

Reference

chapter 1

1. C. Sherrington, The correlation of reflexes and the principle of common final path, *Brit. Ass.* 74:728–741 (1939).
2. B. Katz, *Nerve Muscle and Synapse* (McGraw-Hill, New York, 1966).
3. E. R. Kandel, J. H. Schwartz, and T. M. Jessel, *Principles of Neural Science* (McGraw-Hill, New York, 2000).
4. E. Henneman, G. Somjen, and D. O. Carpenter, Functional significance of cell size in spinal motoneurons, *J. Neurophysiol.* 28:560–580 (1965).
5. G. Vrbovc̆, T. Gordon, and R. Jones, *Nerve-Muscle Interaction* (Chapman & Hall, London, 1995).
6. H. S. Milner-Brown, and R. B. Stein, The relation between the surface electromyogram and muscle force, *J. Physiol.* 246:549–569 (1975).
7. L. Ranvier, De quelques faits relatifs à l'histologie et à la physiologie des muscles striés, *Arch. Physiol. Norm. Path.* 6:1–15 (1874).
8. D. Denny-Brown, On the nature of postural reflexes, *Proc. Roy. Soc. (Biol.)* 104:252–301 (1929).
9. A. J. Buller, J. C. Eccles, and R. M. Eccles, Interactions between motoneurons and muscles in respect of the characteristic speeds of their responses, *J. Physiol.* 150:417–439 (1960).
10. S. Salmons, and G. Vrbovc̆, The influence of activity on some contractile characteristics of mammalian fast and slow muscles, *J. Physiol.* 201:535–549 (1969).
11. D. Pette, M. E. Smith, H. W. Staudte, and G. Vrbovc̆, Effects of long-term electrical stimulation on some contractile and metabolic characteristics of fast rabbit muscle, *Pflüger's Arch.* 338:257–272 (1973).
12. D. Pette, and G. Vrbovc̆, What does chronic electrical stimulation teach us about muscle plasticity? *Muscle Nerve* 22:666–677 (1999).
13. E. R. Chin, E. N. Olson, J. A. Richardson, Q. Yano, C. Humphries, J. M. Shelton, H. Wu, W. G. Zhu, R. Basselduby, and R. S. Williams, A calcineurin-dependent transcriptional pathway controls skeletal muscle fibre type, *Gene Devel.* 12:2499–2509 (1998).
14. G. Vrbovc̆, The effect of motoneurone activity on the speed of contraction of striated muscle, *J. Physiol.* 169:513–526 (1963).
15. J. Tothova, B. Blaauw, G. Pallafacchina, R. Rudolf, C. Argentini, C. Reggiani, S. Schiaffino, NFATc1 nucleocytoplasmic shuttling is controlled by nerve activity in skeletal muscle, *J. Cell. Sci.* 119:1604–1611 (2006).
16. A. Windisch, K. Gundersen, M. J. Szabolcs, H. Gruber, and T. Lomo, Fast to slow transformation of denervated and electrically stimulated rat muscle, *J. Physiol.* 510:623–632 (1998).
17. A. J. R. Lenman, F. M. Tulley, G. Vrbovc̆, M. R. Dimitrijevic, and J. A. Towle, Muscle fatigue in some neurological disorders, *Muscle Nerve* 12:938–942 (1989).
18. H. Kern, K. Rossini, U. Carraro, W. Mayr, M. Vogelauer, U. Hoelwarth, and C. Hofer, Muscle biopsies show that FES of denervated muscles reverses human muscle degeneration from permanent spinal motoneuron lesion, *J. Rehabil. Res. Dev.* 42:43–53 (2005).

chapter 2

1. B. Folkow, and E. Neil, *Circulation* (Oxford University Press, Oxford, 1971).
2. J. A. G. Rhodin, *Handbook of Physiology, Cardiovascular System, Vol II* (American Physiological Society, Bethesda, 1980).
3. O. Hudlicka, M. D. Brown, and S. Egginton, The microcirculation in skeletal muscle in: *Myology, Basic and Clinical*, 3rd edition, edited by A. G. Engel and C. Franzini-Armstrong (McGraw-Hill, New York, 2004), pp. 511–533.
4. J. R. Levick, *An Introduction to Cardiovascular Physiology* (Arnold Publishers, London, 2003).
5. K. K. Kallioski, C. Scheede-Bergdahl, M. Kjaer, and R. Boushel, Muscle perfusion and metabolic heterogeneity: insights from noninvasive imaging techniques, *Exerc. Sport Sci. Rev.* 34:164–170 (2006).
