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References

- Abbruzzese, G., Berardelli, A. (2003). Sensorimotor integration in movement disorders. *Mov Disord* **18**,231-240.
- Adamo, D.E., Martin, B.J. (2009). Position sense asymmetry. *Exp Brain Res* **192**,87-95.
- Allen, T.J., Ansems, G.E., Proske, U. (2008). Evidence from proprioception of fusimotor coactivation during voluntary contractions in humans. *Exp Physiol* **93**,391-398.
- Almeida, T.F., Roizenblatt, S., Tufik, S. (2004). Afferent pain pathways: a neuroanatomical review. *Brain Res* **1000**,40-56.
- Andersen, O.K., Jensen, L.M., Brennum, J., Arendt-Nielsen, L. (1994). Evidence for central summation of C and A[delta] nociceptive activity in man. *Pain* **59**,273-280.
- Andersen, O.K., Gracely, R.H., Arendt-Nielsen, L. (1995). Facilitation of the human nociceptive reflex by stimulation of A-beta fibres in a secondary hyperalgesic area sustained by nociceptive input from the primary hyperalgesic area. *Acta Physiol Scand* **155**,87-97.
- Andersen, O.K., Sonnenborg, F.A., Arendt-Nielsen, L. (1999). Modular organization of human leg withdrawal reflexes elicited by electrical stimulation of the foot sole. *Muscle Nerve* **22**,1520-1530.
- Andersen, O.K., Graven-Nielsen, T., Matre, D., Arendt-Nielsen, L., Schomburg, E.D. (2000). Interaction between cutaneous and muscle afferent activity in polysynaptic reflex pathways: A human experimental study. *Pain* **84**,29-36.
- Andersen, O.K., Sonnenborg, F.A., Arendt-Nielsen, L. (2001). Reflex receptive fields for human withdrawal reflexes elicited by non-painful and painful electrical stimulation of the foot sole. *Clin Neurophysiol* **112**,641-649.
- Andersen, O.K., Sonnenborg, F., Matjacic, Z., Arendt-Nielsen, L. (2003). Foot-sole reflex receptive fields for human withdrawal reflexes in symmetrical standing position. *Exp Brain Res* **152**,434-443.
- Andersen, O.K., Mørch, C.D., Arendt-Nielsen, L. (2006). Modulation of heat evoked nociceptive withdrawal reflexes by painful intramuscular conditioning stimulation. *Exp Brain Res* **174**,775-780.
- Arendt-Nielsen, L., Graven-Nielsen, T. (2008). Muscle pain: sensory implications and interaction with motor control. *Clin J Pain* **24**,291-298.
- Babiloni, C., Capotosto, P., Brancucci, A., Del Percio, C., Petrini, L., Buttiglione, M., Cibelli, G., Romani, G.L., Rossini, P.M., Arendt-Nielsen, L. (2008). Cortical alpha rhythms are related to the anticipation of sensorimotor interaction between painful stimuli and movements: a high-resolution EEG study. *J Pain* **9**,902-911.

- Bailey, J., Nelson, S., Lewis, J., McCabe, C.S. (2013). Imaging and clinical evidence of sensorimotor problems in CRPS: utilizing novel treatment approaches. *J Neuroimmune Pharmacol* **8**,564-575.
- Bandholm, T., Rasmussen, L., Aagaard, P., Diederichsen, L., Jensen, B.R. (2008). Effects of experimental muscle pain on shoulder-abduction force steadiness and muscle activity in healthy subjects. *Eur J Appl Physiol* **102**,643-650.
- Barrett, R.S., Lichtwark, G.A. (2010). Gross muscle morphology and structure in spastic cerebral palsy: a systematic review. *Dev Med Child Neurol* **52**,794-804.
- Bays, P.M., Wolpert, D.M. (2007). Computational principles of sensorimotor control that minimize uncertainty and variability. *J Physiol* **578**,387-396.
- Beck, S., Shamim, E.A., Richardson, S.P., Schubert, M., Hallett, M. (2009). Inter-hemispheric inhibition is impaired in mirror dystonia. *Eur J Neurosci* **29**,1634-1640.
- Beerthuisen, A., van 't Spijker, A., Huygen, F.J., Klein, J., de, W.R. (2009). Is there an association between psychological factors and the Complex Regional Pain Syndrome type 1 (CRPS1) in adults? A systematic review. *Pain* **145**,52-59.
- Beerthuisen, A., Stronks, D.L., Huygen, F.J., Passchier, J., Klein, J., Spijker, A.V. (2011). The association between psychological factors and the development of complex regional pain syndrome type 1 (CRPS1)--a prospective multicenter study. *Eur J Pain* **15**,971-975.
- Bender, R., Lange, S. (2001). Adjusting for multiple testing--when and how? *J Clin Epidemiol* **54**,343-349.
- Bennell, K.L., Hinman, R.S. (2005). Effect of experimentally induced knee pain on standing balance in healthy older individuals. *Rheumatology* **44**,378-381.
- Bennell, K., Wee, E., Crossley, K., Stillman, B., Hodges, P. (2005). Effects of experimentally-induced anterior knee pain on knee joint position sense in healthy individuals. *J Orthop Res* **23**,46-53.
- Birch, L., Christensen, H., Arendt-Nielsen, L., Graven-Nielsen, T., Sogaard, K. (2000a). The influence of experimental muscle pain on motor unit activity during low-level contraction. *Eur J Appl Physiol* **83**,200-206.
- Birch, L., Graven-Nielsen, T., Christensen, H., Arendt-Nielsen, L. (2000b). Experimental muscle pain modulates muscle activity and work performance differently during high and low precision use of a computer mouse. *Eur J Appl Physiol* **83**,492-498.
- Birch, L., Arendt-Nielsen, L., Graven-Nielsen, T., Christensen, H. (2001). An investigation of how acute muscle pain modulates performance during computer work with digitizer and puck. *Appl Ergon* **32**,281-286.
