, Hatfield DL, Blanpied P, Dorfman LR, Riebe D. The effects of myofascial release with foam rolling on performance *J. Strength Condit Res.*, 2014, 28: 61-8.
170. Sullivan KM, Silvey DBJ, Button DC, Behm DG. Roller-massage application to the hamstrings increases sit-and-reach range of motion within five to ten seconds without performance impairments *Int. J. Sports Phys. Ther.*, 2013, 8: 228-36.
171. Jeffreys I. A multidimensional approach to enhancing recovery. *Strength Condit. J.*, 2005, 27(5): 78-85
172. Bishop PA, Jones E, Woods AK. Recovery from training: a brief review. *J. strength Cond. Res*. 2008, 22(3): 1015-24
173. Cantu RI, Grodin AJ. *Myofascial Manipulation Theory and Clinical Application*. Gaithersburg, MD: Aspen Publishers, Inc, 2001.
174. Hammer WI. *Functional Soft Tissue Examination and Treatment by Manual Methods, The Extremities*. Gaithersburg, ML: Aspen Publishers Inc, 1991.
175. Poppendieck W, Wegmann M, Ferrauti A, Kellmann M, Pfeiffer M, Meyer T. Massage and performance recovery: a meta-analytical review *Sports Med.*, 2016, 46(2): 183-204
176. Peake JM, Neubauer O, Della Gatta PA, Nosaka K. Muscle damage and inflammation during recovery from exercise. *J. Appl. Physiol.* 2017, 122(3):559-70

177. Boyle M. *Foam rolling*. In: *Training and Conditioning Magazine*, Frankel E., ed. Ithaca, NY: Momentum Media Sports Publishing, 2006.
178. Castiglione A, ed. *Self Myofascial Release Therapy and Athletes*. AIOSMR Therapy, 2010.
179. Clark M, Russell A. *Self-myofascial Release Techniques*. Available at: www.PerformBetter.com. Accessed 2009.
180. Logan L. *Roll away injuries: the benefits of using a foam roller*. Competitor. 2023.
181. Devlin J, Paton B, Poole L, Güneş W, Ferguson C, Wilson J, Kemi OJ. Blood lactate clearance after maximal exercise depends on active recovery intensity. *J Sports Med Phys Fitness* 2014, 54(3): 271–8.
182. Dupuy O, Douzi W, Theurot D, Bosquet L, Dugué B. An evidence-based approach for choosing post-exercise recovery techniques to reduce markers of muscle damage, soreness, fatigue, and inflammation: a systematic review with meta-analysis. *Front Physiol*, 2018, 9: 403-12.
183. BradburySquires DJ, Nofall JC, Sullivan KM, Behm DG, Power KE, Button DC. Roller-massage to the quadriceps and knee-joint range a motion and neuromuscular efficiency during a lunge. *J Athl. Train.*, 2015, 50: 133-40.
184. Grieve R, Goodwin F, Alfaki M, Bourton A, Jeffries C, Scott H. The immediate effect of bilateral self myofascial release on the plantar surface of the feet on hamstring and lumbar spine flexibility: A pilot randomised controlled trial. *J Bodyw Mov Ther*. 2014, 19(3): 544-52.
185. Scudamore EM, Sayer BL, Church JB, Bryant LG, Přibyslavská V. Effects of foam rolling for delayed onset muscle soreness on loaded military task performance and perceived recovery. *J Exerc Sci Fit* 2021, 19(3): 166–70.
186. Brancaccio P, Lippi G, Maffulli N. Biochemical markers of muscular damage. *Clin ChemLab Med*. 2010, 48(6): 757-67.
187. Guo J, Li L, Gong Y, Zhu R, Xu J, Zou J, Chen X. Massage alleviates delayed onset muscle soreness after strenuous exercise: a systematic review and meta-analysis. *Front Physiol* 2017, 8: 747-61.
188. Sorichter S, Koller A, Haid C, Wicke K, Judmaier W, Werner P, Raas E. Light concentric exercise and heavy eccentric muscle loading: effects on CK, MRI and markers of inflammation. *Int J Sports Med*. 1995, 16(5): 288-92.
189. Beimborn B. The Effects Of Foam Rolling On Exercise-Induced Muscle Damage. Long Beach, Master Thesis, California State University, 2019.