6. R. Myrhaage, and O. Hudlicka, The microvascular bed and capillary surface area in rat extensor hallucis proprius muscle (EHP), *Microvasc. Res.* 11:315–323 (1976).
7. M. H. Laughlin, Cardiovascular responses to exercise, *Am. J. Physiol.* 277:S244–259 (1999).
8. S. S. Segal, and S. E. Bearden, Organisation and control of circulation to skeletal muscle, in: *ACSM's Advanced Exercise Physiology*, edited by C. T. Tipton (Lippincott, Williams & Wilkins, Philadelphia, 2006), pp. 343–356.
9. M. H. Laughlin, Distribution of skeletal muscle blood flow during locomotory exercise, *Adv. Exp. Med. Biol.* 227:87–101 (1988).
10. C. G. Blomqvist, and B. Saltin, Cardiovascular adaptations to physical training, *Annu. Rev. Physiol.* 45:169–189 (1983).
11. O. Hudlicka, and M. D. Brown, Modulators of angiogenesis, in: *Angiogenesis in Health and Disease*, edited by G. M. Rubanyi (Marcel Dekker, New York, 2000), pp. 215–244.
12. O. Hudlicka, M. D. Brown, and S. Egginton, Angiogenesis in skeletal and cardiac muscle, *Physiol. Rev.* 72:369–417 (1992).
13. N. M. Moyna, and P. D. Thompson, The effect of physical activity on endothelial function in man, *Acta Physiol. Scand.* 180:113–123 (2004).

14. O. Hudlicka, M. D. Brown, S. May, A. Zakrzewicz, and A. R. Pries, Changes in capillary shear stress in skeletal muscles exposed to long-term activity: role of NO, *Microcirculation* 13:249–59 (2006).
15. M. D. Brown, M. A. Cotter, O. Hudlicka, and G. Vrbova, The effects of different patterns of muscle activity on capillary density, mechanical properties and structure of slow and fast rabbit muscles. *Pflugers Arch. Eur. J. Physiol.* 361:241–50 (1976).
16. J. M. Dawson, and O. Hudlicka, The effect of long-term activity on the microvasculature of rat glycolytic skeletal muscle, *Int. J. Microcirc. Clin. Exper.* 8:53–69 (1989).
17. M. D. Brown, S. Jeal, J. Bryant, and J. Gamble, Modification of microvascular filtration capacity in human limbs by training and electrical stimulation, *Acta Physiol. Scand.* 173:359–368 (2001).
18. P. D. Fagri, J. J. Votto, and C. F. Hovorka, Venous dynamics in the lower extremities in response to electrical stimulation, *Arch. Phys. Med. Rehabil.* 79:842–848 (1998).
19. I. O. Man, G. S. Lepar, M. C. Morrissey, and J. K. Cywinski, Effect of neuromuscular electrical stimulation on foot/ankle volume during standing, *Med. Sci. Sport. Exerc.* 35:630–634 (2003).
20. M. Cabric, H. J. Appell, and A. Resic, Stereological analysis of capillaries in electrostimulated human muscles. *Int. J. Sports. Med.* 8:327–330 (1987).
21. A. U. Ferrari, A. Radaelli, and M. Centola, Invited review: aging and the role of the cardiovascular system. *J. Appl. Physiol.* 95:2591–7 (2003).
22. B. A. Harris, The influence of endurance and resistance exercise in muscle capillarisation in the elderly: a review. *Acta Physiol. Scand.* 185:89–97 (2005).
23. B. Folkow, Pathophysiology of hypertension. *J. Hypertension* 11:S21–S24 (1993).
24. J. M. Hagberg, J. J. Park, and M. D. Brown, The role of exercise training in the treatment of hypertension: an update, *Sports. Med.* 30:193–206 (2000).
25. P. Rerkpattanpipat, W. G. Hudndley, K. M. Link, P. H. Brubaker, C. A. Hamilton, S. N. Darty, T. M. Morgan, and D. W. Kitzman, Relation of aortic distensibility determined by magnetic resonance imaging in patients \geq 60 years of age to systolic heart failure and exercise capacity to systolic heart failure and exercise capacity, *Am. J. Cardiol.* 90:1221–1225 (2002).
26. B. D. Duscha, F. W. Kraus, S. J. Keteveian, M. J. Sullivan, H. J. Green, F. H. Schachat, A. M. Pippen, C. A. Brawner, J. M. Blank, and B. H. Annex, Capillary density of skeletal muscle: a contributing mechanism for exercise intolerance in class II-III chronic heart failure independent of other peripheral alterations, *J. Am. Coll. Cardiol.* 33:1956–1963 (1999).