- Birklein, F., Riedl, B., Sieweke, N., Weber, M., Neundorfer, B. (2000). Neurological findings in complex regional pain syndromes--analysis of 145 cases. *Acta Neurol Scand* **101**,262-269.
- Birklein, F., Schmelz, M., Schifter, S., Weber, M. (2001). The important role of neuropeptides in complex regional pain syndrome. *Neurology* **57**,2179-2184.
- Birklein, F., Schmelz, M. (2008). Neuropeptides, neurogenic inflammation and complex regional pain syndrome (CRPS). *Neurosci Lett* **437**,199-202.
- Birklein, F., Kingery, W.S. (2009). Complex regional pain syndrome: A loss of inhibition? *Pain* **142**,177-178.

- Birznieks, I., Burton, A.R., Macefield, V.G. (2008). The effects of experimental muscle and skin pain on the static stretch sensitivity of human muscle spindles in relaxed leg muscles. *J Physiol* **586**,2713-2723.
- Blouin, J.S., Corbeil, P., Teasdale, N. (2003). Postural stability is altered by the stimulation of pain but not warm receptors in humans. *BMC Musculoskelet Disord* **4**,23.
- Bonifazi, M., Ciccarone, G., Della Volpe, R., Spidalieri, R., Rossi, A. (2004). Influences of chemically-induced muscle pain on power output of ballistic upper limb movements. *Clin Neurophysiol* **115**,1779-1785.
- Branch, C.H., Buxbaum, L.J., Schwobbel, J. (2008). Accurate reaching after active but not passive movements of the hand: evidence for forward modeling. *Behav Neurol* **19**,117-125.
- Bruehl, S., Carlson, C.R. (1992). Predisposing psychological factors in the development of reflex sympathetic dystrophy. A review of the empirical evidence. *Clin J Pain* **8**,287-299.
- Bruehl, S. (2001). Do psychological factors play a role in the onset and maintenance of CRPS? In: Complex Regional Pain Syndrome, R.N. Harden, R. Baron, and W. Janig, eds. (Seattle: IASP Press).
- Bruehl, S., Chung, O.Y. (2006). Psychological and behavioral aspects of complex regional pain syndrome management. *Clin J Pain* **22**,430-437.
- Buchanan, J.J., Ryu, Y.U. (2006). One-to-one and polyrhythmic temporal coordination in bimanual circle tracing. *J Mot Behav* **38**,163-184.
- Buchanan, J.J., Ryu, Y.U. (2012). Scaling movement amplitude: adaptation of timing and amplitude control in a bimanual task. *J Mot Behav* **44**,135-147.
- Burden, A. (2010). How should we normalize electromyograms obtained from healthy participants? What we have learned from over 25 years of research. *J Electromyogr Kinesiol* **20**,1023-1035.
- Burke, R.E., Fahn, S., Marsden, C.D., Bressman, S.B., Moskowitz, C., Friedman, J. (1985). Validity and reliability of a rating scale for the primary torsion dystonias. *Neurology* **35**,73-77.
- Burke, D., Gandevia, S.C., Macefield, G. (1988). Responses to passive movement of receptors in joint, skin and muscle of the human hand. *J Physiol* **402**,347-361.
- Carey, L.M., Oke, L.E., Matyas, T.A. (1996). Impaired limb position sense after stroke: a quantitative test for clinical use. *Arch Phys Med Rehabil* **77**,1271-1278.
- Carson, R.G., Goodman, D., Kelso, J.A., Elliott, D. (1995). Phase Transitions and Critical Fluctuations in Rhythmic Coordination of Ipsilateral Hand and Foot. *J Mot Behav* **27**,211-224.
- Carson, R.G. (2005). Neural pathways mediating bilateral interactions between the upper limbs. *Brain Res Brain Res Rev* **49**,641-662.
- Cheong, J.Y., Yoon, T.S., Lee, S.J. (2003). Evaluations of inhibitory effect on the motor cortex by cutaneous pain via application of capsaicin. *Electromyogr Clin Neurophysiol* **43**,203-210.
- Ciccone, D.S., Bandilla, E.B., Wu, W. (1997). Psychological dysfunction in patients with reflex sympathetic dystrophy. *Pain* **71**,323-333.
- Cincotta, M., Ziemann, U. (2008). Neurophysiology of unimanual motor control and mirror movements. *Clin Neurophysiol* **119**,744-762.

- Ciubotariu, A., Arendt-Nielsen, L., Graven-Nielsen, T. (2004). The influence of muscle pain and fatigue on the activity of synergistic muscles of the leg. *Eur J Appl Physiol* **91**,604-614.
- Ciubotariu, A., Arendt-Nielsen, L., Graven-Nielsen, T. (2007). Localized muscle pain causes prolonged recovery after fatiguing isometric contractions. *Exp Brain Res* **181**,147-158.
- Clarke, R.W., Harris, J. (2004). The organization of motor responses to noxious stimuli. *Brain Res Rev* **46**,163-172.
- Cobb, C.R., de Vries, H.A., Urban, R.T., Luekens, C.A., Bagg, R.J. (1975). Electrical activity in muscle pain. *Am J Phys Med* **54**,80-87.
- Collins, S.L., Moore, R.A., McQuay, H.J. (1997). The visual analogue pain intensity scale: what is moderate pain in millimetres? *Pain* **72**,95-97.
- Collins, D.F., Refshauge, K.M., Todd, G., Gandevia, S.C. (2005). Cutaneous receptors contribute to kinesthesia at the index finger, elbow, and knee. *J Neurophysiol* **94**,1699-1706.
- Corbeil, P., Blouin, J.S., Teasdale, N. (2004). Effects of intensity and locus of painful stimulation on postural stability. *Pain* **108**,43-50.
- Cordo, P., Carlton, L., Bevan, L., Carlton, M., Kerr, G.K. (1994). Proprioceptive coordination of movement sequences: role of velocity and position information. *J Neurophysiol* **71**,1848-1861.
- Cox, B.C., Cincotta, M., Espay, A.J. (2012). Mirror movements in movement disorders: a review. *Tremor Other Hyperkinet Mov (NY)* **2**, pii: tre-02-59-398-1.