190. Hucheng O. Effect of Rolling Vibration Foam for Delayed Onset Muscle Soreness and Athletic Performance. Degree Thesis of the Department of Sports and Athletics, Master Thesis, Tainan: Changrong University). 2017.
191. Adamczyk JG, Gryko K, Boguszewski D. Does the type of foam roller influence the recovery rate, thermal response and DOMS prevention? *Plos One*, 2020, 15(6): 26-38.
192. Kurt C, Kafkas M. Foam roller'la uygulanan myofasyal gevşetme egzersizlerinin toparlanma amaçlı kullanımı. *İnönü Üniversitesi Beden Eğitimi ve Spor Bilimleri Dergisi*, 2018, 5(2):25-38
193. Ra SG, Miyazaki T, Ishikura K, Nagayama H, Komine S, Nakata Y, Maeda S, Matsuzaki Y, Ohmori H. Combined effect of branched-chain amino acids and taurine supplementation on delayed onset muscle soreness and muscle damage in high-intensity eccentric exercise. *J Int Soc Sports Nutr* 2013, 10(1): 51-62.
194. Yarizadh H, Shab-Bidar S, Zamani B, Vanani AN, Baharloo H, Djafarian K. The effect of l-carnitine supplementation on exercise-induced muscle damage: a systematic review and meta-analysis of randomized clinical trials. *J Am Coll Nutr* 2020, 39(5), 457-68.
195. Medbo JJ, Mamen A, Holt Olsen O, Evertsen F. Examination of four different instruments for measuring blood lactate concentration. *Scand J Clin Lab Invest* 2000, 60(5): 367-80.
196. Tokinoya K, Ishikura K, Ra SG, Ebina K, Miyakawa S, Ohmori H. Relationship between early-onset muscle soreness and indirect muscle damage markers and their dynamics after a full marathon. *J Exerc Sci Fit* 2020: 18(3): 115-21.
197. Jay K, Sundstrup E, Sondergaard SD, Behm D, Brandt M, Særvoll CA, Jakobsen MD, Lars LA. Specific and cross over effects of massage for muscle soreness: randomized controlled trial. *Int J Sports Phys Ther*. 2014, 9(1): 82-91.
198. Peacock CA, Krein DD, Antonio J, Sanders GJ, Silver TA, Colas M. Comparing acute bouts of sagittal plane progression foam rolling vs. frontal plane progression foam rolling. *J Strength Cond Res* 2015, 29: 2310-5.
199. Halperin I, Aboodarda SJ, Button DC, Andersen LL, Behm DG. Roller massage improves range of motion of plantar flexor muscles without subsequent decreases in force parameters. *Int. J. Sports Phys. Ther*. 2014, 9: 92-102
200. Byrne C, Twist C, Eston R. Neuromuscular function after exercise-induced muscle damage: theoretical and applied implications. *Sports Med*. 2004, 34(1): 49-69.

201. Sassi RH, Dardouri W, Yahmed MH, Gmada N, Mahfoudhi ME, Gharbi Z. Relative and absolute reliability of a modified agility T-test and its relationship with vertical jump and straight sprint. *J Strength Cond Res.* 2009, 23(6): 1644-51.
202. Rey E, N-Cabo AP, Costa PB, Barcala-Furelos R. Effects of foam rolling as a recovery tool in professional soccer players. *J Strength Condit Res.*, 2019, 33: 2194-201.
203. Harman E, Garhammer J. Administration, Scoring and Interpretation of Selected Tests. In: Baechle, TR and Earle, RW, Essentials of Strength Training and Conditioning. Champaign, IL: Human Kinetics, 2008, 250-92.
204. Janot J, Malin B, Cook R, Hagenbucher J, Draeger A, Jordan M, Van Guilder G. Effects of self myofascial release and static stretching on anaerobic power output. *J Fit Res* 2013, 2: 41-54.
205. MacDonald GZ, Button DC, Drinkwater EJ, Behm DG. Foam rolling as a recovery tool after an intense bout of physical activity. *Med Sci Sports Exerc* 2014, 46: 131-42.
206. Peacock CA, Krein DD, Silver TA, Sanders GJ, von Carlowitz KPA. An acute bout of self-myofascial release in the form of foam rolling improves performance testing. *Int J Exerc Sci* 2014, 7(5): 202-11.
207. Mikesky AE, Bahamonde RE, Stanton K, Alvey T, Fitton T. Acute effects of the stick on strength, power, and flexibility. *J Strength Cond Res* 2002, 16: 446-50.