27. M. D. Witham, A. D. Struthers, and M. E. McMurdo, Exercise training as a therapy for chronic heart failure: can older people benefit? *J. Am. Geriatr. Soc.* 51:699–709 (2003).
28. J. F. Maillefert, J. C. Eicher, P. Walker, I. Rouhier-Marcet, F. Branley, M. Cohen, F. Brunotte, J. E. Wolf, J. M. Casillas, and J. P. Didier, Effects of low-frequency electrical stimulation on quadriceps and calf muscles in patients with chronic heart failure, *J. Cardiopulm. Rehabil.* 18:277–282 (1998).
29. C. J. Kelsall, M. D. Brown, J. Kent, M. Kloehn, and O. Hudlicka, Arteriolar endothelial dysfunction is restored in ischaemic muscles by chronic electrical stimulation, *J. Vasc. Res.* 41:241–251 (2004).
30. N. C. Hickey, O. Hudlicka, P. Gosling, C. P. Shearman, and M. H. Simms, Intermittent claudication incites systemic neutrophil activation and increased vascular permeability, *Br. J. Surg.* 80:181–184 (1993).
31. P. V. Tisi, and C. P. Shearman, The evidence for exercise-induced inflammation in intermittent claudication. Should we encourage patients to walk? *Eur. J. Vasc. Endovasc. Surg.* 15:7–17 (1998).
32. O. Hudlicka, M. D. Brown, S. Egginton, and J. M. Dawson, Effect of long-term electrical stimulation on vascular supply and fatigue in chronically ischemic muscles, *J. Appl. Physiol.* 77:1317–1324 (1994).
33. O. Hudlicka, and M. D. Brown, Hemodynamic forces, exercise and angiogenesis, in: *Therapeutic Angiogenesis*, edited by J. A. Dormandy, W. P. Dole and G. M. Rubanyi (Springer-Verlag, Berlin, Heidelberg, 1999), pp. 87–123.
34. G. M. Tsang, M. A. Green, A. J. Crow, F. C. Smith, S. Beck, O. Hudlicka, and C. P. Shearman, Chronic muscle stimulation improves ischaemic muscle performance in patients with peripheral vascular disease, *Eur. J. Vasc. Surg.* 8:419–427 (1994).
35. S. I. Anderson, P. Whatling, O. Hudlicka, P. Gosling, M. Simms, and M. D. Brown, Chronic transcutaneous electrical stimulation of calf muscles improves functional capacity without inducing systemic inflammation in claudicants, *Eur J Vasc Endovasc Surg.* 27:201–209 (2004).
36. M. A. Oldfield, M. Simms, and M. D. Brown, Microvascular filtration capacity is modified by chronic stimulation in ischemic human limbs without changes in local vascular control, *Microcirculation* 12:666 (2005).
37. A. J. Clover, M. J. McCarthy, K. Hodgkinson, P. R. Bell, and N. P. Brindle, Noninvasive augmentation of microvessel number in patients with peripheral vascular disease, *J. Vasc. Surg.* 38:1309–1312 (2003).
38. M. F. McCarthy, Up-regulation of endothelial nitric oxide activity as a central strategy for prevention of ischemic stroke – just say No to stroke! *Med. Hypothesis* 55:386–403 (2000).

39. P. D. Faghri, The effects of neuromuscular stimulation-induced muscle contractions versus elevation on hand edema in CVA patients, *J. Hand. Ther.* 10:29–34 (1997).
40. M. D. Delp, M. Brown, M. H. Laughlin, and E. M. Hassler, Rat aortic vasoreactivity is altered by old age and limb unloading, *J. Appl. Physiol.* 78:2079–2086 (1995).
41. D. A. Lake, Neuromuscular electrical stimulation. An overview and its application in the treatment of sports injuries, *Sports Med.* 13:320–336 (1992).
42. A. B. Borisov, S. K. Huang, and B. M. Carlson, Remodelling of the vascular bed and progressive loss of capillaries in denervated skeletal muscle, *Anat. Record* 258:292–304 (2000).
43. R. M. Crameri, A. Weston, M. Climstein, G. M. Davis, and J. R. Sutton, Effects of electrical stimulation-induced leg training on skeletal muscle adaptability in spinal cord injury, *Scand. J. Med. Sci. Sports* 12:316–322 (2002).
44. H. Leinonen, J. Juntunen, H. Somer, and J. Rapola, Capillary circulation and morphology in Duchenne muscular dystrophy, *Eur. Neurol.* 18:249–255 (1979).
45. F. Dela, T. Mohr, C. M. Jensen, H. L. Haahr, N. H. Sechenr, F. Biering-Sorensen, and M. Kjaer, Cardiovascular control during exercise: insights from spinal cord-injured humans, *Circulation* 107:2127–2133 (2003).