- Cullen, K.E. (2004). Sensory signals during active versus passive movement. *Curr Opin Neurobiol* **14**,698-706.
- Daffertshofer, A., van den Berg, C., Beek, P.J. (1999). A dynamical model for mirror movements. *Physica D* **2253**,1-24.
- Damiano, D.L., Martellotta, T.L., Sullivan, D.J., Granata, K.P., Abel, M.F. (2000). Muscle force production and functional performance in spastic cerebral palsy: relationship of cocontraction. *Arch Phys Med Rehabil* **81**,895-900.
- Daube, J.R., Rubin, D.I. (2009). Needle electromyography. *Muscle Nerve* **39**,244-270.
- de Boer, B.J., Peper, C.L., Beek, P.J. (2011). Frequency-induced changes in interlimb interactions: increasing manifestations of closed-loop control. *Behav Brain Res* **220**,202-214.
- de Boer, B.J., Peper, C.E., Beek, P.J. (2012). Development of temporal and spatial bimanual coordination during childhood. *Motor Control* **16**,537-559.
- de Boer, B.J., Peper, C.E., Ridderikhoff, A., Beek, P.J. (2013). Phase entrainment strength scales with movement amplitude disparity. *Motor Control* **17**,399-411.
- de Jong, J.R., Vlaeyen, J.W., Onghena, P., Cuyppers, C., den Hollander, M., Ruijgrok, J. (2005). Reduction of pain-related fear in complex regional pain syndrome type I: the application of graded exposure in vivo. *Pain* **116**,264-275.
- de Jong, J.R., Vlaeyen, J.W., de Gelder, J.M., Patijn, J. (2011). Pain-related fear, perceived harmfulness of activities, and functional limitations in complex regional pain syndrome type I. *J Pain* **12**,1209-1218.
- de Luca, C.J. (1997). The use of surface electromyography in biomechanics. *J Appl Biomech* **13**,135-163.

- de Mos, M., de Bruijn, A.G., Huygen, F.J., Dieleman, J.P., Stricker, B.H., Sturkenboom, M.C. (2007). The incidence of complex regional pain syndrome: a population-based study. *Pain* **129**,12-20.
- de Mos, M., Huygen, F.J., Dieleman, J.P., Koopman, J.S., Stricker, B.H., Sturkenboom, M.C. (2008). Medical history and the onset of complex regional pain syndrome (CRPS). *Pain* **139**,458-466.
- de Mos, M., Sturkenboom, M.C., Huygen, F.J. (2009). Current understandings on complex regional pain syndrome. *Pain Pract* **9**,86-99.
- de Poel, H.J., Peper, C.L., Beek, P.J. (2009). Disentangling the effects of attentional and amplitude asymmetries on relative phase dynamics. *J Exp Psychol Hum Percept Perform* **35**,762-777.
- de Rooij, A.M., Perez, R.S., Huygen, F.J., van Eijs, F., van Kleef, M., Bauer, M.C., van Hilten, J.J., Marinus, J. (2010). Spontaneous onset of complex regional pain syndrome. *Eur J Pain* **14**,510-513.
- del Santo, F., Gelli, F., Spidalieri, R., Rossi, A. (2007). Corticospinal drive during painful voluntary contractions at constant force output. *Brain Res* **1128**,91-98.
- Diederichsen, L.P., Winther, A., Dyhre-Poulsen, P., Krogsgaard, M.R., Nørregaard, J. (2009). The influence of experimentally induced pain on shoulder muscle activity. *Exp Brain Res* **194**,329-337.
- Eberle, T., Doganci, B., Kramer, H.H., Geber, C., Fechir, M., Magerl, W., Birklein, F. (2009). Warm and cold complex regional pain syndromes: differences beyond skin temperature? *Neurology* **72**,505-512.
- Eccleston, C., Crombez, G. (1999). Pain demands attention: a cognitive-affective model of the interruptive function of pain. *Psychol Bull* **125**,356-366.
- Edens, J.L., Gil, K.M. (1995). Experimental induction of pain: Utility in the study of clinical pain. *Behavior Therapy* **26**,197-216.
- Edwards, M.J., Moretto, G., Schwingenschuh, P., Katschnig, P., Bhatia, K.P., Haggard, P. (2011). Abnormal sense of intention preceding voluntary movement in patients with psychogenic tremor. *Neuropsychologia* **49**,2791-2793.
- Eisenberg, E., Chistyakov, A.V., Yudashkin, M., Kaplan, B., Hafner, H., Feinsod, M. (2005). Evidence for cortical hyperexcitability of the affected limb representation area in CRPS: a psychophysical and transcranial magnetic stimulation study. *Pain* **113**,99-105.
- Ek, J.W., van Gijn, J.C., Samwel, H., van Egmond, J., Klomp, F.P., van Dongen, R.T. (2009). Pain exposure physical therapy may be a safe and effective treatment for longstanding complex regional pain syndrome type 1: a case series. *Clin Rehabil* **23**,1059-1066.
- Ellrich, J., Treede, R.D. (1998). Convergence of nociceptive and non-nociceptive inputs onto spinal reflex pathways to the tibialis anterior muscle in humans. *Acta Physiol Scand* **163**,391-401.
- Ellrich, J., Steffens, H., Schomburg, E.D. (2000). Neither a general flexor nor a withdrawal pattern of nociceptive reflexes evoked from the human foot. *Neurosci Res* **37**,79-82.
- Erickson, R.I.C., Karduna, A.R. (2012). Three-dimensional repositioning tasks show differences in joint position sense between active and passive shoulder motion. *Journal of Orthopaedic Research* **30**,787-792.
- Ernst, M.O., Bühlhoff, H.H. (2004). Merging the senses into a robust percept. *Trends Cogn Sci* **8**,162-169.

- Ervilha, U.F., Arendt-Nielsen, L., Duarte, M., Graven-Nielsen, T. (2004a). Effect of load level and muscle pain intensity on the motor control of elbow-flexion movements. *Eur J Appl Physiol* **92**,168-175.