46. F. Ingjer, Effects of endurance training on muscle fibre ATP-ase activity, capillary supply and mitochondrial content in man, *J. Physiol (London)* 294:419–432 (1979).
47. J. L. Olive, J. M. Slade, J. A. Dudley, and K. K. McCully, Blood flow and muscle fatigue in SCI individuals during electrical stimulation, *J. Appl. Physiol.* 94:701–708 (2003).
48. K. M. Bogie, S. I. Reger, S. P. Levine, and V. Saghal, Electrical stimulation for pressure sore prevention and wound healing, *Assist. Technol.* 12:50–66 (2000).

chapter 3

1. W. I. Drechsler, M. C. Cramp, and O. M. Scott, Changes in muscle strength and EMG median frequency after anterior cruciate ligament reconstruction, *Eur. J. Appl. Physiol.* 98:613–623 (2006).
2. A. Delitto, S. J. Rose, J. M. McKowen, R. C. Lehman, J. A. Thomas, and R. A. Shively, Electrical stimulation versus voluntary exercise in strengthening thigh musculature after anterior cruciate ligament surgery, *Phys. Ther.* 68:660–663 (1988).
3. L. Snyder-Mackler, A. Delitto, S. L. Bailey, and S. W. Stralka, Strength of the quadriceps femoris muscle and functional recovery after reconstruction of the anterior cruciate ligament. A prospective, randomized clinical trial of electrical stimulation, *J. Bone Joint Surg.* 77:1166–1173 (1995).
4. J. E. Stevens, R. L. Mizner, and L. Snyder-Mackler, Neuromuscular electrical stimulation for quadriceps muscle strengthening after bilateral total knee arthroplasty: a case series, *J. Orth. Sports Phys. Ther.* 34:21–29 (2004).
5. M. M. Dimitrijevic, and M. R. Dimitrijevic, Clinical elements for the neuromuscular stimulation and functional electrical stimulation protocols in the practice of neurorehabilitation, *Artif. Organs* 26:256–259 (2002).
6. L. R. Sheffler, and J. Chae, Neuromuscular electrical stimulation in neurorehabilitation, *Muscle Nerve* 35:562–590 (2007).
7. J. Worthington, and L. Desouza, The use of clinical measures in the evaluation of neuromuscular stimulation in multiple sclerosis patients, in: *Current Concepts in Multiple Sclerosis*, edited by H. Wielhltter, J. Dichgans, and J. Mertin (Elsevier, Amsterdam, 1991), pp. 213–218.
8. A. Kralj, and L. Vodovnik, Functional electrical stimulation of the extremities: Part 1, *J. Med. Eng. Technol.* 1:2–15 (1971).
9. J. H. Grill, and P. H. Peckham, Functional neuromuscular stimulation for combined control of elbow extension and hand grasp in C5 and C6 quadriplegics, *IEEE Trans. Rehabil. Eng.* 6:190–199 (1998).
10. U. Carraro, K. Rossini, W. Mayr, and H. Kern, Muscle fiber regeneration in human permanent lower motoneuron denervation: relevance to safety and effectiveness of FES-training, which induces muscle recovery in SCI subjects, *Artif. Organs* 29:187–191 (2005).
11. H. Kern, C. Hofer, M. Strohhofer, W. Mayr, W. Richter, and H. Sthr, Standing up with denervated muscles in humans using functional electrical stimulation, *Artif. Organs* 23:447–452 (1999).
12. M. Mdlin, C. Forstner, C. Hofer, W. Mayr, W. Richter, U. Carraro, F. Protasi, and H. Kern, Electrical stimulation of denervated muscles: first results of a clinical study, *Artif. Organs* 29:203–206 (2005).
13. G. Alon, A. F. Levitt, and P. A. McCarthy, Functional electrical stimulation enhancement of upper extremity functional recovery during stroke rehabilitation: a pilot study, *Neurorehab. Neural Repair* 21:207–215 (2007).
14. H. Kobayashi, H. Onishi, K. Ihashi, R. Yagi, and Y. Handa, Reduction in subluxation and improved muscle function of the hemiplegic shoulder joint after therapeutic electrical stimulation, *J. Electromyogr. Kinesiol* 9:327–336 (1999).
15. C. J. Newsam, and L. L. Baker, Effect of electric stimulation facilitation program on quadriceps motor unit recruitment after stroke, *Arch. Phys. Rehab.* 85:2040–2045 (2004).
16. T. J. Kimberley, and P. T. Carey, Neuromuscular electrical stimulation in stroke rehabilitation, *Minn. Med.* 85:34–37 (2002).

17. W. W. Glenn, and M. L. Phelps, Diaphragm pacing by electrical stimulation of the phrenic nerve, *Neurosurgery* 17:974–984 (1985).
18. S. Jezernik, M. Craggs, W. M. Grill, G. Creasey, and N. J. Rijkhoff, Electrical stimulation for the treatment of bladder dysfunction: current status and future possibilities, *Neurol. Res.* 24:413–430 (2002).
19. L. Brubaker, Electrical stimulation in overactive bladder, *Urology* 55:17–32 (2000).
20. O. M. Scott, G. Vrbovc, S. A. Hyde, and V. Dubowitz, Responses of muscle of patients with Duchenne muscular atrophy to chronic electrical stimulation, *J. Neurol. Neurosurg. Psychiatr.* 49:1427–1434 (1986).
21. O. M. Scott, S. A. Hyde, G. Vrbovc, and V. Dubowitz, Therapeutic possibilities of chronic low frequency electrical stimulation in children with Duchene muscular dystrophy, *J. Neurol. Sci.* 95:171–182 (1990).
22. A. Zupan, Long-term electrical stimulation of muscles in children with Duchene and Becker muscular dystrophy, *Muscle Nerve* 15:362–367 (1992).
23. A. Zupan, M. Gregoric, V. Valencic, and S. Vandot, Effects of electrical stimulation on muscles of children with Duchenne and Becker muscular dystrophy, *Neuropediatrics* 24:189–192 (1993).
24. G. Vrbovc, Function induced modifications of gene expression: an alternative approach to gene therapy of Duchene muscular dystrophy, *J. Muscle Res. Cell Motil.* 25:187–192 (2004).
25. V. A. Convertino, S. A. Bloomfield, and J. F. Greenfield, An overview of the issues: physiological effects of bed rest and restricted physical activity, *Med. Sci Sports Exerc.* 29:187–190 (1997).
26. J. Duchateau, Bed rest induces neural and contractile adaptation in triceps surae, *Med. Sci. Sports Exerc.* 27:1581–1589 (1995).
27. K. Takenaka, Y. Suzuki, K. Kawakubo, Y. Haruna, R. Yanagibori, H. Kashihara, T. Igarashi, F. Watanabe, M. Omata, F. Bonde-Petersen, et al., Cardiovascular effects of 20 days bed rest in healthy young subjects. *Acta Physiol. Scand. Suppl* 616:59–63 (1994).
28. G. Ferretti, G. Antonutto, C. Denis, H. Hoppeler, A. E. Minetti, M. V. Narici, and D. Desplanches, The interplay of central and peripheral factors in limiting maximal O₂ consumption in man after prolonged bed rest, *J. Physiol.* 501:677–686 (1997).
29. S. A. Bloomfield, Changes in musculoskeletal structure and function with prolonged bed rest, *Med. Sci. Sports Exerc.* 29:197–206 (1997).
30. T. Iwasaki, N. Shiba, H. Matsuse, T. Nago, Y. Umezumi, Y. Tagawa, K. Nagata, and J. R. Bassford, Improvement of knee strength through training by means of combined electrical stimulation and voluntary muscle contraction, *Tohoku J. Exp. Med.* 209:33–40 (2006).
31. L. I. Kakurin, B. B. Yegorov, Y. I. Il'ina, and M. A. Cherepakhin, Effects of muscle electrostimulation during simulated weightlessness, *Acta Astronaut.* 2:241–246 (1975).
32. M. A. Cherepakhin, L. I. Kakurin, E. I. Ilina–Kakueva, and G. T. Fedorenko, Evaluation of the effectiveness of electrostimulation of the muscles in preventing disorders related to prolonged limited motor activity in man, *Kosm. Biol. Aviakosm. Med.* 11:64–68 (1977).
33. W. Mayr, M. Bijak, W. Girsch, C. Hofer, H. Lanmüller, D. Rafolt, M. Rakos, S. Sauermann, C. Schmutterer, G. Schnetz, E. Unger, and G. Freilinger, MYOSIM FES to prevent muscle atrophy in microgravity and bed rest: preliminary report, *Artif. Organs* 23:428–431 (1999).
34. A. Stefanovska, L. Vodovnik, H. Benko, and R. N. Turk, Treatment of chronic wounds by means of electric and electromagnetic fields. Part 2. Value of FES parameters for pressure sore treatment. *Med. Biol. Eng. Comput.* 31:213–220 (1993).
35. K. M. Bogie, S. I. Reger, S. P. Levine, and V. Saghal, Electrical stimulation for pressure sore prevention and wound healing, *Assist. Technol.* 12:50–66 (2000).