- Ervilha, U.F., Arendt-Nielsen, L., Duarte, M., Graven-Nielsen, T. (2004b). The effect of muscle pain on elbow flexion and coactivation tasks. *Exp Brain Res* **156**,174-182.
- Ervilha, U.F., Farina, D., Arendt-Nielsen, L., Graven-Nielsen, T. (2005). Experimental muscle pain changes motor control strategies in dynamic contractions. *Exp Brain Res* **164**,215-224.
- Ezendam, D., Bongers, R.M., Jannink, M.J. (2009). Systematic review of the effectiveness of mirror therapy in upper extremity function. *Disabil Rehabil* **31**,2135-2149.
- Fadiga, L., Craighero, L., Dri, G., Facchin, P., Destro, M.F., Porro, C.A. (2004). Corticospinal excitability during painful self-stimulation in humans: a transcranial magnetic stimulation study. *Neurosci Lett* **361**,250-253.
- Fahn, S. (1988). Concept and classification of dystonia. *Adv Neurol* **50**,1-8.
- Fahn, S., Williams, D.T. (1988). Psychogenic dystonia. *Adv Neurol* **50**,431-455.
- Falla, D., Farina, D., Graven-Nielsen, T. (2007). Experimental muscle pain results in reorganization of coordination among trapezius muscle subdivisions during repetitive shoulder flexion. *Exp Brain Res* **178**,385-393.
- Falla, D., Arendt-Nielsen, L., Farina, D. (2008). Gender-specific adaptations of upper trapezius muscle activity to acute nociceptive stimulation. *Pain* **138**,217-225.
- Falla, D., Arendt-Nielsen, L., Farina, D. (2009). The pain-induced change in relative activation of upper trapezius muscle regions is independent of the site of noxious stimulation. *Clin Neurophysiol* **120**,150-157.
- Falla, D., Andersen, H., Danneskiold-Samsøe, B., Arendt-Nielsen, L., Farina, D. (2010). Adaptations of upper trapezius muscle activity during sustained contractions in women with fibromyalgia. *J Electromyogr Kinesiol* **20**,457-464.
- Farina, D., Arendt-Nielsen, L., Merletti, R., Graven-Nielsen, T. (2004a). Effect of experimental muscle pain on motor unit firing rate and conduction velocity. *J Neurophysiol* **91**,1250-1259.
- Farina, D., Merletti, R., Enoka, R.M. (2004b). The extraction of neural strategies from the surface EMG. *J Appl Physiol* **96**,1486-1495.
- Farina, D., Arendt-Nielsen, L., Graven-Nielsen, T. (2005a). Experimental muscle pain decreases voluntary EMG activity but does not affect the muscle potential evoked by transcutaneous electrical stimulation. *Clin Neurophysiol* **116**,1558-1565.
- Farina, D., Arendt-Nielsen, L., Graven-Nielsen, T. (2005b). Experimental muscle pain reduces initial motor unit discharge rates during sustained submaximal contractions. *J Appl Physiol* **98**,999-1005.
- Farina, D., Arendt-Nielsen, L., Roatta, S., Graven-Nielsen, T. (2008). The pain-induced decrease in low-threshold motor unit discharge rate is not associated with the amount of increase in spike-triggered average torque. *Clin Neurophysiol* **119**,43-51.
- Farina, S., Valeriani, M., Rosso, T., Aglioti, S., Tamburin, S., Fiaschi, A., Tinazzi, M. (2001). Transient inhibition of the human motor cortex by capsaicin-induced pain. A study with transcranial magnetic stimulation. *Neurosci Lett* **314**,97-101.

- Fernández-Carnero, J., Ge, H.Y., Kimura, Y., Fernández-de-las-Peñas, C., Arendt-Nielsen, L. (2010). Increased spontaneous electrical activity at a latent myofascial trigger point after nociceptive stimulation of another latent trigger point. *Clin J Pain* **26**,138-143.
- Festinger, L., Canon, L.K. (1965). Information about spatial location based on knowledge about efference. *Psychol Rev* **72**,373-384.
- Field, A. (2009). *Discovering statistics using SPSS* (London, UK: Sage Publications).
- Field, J., Gardner, F.V. (1997). Psychological distress associated with algodystrophy. *J Hand Surg Br* **22**,100-101.
- Fierro, B., de Tommaso, M., Giglia, F., Giglia, G., Palermo, A., Brighina, F. (2010). Repetitive transcranial magnetic stimulation (rTMS) of the dorsolateral prefrontal cortex (DLPFC) during capsaicin-induced pain: modulatory effects on motor cortex excitability. *Exp Brain Res* **203**,31-38.
- Fillingim, R.B., King, C.D., Ribeiro-Dasilva, M.C., Rahim-Williams, B., Riley, J.L., III (2009). Sex, gender, and pain: a review of recent clinical and experimental findings. *J Pain* **10**,447-485.
- Fischer, S.G., Zuurmond, W.W., Birklein, F., Loer, S.A., Perez, R.S. (2010). Anti-inflammatory treatment of Complex Regional Pain Syndrome. *Pain* **151**,251-256.
- Fisher, N.I. (1993). *Statistical analysis of circular data* (Cambridge: Cambridge University Press).
- Fisher, R.A. (1915). Frequency distribution of the values of correlation coefficient in samples from an indefinitely large population. *Biometrika* **10**,507-521.
- Floeter, M.K. (2003). Cutaneous silent periods. *Muscle Nerve* **28**,391-401.
- Förderreuther, S., Sailer, U., Straube, A. (2004). Impaired self-perception of the hand in complex regional pain syndrome (CRPS). *Pain* **110**,756-761.
- Fraisse, P. (1982). Rhythm and tempo. In: The psychology of music, D. Deutsch, ed. (New York: Academic Press), pp. 149-180.
- Frettlöh, J., Hüppe, M., Maier, C. (2006). Severity and specificity of neglect-like symptoms in patients with complex regional pain syndrome (CRPS) compared to chronic limb pain of other origins. *Pain* **124**,184-189.