36. A. A. Al Majeed, T. M. Brushart, and T. Gordon, Electrical stimulation accelerates and increases expression of BDNF and trkB mRNA in regenerating rat femoral motoneurons, *Eur. J. Neurosci.* 12:4381–4390 (2000).
37. T. M. Brushart, R. Jari, V. Verge, C. Rohde, and T. Gordon, Electrical stimulation restores the specificity of sensory axon regeneration, *Exp. Neurol.* 194:221–229 (2005).
38. G. Vrbovc, Rationale for activating nerves and muscles in patients with facial palsy with appropriate patterns of activity, 2001 May, Dept of Anatomy and Developmental Biology, University College London (2001).
39. K. M. Bogie, and R. J. Triolo, Effects of regular use of neuromuscular electrical stimulation on tissue health, *J. Rehabil. Res. Dev.* 40:469–475 (2003).
40. R. B. Stein, T. Gordon, J. Jefferson, A. Shafterberger, J. F. Yang, J. T. de Zepetnek, and M. Belanger, Optimal stimulation of paralyzed muscle after spinal cord injury, *J. Appl. Physiol.* 72:1392–1400 (1992).
41. T. P. Martin, R. B. Stein, P. H. Hoepfner, and D. C. Reid, Influence of electrical stimulation on the morphological and metabolic properties of paralyzed muscle, *J. Appl. Physiol.* 72:1401–1406 (1992).
42. R. M. Crameri, A. Weston, M. Climstein, G. M. Davis, and J. R. Sutton, Effects of electrical stimulation-induced leg training on skeletal muscle adaptability in spinal cord injury, *Scand. J. Med. Sci. Sports* 12:316–322 (2003).
43. P. D. Faghri, and J. Yount, Electrically induced and voluntary activation of physiologic muscle pump: a comparison between spinal cord-injured and able-bodied individuals, *Clin. Rehabil.* 16:878–888 (2002).

44. R. T. Katz, D. Green, T. Sullivan, and G. Yarkony, Functional electric stimulation to enhance systemic fibrinolytic activity in spinal cord injury patients, *Arch. Phys. Med. Rehabil.* 68:423–416 (1987).
45. D. H. Thijssen, P. Heesterbeek, D. J. van Kuppevelt, J. Duysens, and M. T. Hopman, Local vascular adaptation after hybrid training in spinal cord-injured subjects, *Med. Sci. Sports Exerc.* 37:1112–1118 (2005).
46. I. Arvidsson, H. Arvidsson, E. Eriksson, and E. Jansson, Prevention of quadriceps wasting after immobilization: an evaluation of the effect of electrical stimulation, *Orthopedics* 9:1519–1528 (1986).
47. N. Gould, D. Donnermeyer, G. G. Gammon, M. Popez, and T. Ashikaga, Transcutaneous muscle stimulation to retard disuse atrophy after open meniscotomy, *Clin. Orthoped. Rel. Res.* 17:180–195 (1983).
48. M. R. Duvoisin, V. A. Convertino, P. Buchanan, P. D. Gollnick, and G. A. Dudley, Characteristics and preliminary observations of the influence of electromyostimulation on the size and function of human skeletal muscle during 30 days of simulated microgravity, *Aviat. Space Environ. Med.* 60:671–678 (1989).

chapter 4

1. Herman Schaefer founded Slendertone Ltd in 1964, Companies House London No 00838231, later incorporated as part of Ultratone Scientific Instruments Ltd. (No. 01432229, 1989).
2. J. P. Porcari, J. Miller, K. Cornwell, C. Foster, M. Gibson, K. McLean, and T. Kernozek, The effects of neuromuscular stimulation training on abdominal strength, endurance and selected anthropometric measure, *J. Sports Sci. Med.* 4:66–75 (2005).
3. E. Ballantine, and B. Donne, Effects of neuromuscular electrical stimulation on static and dynamic abdominal strength and endurance in healthy males, 4th Annual Congress of the European College of Sports Science, Rome, 14–17 July 1999.
4. G. Alon, S. A. McCombe, S. Koutsantinis, L. J. Stumphauzer, K. C. Burgwin, M. M. Parent, and R. A. Bosworth, Comparison of the effects of electrical stimulation and exercise on abdominal musculature, *J. Orthopaed. Sports Phy. Therap.* 8:567–573 (1987).
5. N. Babault, G. Cometti, M. Bernardin, M. Pousson, and J. C. Chatard, Effects of electromyostimulation training on muscle strength and power of elite rugby players. *J. Strength Cond. Res.* 21: 431–437 (2007).