- Friden, J., Lieber, R.L. (1992). Structural and mechanical basis of exercise-induced muscle injury. *Med Sci Sports Exerc* **24**,521-530.
- Fuentes, C.T., Bastian, A.J. (2010). Where is your arm? Variations in proprioception across space and tasks. *J Neurophysiol* **103**,164-171.
- Galer, B.S., Butler, S., Jensen, M.P. (1995). Case reports and hypothesis: a neglect-like syndrome may be responsible for the motor disturbance in reflex sympathetic dystrophy (Complex Regional Pain Syndrome-1). *J Pain Symptom Manage* **10**,385-391.
- Galer, B.S., Henderson, J., Perander, J., Jensen, M.P. (2000). Course of symptoms and quality of life measurement in Complex Regional Pain Syndrome: a pilot survey. *J Pain Symptom Manage* **20**,286-292.
- Gatchel, R.J., Polatin, P.B., Mayer, T.G. (1995). The dominant role of psychosocial risk factors in the development of chronic low back pain disability. *Spine (Phila Pa 1976)* **20**,2702-2709.
- Gay, A., Harbst, K., Kaufman, K.R., Hansen, D.K., Laskowski, E.R., Berger, R.A. (2010). New method of measuring wrist joint position sense avoiding cutaneous and visual inputs. *J Neuroeng Rehabil* **7**,5.

- Ge, H.Y., Arendt-Nielsen, L., Farina, D., Madeleine, P. (2005). Gender-specific differences in electromyographic changes and perceived pain induced by experimental muscle pain during sustained contractions of the upper trapezius muscle. *Muscle Nerve* **32**,726-733.
- Ge, H.Y., Collet, T., Mørch, C.D., Arendt-Nielsen, L., Andersen, O.K. (2007). Depression of the human nociceptive withdrawal reflex by segmental and heterosegmental intramuscular electrical stimulation. *Clin Neurophysiol* **118**,1626-1632.
- Ge, H.Y., Zhang, Y., Boudreau, S., Yue, S.W., Arendt-Nielsen, L. (2008). Induction of muscle cramps by nociceptive stimulation of latent myofascial trigger points. *Exp Brain Res* **187**,623-629.
- Geertzen, J.H., Dijkstra, P.U., van Sonderen, E.L., Groothoff, J.W., ten Duis, H.J., Eisma, W.H. (1998). Relationship between impairments, disability and handicap in reflex sympathetic dystrophy patients: a long-term follow-up study. *Clin Rehabil* **12**,402-412.
- Gentilucci, M., Toni, I., Chieffi, S., Pavesi, G. (1994). The role of proprioception in the control of prehension movements: a kinematic study in a peripherally deafferented patient and in normal subjects. *Exp Brain Res* **99**,483-500.
- Gierthmühlen, J., Maier, C., Baron, R., Tolle, T., Treede, R.D., Birbaumer, N., Hüge, V., Koroschetz, J., Krumova, E.K., Lauchart, M., Maihöfner, C., Richter, H., Westermann, A. (2012). Sensory signs in complex regional pain syndrome and peripheral nerve injury. *Pain* **153**,765-774.
- Goble, D.J., Brown, S.H. (2008). Upper limb asymmetries in the matching of proprioceptive versus visual targets. *J Neurophysiol* **99**,3063-3074.
- Goris, R.J., Reynen, J.A., Veldman, P. (1990). [The clinical symptoms in post-traumatic dystrophy]. *Ned Tijdschr Geneesk* **134**,2138-2141.
- Graven-Nielsen, T., Svensson, P., Arendt-Nielsen, L. (1997a). Effects of experimental muscle pain on muscle activity and co-ordination during static and dynamic motor function. *Electroencephalogr Clin Neurophysiol* **105**,156-164.
- Graven-Nielsen, T., McArdle, A., Phoenix, J., Arendt-Nielsen, L., Jensen, T.S., Jackson, M.J., Edwards, R.H.T. (1997b). In vivo model of muscle pain: quantification of intramuscular chemical, electrical, and pressure changes associated with saline-induced muscle pain in humans. *Pain* **69**,137-143.
- Graven-Nielsen, T., Mense, S. (2001). The peripheral apparatus of muscle pain: evidence from animal and human studies. *Clin J Pain* **17**,2-10.
- Graven-Nielsen, T., Lund, H., Arendt-Nielsen, L., Danneskiold-Samsøe, B., Bliddal, H. (2002). Inhibition of maximal voluntary contraction force by experimental muscle pain: a centrally mediated mechanism. *Muscle Nerve* **26**,708-712.
- Graven-Nielsen, T. (2006). Fundamentals of muscle pain, referred pain, and deep tissue hyperalgesia. *Scand J Rheumatol Suppl* **122**,1-43.
- Grisart, J.M., van der Linden, M. (2001). Conscious and automatic uses of memory in chronic pain patients. *Pain* **94**,305-313.
- Gritsenko, V., Krouchev, N.I., Kalaska, J.F. (2007). Afferent input, efference copy, signal noise, and biases in perception of joint angle during active versus passive elbow movements. *J Neurophysiol* **98**,1140-1154.

- Grönroos, M., Pertovaara, A. (1993). Capsaicin-induced central facilitation of a nociceptive flexion reflex in humans. *Neurosci Lett* **159**,215-218.
- Hallett, M. (2010). Physiology of psychogenic movement disorders. *J Clin Neurosci* **17**,959-965.
- Harden, R.N., Bruehl, S., Galer, B.S., Saltz, S., Bertram, M., Backonja, M., Gayles, R., Rudin, N., Bhugra, M.K., Stanton-Hicks, M. (1999). Complex regional pain syndrome: are the IASP diagnostic criteria valid and sufficiently comprehensive? *Pain* **83**,211-219.
- Harden, R.N., Weinland, S.R., Remble, T.A., Houle, T.T., Colio, S., Steedman, S., Kee, W.G. (2005). Medication Quantification Scale Version III: update in medication classes and revised detriment weights by survey of American Pain Society Physicians. *J Pain* **6**,364-371.
- Harden, R.N., Bruehl, S., Stanton-Hicks, M., Wilson, P.R. (2007). Proposed new diagnostic criteria for complex regional pain syndrome. *Pain Med* **8**,326-331.
- Harden, R.N., Bruehl, S., Perez, R.S., Birklein, F., Marinus, J., Maihöfner, C., Lubenow, T., Buvanendran, A., Mackey, S., Graciosa, J., Mogilevski, M., Ramsden, C., Schlereth, T., Chont, M., Vatine, J.J. (2010). Development of a severity score for CRPS. *Pain* **151**,870-876.
- Harden, R.N., Oaklander, A.L., Burton, A.W., Perez, R.S., Richardson, K., Swan, M., Barthel, J., Costa, B., Graciosa, J.R., Bruehl, S. (2013). Complex regional pain syndrome: practical diagnostic and treatment guidelines, 4th edition. *Pain Med* **14**,180-229.
- Hawley, J.S., Weiner, W.J. (2011). Psychogenic dystonia and peripheral trauma. *Neurology* **77**,496-502.
- Hemsdörfer, J., Nowak, D.A. (2009). Disorders of the somatosensory system. In: Sensorimotor control of grasping: Physiology and pathophysiology, J. Hemsdörfer, and D.A. Nowak, eds. (Cambridge: Cambridge University Press), pp. 269-284.
- Henriksen, M., Alkjaer, T., Lund, H., Simonsen, E.B., Graven-Nielsen, T., Danneskiold-Samsøe, B., Bliddal, H. (2007). Experimental quadriceps muscle pain impairs knee joint control during walking. *J Appl Physiol* **103**,132-139.
- Henriksen, M., Christensen, R., Alkjaer, T., Lund, H., Simonsen, E.B., Bliddal, H. (2008). Influence of pain and gender on impact loading during walking: a randomised trial. *Clin Biomech* **23**,221-230.
- Henriksen, M., Aaboe, J., Simonsen, E.B., Alkjaer, T., Bliddal, H. (2009a). Experimentally reduced hip abductor function during walking: Implications for knee joint loads. *J Biomech* **42**,1236-1240.
- Henriksen, M., Alkjaer, T., Simonsen, E.B., Bliddal, H. (2009b). Experimental muscle pain during a forward lunge—the effects on knee joint dynamics and electromyographic activity. *Br J Sports Med* **43**,503-507.
- Henriksen, M., Graven-Nielsen, T., Aaboe, J., Andriacchi, T.P., Bliddal, H. (2010a). Gait changes in patients with knee osteoarthritis are replicated by experimental knee pain. *Arthritis Care Res* **62**,501-509.
- Henriksen, M., Rosager, S., Aaboe, J., Graven-Nielsen, T., Bliddal, H. (2010b). Experimental knee pain reduces muscle strength. *J Pain* **12**,460-467.
- Henriksen, M., Aaboe, J., Graven-Nielsen, T., Bliddal, H., Langberg, H. (2011). Motor responses to experimental Achilles tendon pain. *Br J Sports Med* **45**,393-398.
- Heslinga, J.W., Huijting, P.A. (1992). Effects of short length immobilization of medial gastrocnemius muscle of growing young adult rats. *Eur J Morphol* **30**,257-273.

- Heuer, H., Klein, W. (2005). Intermanual interactions in discrete and periodic bimanual movements with same and different amplitudes. *Exp Brain Res* **167**,220-237.
- Hinder, M.R., Schmidt, M.W., Garry, M.I., Summers, J.J. (2010). Unilateral contractions modulate interhemispheric inhibition most strongly and most adaptively in the homologous muscle of the contralateral limb. *Exp Brain Res* **205**,423-433.
- Hinrichs-Rocker, A., Schulz, K., Jarvinen, I., Lefering, R., Simanski, C., Neugebauer, E.A. (2009). Psychosocial predictors and correlates for chronic post-surgical pain (CPSP) - a systematic review. *Eur J Pain* **13**,719-730.
- Hirata, R.P., Arendt-Nielsen, L., Graven-Nielsen, T. (2010). Experimental calf muscle pain attenuates the postural stability during quiet stance and perturbation. *Clin Biomech* **25**,931-937.
- Hodges, P.W., Ervilha, U.F., Graven-Nielsen, T. (2008). Changes in motor unit firing rate in synergist muscles cannot explain the maintenance of force during constant force painful contractions. *J Pain* **9**,1169-1174.
- Hodges, P.W., Mellor, R., Crossley, K., Bennell, K. (2009). Pain induced by injection of hypertonic saline into the infrapatellar fat pad and effect on coordination of the quadriceps muscles. *Arthritis Rheum* **61**,70-77.
- Hodges, P.W., Tucker, K. (2011). Moving differently in pain: a new theory to explain the adaptation to pain. *Pain* **152**,S90-S98.
- Hoeger Bement, M.K., Weyer, A., Hartley, S., Yoon, T., Hunter, S.K. (2009). Fatiguing exercise attenuates pain-induced corticomotor excitability. *Neurosci Lett* **452**,209-213.
- Huge, V., Lauchart, M., Forderreuther, S., Kaufhold, W., Valet, M., Azad, S.C., Beyer, A., Magerl, W. (2008). Interaction of hyperalgesia and sensory loss in complex regional pain syndrome type I (CRPS I). *PLoS One* **3**,e2742.
- Huge, V., Lauchart, M., Magerl, W., Beyer, A., Moehle, P., Kaufhold, W., Schelling, G., Azad, S.C. (2011). Complex interaction of sensory and motor signs and symptoms in chronic CRPS. *PLoS One* **6**,e18775.
- Huijing, P.A. (2007). Epimuscular myofascial force transmission between antagonistic and synergistic muscles can explain movement limitation in spastic paresis. *J Electromyogr Kinesiol* **17**,708-724.