6. J. F. Hopp, and W. K. Palmer, Effect of electrical stimulation on intracellular triacylglycerol in isolated skeletal muscle, *J. Appl. Physiol.* 68:348–354 (1990).
7. J. F. Hopp, and W. K. Palmer, Electrical stimulation alters fatty acid metabolism in isolated skeletal muscle, *J. Appl. Physiol.* 68:2473–2481 (1990).
8. G. Pedini, and P. Zaietta, On some aspects of activation of tissue lipolysis by electric factors, *Minerva Med.* 66:324–329 (1975).
9. M. Ruffin, and S. Micolaidis, Electrical stimulation of the ventromedial hypothalamus enhances both fat utilization and metabolic rate that precede and parallel the inhibition of feeding behaviour, *Brain Res.* 846:23–29 (1999).
10. P. Banerjee, B. Caulfield, L. Crowe, and A. Clark, Prolonged electrical muscle stimulation exercise improves strength and aerobic capacity in healthy sedentary adults, *J. Appl. Physiol.* 99:2307–2311 (2005).
11. D. Pette, and G. Vrbovc, What does chronic electrical stimulation teach us about muscle plasticity? *Muscle Nerve* 22:666–677 (1999).
12. A. J. Robinson, and L. Snyder-Mackler, *Clinical Electrophysiology* (Williams & Wilkins, Baltimore, 1992).
13. V. Dubowitz, S. A. Hyde, O. Scott, and G. Vrbovc, Effect of long term electrical stimulation on the fatigue of human muscle, Presented at the Physiological Society Annual Conference, UCL, London, March 26,27, 1982.
14. G. Vrbovc, Considerations for the therapeutic use of chronic electrical stimulation of skeletal muscles, Newsletter of the Department of Anatomy and Embryology, University College London, March 1982.
15. G. M. Eom, T. Watanabe, N. Hoshimiya, and G. Khang, Gradual potentiation of isometric muscle force during constant electrical stimulation, *Med. Biol. Eng. Comput.* 40:137–143 (2002).
16. P. Chan, and K. I. Kwann, The frequency-specificity theory, *Hong Kong Physiother. J.* 13:23–27 (1991/1992).
17. I. O. W. Man, G. S. Lepar, M. C. Morrissey, and J. K. Cywinski, Effect of neuromuscular electrical stimulation on foot and ankle volume during standing. *Med. Sci. Sports Exerc.* 35:630–634 (2003).
18. J. Kahn, *Principles and Practices of Electrotherapy* (Churchill Livingstone, New York, 1994).
19. J. Low, and A. Reed, *Electrotherapy Explained* (Butterworth & Heinman, Oxford, 1994).
20. H. X. Liu, J. B. Tian, F. Luo, Y. H. Jiang, Z. G. Deng, L. Xiong, C. Liu, J. S. Wang, and J. S. Han, Repeated 100 Hz TENS for the treatment of chronic inflammatory hyperalgesia and suppression of spinal release of substance P in monoarthritic rats. *Evid. Based Complement. Alternat. Med.* 4:65–75 (2007).
21. O. Scott, S. Kitchen, and S. Bazin, *Clayton's Electrotherapy* (W.B. Saunders, London, 1998).
22. D. Poole, Use of tens in pain management. Part One: How TENS works, *Nurs. Times* 103:28–29 (2007).
23. M. Erdogan, A. Erdogan, N. Erbil, H. K. Karakaya, and A. Demircan, Prospective, randomized, placebo-controlled study of the effect of TENS on postthoracotomy pain and pulmonary function, *World J. Surg.* 29:1563–1570 (2005).
24. T. Nalty, *Electrotherapy Clinical Procedures Manual* (McGraw-Hill, New York, 2001).
25. H. Waldorf, and J. Fewkes, Wound healing, *Adv. Dermatol.* 10:77–97 (1995).

26. E. M. Wojtys, J. E. Carpenter, and G. A. Ott, Electrical stimulation of soft tissues, *Instr. Course Lect.* 42:443–452 (1993).
27. M. T. Omar, A. M. El-Badawy, W. H. Borhan, and A. A. Nossier, Improvement of oedema and hand function in superficial and second degree hand burns using electrical stimulation, *Egypt J. Plast. Reconstr. Surg.* 28:141–147 (2004).
28. E. M. Wojtys, J. E. Carpenter, and G. A. Ott, Electrical stimulation of soft tissues, *Instr. Course Lect.* 42:443–452 (1993).
29. G. D. Gentzkow, Electrical stimulation to heal dermal wounds, *J. Dermatol. Surg. Oncol.* 19:753–758 (1993).
30. J. A. Feedar, L. C. Kloth, and G. D. Gentzkow, Chronic dermal ulcer healing enhanced with monophasic pulsed electrical stimulation, *Phys. Ther.* 71:639–649 (1991).