- Hulsman, N.M., Geertzen, J.H., Dijkstra, P.U., van den Dungen, J.J., den Dunnen, W.F. (2009). Myopathy in CRPS-I: disuse or neurogenic? *Eur J Pain* **13**,731-736.
- Inghilleri, M., Cruccu, G., Argenta, M., Polidori, L., Manfredi, M. (1997). Silent period in upper limb muscles after noxious cutaneous stimulation in man. *Electroencephalogr Clin Neurophysiol* **105**,109-115.
- Ito, M. (1970). Neurophysiological aspects of the cerebellar motor control system. *Int J Neurol* **7**,162-176.
- Jaberzadeh, S., Svensson, P., Nordstrom, M.A., Miles, T.S. (2003). Differential modulation of tremor and pulsatile control of human jaw and finger by experimental muscle pain. *Exp Brain Res* **150**,520-524.
- Jankovic, J. (1998). Medical therapy and botulinum toxin in dystonia. *Adv Neurol* **78**,169-183.
- Jankowska, E. (1992). Interneuronal relay in spinal pathways from proprioceptors. *Prog Neurobiol* **38**,335-378.
- Janwantanakul, P., Magarey, M.E., Jones, M.A., Dansie, B.R. (2001). Variation in shoulder position sense at mid and extreme range of motion. *Arch Phys Med Rehabil* **82**,840-844.

- Johansson, H., Sojka, P. (1991). Pathophysiological mechanisms involved in genesis and spread of muscular tension in occupational muscle pain and in chronic musculoskeletal pain syndromes: a hypothesis. *Med Hypotheses* **35**,196-203.
- Jones, S.A., Cressman, E.K., Henriques, D.Y. (2010). Proprioceptive localization of the left and right hands. *Exp Brain Res* **204**,373-383.
- Juottonen, K., Gockel, M., Silen, T., Hurri, H., Hari, R., Forss, N. (2002). Altered central sensorimotor processing in patients with complex regional pain syndrome. *Pain* **98**,315-323.
- Kaneko, K., Kawai, S., Taguchi, T., Fuchigami, Y., Yonemura, H., Fujimoto, H. (1998). Cortical motor neuron excitability during cutaneous silent period. *Electroencephalogr Clin Neurophysiol* **109**,364-368.
- Katz, R., Pierrot-Deseilligny, E. (1999). Recurrent inhibition in humans. *Prog Neurobiol* **57**,325-355.
- Kemler, M.A., Schouten, H.J., Gracely, R.H. (2000). Diagnosing sensory abnormalities with either normal values or values from contralateral skin: comparison of two approaches in complex regional pain syndrome I. *Anesthesiology* **93**,718-727.
- Kirveskari, E., Vartiainen, N.V., Gockel, M., Forss, N. (2010). Motor cortex dysfunction in complex regional pain syndrome. *Clin Neurophysiol* **121**,1085-1091.
- Knikou, M. (2008). The H-reflex as a probe: pathways and pitfalls. *J Neurosci Methods* **171**,1-12.
- Knutson, G.A. (2000). The role of the [gamma]-motor system in increasing muscle tone and muscle pain syndromes: A review of the Johansson/Sojka hypothesis. *J Manipulative Physiol Ther* **23**,564-572.
- Kofler, M., Glocker, F.X., Leis, A.A., Seifert, C., Wissel, J., Kronenberg, M.F., Fuhr, P. (1998). Modulation of upper extremity motoneurone excitability following noxious finger tip stimulation in man: a study with transcranial magnetic stimulation. *Neurosci Lett* **246**,97-100.
- Kofler, M., Fuhr, P., Leis, A.A., Glocker, F.X., Kronenberg, M.F., Wissel, J., Stetkarova, I. (2001). Modulation of upper extremity motor evoked potentials by cutaneous afferents in humans. *Clin Neurophysiol* **112**,1053-1063.
- Krause, P., Förderreuther, S., Straube, A. (2004). Bilateral motor cortex disinhibition in complex regional pain syndrome (CRPS) type I of the hand. *Neurology* **62**,1654-1655.
- Krause, P., Frderreuther, S., Straube, A. (2006). TMS motor cortical brain mapping in patients with complex regional pain syndrome type I. *Clin Neurophysiol* **117**,169-176.
- Kuner, R. (2010). Central mechanisms of pathological pain. *Nat Med* **16**,1258-1266.
- Latremliere, A., Woolf, C.J. (2009). Central sensitization: a generator of pain hypersensitivity by central neural plasticity. *J Pain* **10**,895-926.
- Laufer, Y., Hocherman, S. (1998). Visual and kinesthetic control of goal-directed movements to visually and kinesthetically presented targets. *Percept Mot Skills* **86**,1375-1391.
- Laufer, Y., Hocherman, S., Dickstein, R. (2001). Accuracy of reproducing hand position when using active compared with passive movement. *Physiother Res Int* **6**,65-75.

- le Pera, D., Graven-Nielsen, T., Valeriani, M., Oliviero, A., Di Lazzaro, V., Tonali, P.A., Arendt-Nielsen, L. (2001). Inhibition of motor system excitability at cortical and spinal level by tonic muscle pain. *Clin Neurophysiol* **112**,1633-1641.
- Leis, S., Weber, M., Isselmann, A., Schmelz, M., Bircklein, F. (2003). Substance-P-induced protein extravasation is bilaterally increased in complex regional pain syndrome. *Exp Neurol* **183**,197-204.
- Lenz, M., Hoffken, O., Stude, P., Lissek, S., Schwenkreis, P., Reinersmann, A., Frettlow, J., Richter, H., Tegenthoff, M., Maier, C. (2011). Bilateral somatosensory cortex disinhibition in complex regional pain syndrome type I. *Neurology* **77**,1096-1101.
- Lewis, J.S., Kersten, P., McCabe, C.S., McPherson, K.M., Blake, D.R. (2007). Body perception disturbance: a contribution to pain in complex regional pain syndrome (CRPS). *Pain* **133**,111-119.