31. W. D. Currier, Effects of electronic stimulation of the VII nerve. On senescent changes of the face, *Ann. Otol. Rhinol. Laryngol.* 72:289–306 (1963).
32. A. A. Al-Majed, C. M. Neumann, T. M. Brushart, and T. Gordon, Brief electrical stimulation promotes the speed and accuracy of motor axonal regeneration, *J. Neurosci.* 20:2602–2608 (2000).
33. M. S. Agren, M. A. Engel, and P. M. Mertz, Collagenase during burn wound healing: influence of a hydrogel dressing and pulsed electrical stimulation, *Plast. Reconstr. Surg.* 94:518–524 (1994).
34. F. Bobanovic, S. Simić, V. Kotnik, and L. Vodovnik, Pulsed electrical current enhances the phorbol ester induced oxidative burst in human neutrophils, *FEBS Lett.* 311:95–98 (1992).
35. Y. N. Berner, O. Lif Kimchi, V. Spokoiny, and B. Finkeltov, The effect of electric stimulation treatment on the functional rehabilitation of acute geriatric patients with stroke – a preliminary study. *Arch. Gerontol. Geriatr.* 39:125–132 (2004).
36. S. N. Kukke, and R. J. Triolo, The effects of trunk stimulation on bimanual seated workspace. *IEEE Trans. Neural. Syst. Rehabil. Eng.* 12:177–185 (2004).
37. W. D. Memberg, P. E. Crago, and M. W. Keith, Restoration of elbow extension via functional electrical stimulation in individuals with tetraplegia. *J. Rehabil. Res. Dev.* 40:477–486 (2003).
38. T. Yanagi, N. Shiba, T. Maeda, K. Iwasa, Y. Umezū, Y. Tagawa, S. Matsuo, K. Nagata, T. Yamamoto, and J. R. Basford, Agonist contractions against electrically stimulated antagonists. *Arch. Phys. Med. Rehabil.* 84:843–848 (2003).
39. D. N. Rushton, Electrical stimulation in the treatment of pain. *Disabil. Rehabil.* 24:407–515 (2002).
40. M. M. Ng, M. C. Leung, and D. M. Poon, The effects of electro-acupuncture and transcutaneous electrical nerve stimulation on patients with painful osteoarthritic knees: a randomized controlled trial with follow-up evaluation. *J. Alternat. Complement. Med.* 9:641–649 (2003).
41. L. S. Chesterton, N. E. Foster, C. C. Wright, G. D. Baxter, and P. Barlas, Effects of TENS frequency, intensity and stimulation site parameter manipulation on pressure pain thresholds in healthy human subjects. *Pain* 106:73–80 (2003).
42. M. Osiri, V. Welch, L. Brosseau, B. Shea, J. McGowan, P. Tugwell, and G. Wells, Transcutaneous electrical nerve stimulation for knee osteoarthritis. *Cochrane Database Systematic Reviews* 4:CD002823 (2000).
43. W. P. Cooney, Electrical stimulation and the treatment of complex regional pain syndromes of the upper extremity. *Hand Clin.* 13:519–526 (1997).
44. T. Forst, M. Nguyen, S. Forst, B. Disselhoff, T. Pohlmann, and A. Pflutzner, Impact of low frequency transcutaneous electrical nerve stimulation on symptomatic diabetic neuropathy using the new Salutaris device. *Diabetes Nutr. Metab.* 17:163–168 (2004).
45. A. Kararmaz, S. Kaya, H. Karaman, and S. Turhanoglu, Effect of the frequency of transcutaneous electrical nerve stimulation on analgesia during extracorporeal shock wave lithotripsy. *Urol. Res.* 32:411–415 (2004).
46. L. S. Chesterton, P. Barlas, N. E. Foster, G. D. Baxter, and C. C. Wright, Gender differences in pressure pain threshold in healthy humans. *Pain* 101:259–266 (2003).
47. G. L. Cheing, A. Y. Tsui, S. K. Lo, and C. W. Hui-Chan, Optimal stimulation duration of tens in the management of osteoarthritic knee pain. *J. Rehabil. Med.* 35:62–68 (2003).
48. J. T. van der Spank, D. C. Cambier, H. M. De Paepe, L. A. Danneels, E. E. Witvrouw, and L. Beerens, Pain relief in labour by transcutaneous electrical nerve stimulation (TENS). *Arch. Gynecol. Obstet.* 264:131–136 (2000).
49. J. Kahn, *Principles and Practice of Electrotherapy* (Churchill Livingstone, New York, 1987).