- Lewis, J.S., Kersten, P., McPherson, K.M., Taylor, G.J., Harris, N., McCabe, C.S., Blake, D.R. (2010). Wherever is my arm? Impaired upper limb position accuracy in complex regional pain syndrome. *Pain* **149**,463-469.
- Longo, M.R., Haggard, P. (2010). An implicit body representation underlying human position sense. *Proc Natl Acad Sci U S A* **107**,11727-11732.
- Lönn, J., Crenshaw, A.G., Djupsjöbacka, M., Pedersen, J., Johansson, H. (2000). Position sense testing: influence of starting position and type of displacement. *Arch Phys Med Rehabil* **81**,592-597.
- Lund, J.P., Donga, R., Widmer, C.G., Stohler, C.S. (1991). The pain-adaptation model: a discussion of the relationship between chronic musculoskeletal pain and motor activity. *Can J Physiol Pharmacol* **69**,683-694.
- Madeleine, P., Voigt, M., Arendt-Nielsen, L. (1998). Subjective, physiological and biomechanical responses to prolonged manual work performed standing on hard and soft surfaces. *Eur J Appl Physiol Occup Physiol* **77**,1-9.
- Madeleine, P., Lundager, B., Voigt, M., Arendt-Nielsen, L. (1999a). Shoulder muscle co-ordination during chronic and acute experimental neck-shoulder pain. An occupational pain study. *Eur J Appl Physiol Occup Physiol* **79**,127-140.
- Madeleine, P., Voigt, M., Arendt-Nielsen, L. (1999b). Reorganisation of human step initiation during acute experimental muscle pain. *Gait Posture* **10**,240-247.
- Madeleine, P., Prietzel, H., Svarrar, H., Arendt-Nielsen, L. (2004). Quantitative posturography in altered sensory conditions: a way to assess balance instability in patients with chronic whiplash injury. *Arch Phys Med Rehabil* **85**,432-438.
- Madeleine, P., Arendt-Nielsen, L. (2005). Experimental muscle pain increases mechanomyographic signal activity during sub-maximal isometric contractions. *J Electromyogr Kinesiol* **15**,27-36.
- Madeleine, P., Leclerc, F., Arendt-Nielsen, L., Ravier, P., Farina, D. (2006). Experimental muscle pain changes the spatial distribution of upper trapezius muscle activity during sustained contraction. *Clin Neurophysiol* **117**,2436-2445.
- Madeleine, P., Mathiassen, S.E., Arendt-Nielsen, L. (2008). Changes in the degree of motor variability associated with experimental and chronic neck-shoulder pain during a standardised repetitive arm movement. *Exp Brain Res* **185**,689-698.

- Maier, C., Baron, R., Tolle, T.R., Binder, A., Birbaumer, N., Birklein, F., Gierthmuhlen, J., Flor, H., Geber, C., Hüge, V., Krumova, E.K., Landwehrmeyer, G.B., Magerl, W., Maihofner, C., Richter, H., Rolke, R., Scherens, A., Schwarz, A., Sommer, C., Tronnier, V., Uceyler, N., Valet, M., Wasner, G., Treede, R.D. (2010). Quantitative sensory testing in the German Research Network on Neuropathic Pain (DFNS): somatosensory abnormalities in 1236 patients with different neuropathic pain syndromes. *Pain* **150**,439-450.
- Maihofner, C., Handwerker, H.O., Neundorfer, B., Birklein, F. (2003). Patterns of cortical reorganization in complex regional pain syndrome. *Neurology* **61**,1707-1715.
- Maihofner, C., Baron, R., DeCol, R., Binder, A., Birklein, F., Deuschl, G., Handwerker, H.O., Schattschneider, J. (2007). The motor system shows adaptive changes in complex regional pain syndrome. *Brain* **130**,2671-2687.
- Malaiya, R., McNee, A.E., Fry, N.R., Eve, L.C., Gough, M., Shortland, A.P. (2007). The morphology of the medial gastrocnemius in typically developing children and children with spastic hemiplegic cerebral palsy. *J Electromyogr Kinesiol* **17**,657-663.
- Malfait, N., Sanger, T.D. (2007). Does dystonia always include co-contraction? A study of unconstrained reaching in children with primary and secondary dystonia. *Exp Brain Res* **176**,206-216.
- Mardia, K.V. (1972). *Statistical analysis of directional data* (London: Academic Press).
- Marinus, J., Moseley, G.L., Birklein, F., Baron, R., Maihofner, C., Kingery, W.S., van Hilten, J.J. (2011). Clinical features and pathophysiology of complex regional pain syndrome. *Lancet Neurol* **10**,637-648.
- Marinus, J., Perez, R.S., van Eijs, F., van Gestel, M.A., Geurts, J.W., Huygen, F.J., Bauer, M.C., van Hilten, J.J. (2013). The role of pain coping and kinesiophobia in patients with complex regional pain syndrome type 1 of the legs. *Clin J Pain* **29**,563-569.
- Martin, P.G., Weerakkody, N., Gandevia, S.C., Taylor, J.L. (2008). Group III and IV muscle afferents differentially affect the motor cortex and motoneurons in humans. *J Physiol* **586**,1277-1289.
- Masuda, K., Masuda, T., Sadoyama, T., Inaki, M., Katsuta, S. (1999). Changes in surface EMG parameters during static and dynamic fatiguing contractions. *J Electromyogr Kinesiol* **9**,39-46.
- Matre, D.A., Sinkjaer, T., Svensson, P., Arendt-Nielsen, L. (1998). Experimental muscle pain increases the human stretch reflex. *Pain* **75**,331-339.
- Matre, D.A., Sinkjaer, T., Knardahl, S., Andersen, J.B., Arendt-Nielsen, L. (1999). The influence of experimental muscle pain on the human soleus stretch reflex during sitting and walking. *Clin Neurophysiol* **110**,2033-2043.
- Matre, D., Arendt-Nielsen, L., Knardahl, S. (2002). Effects of localization and intensity of experimental muscle pain on ankle joint proprioception. *Eur J Pain* **6**,245-260.
- McCabe, C.S., Blake, D.R. (2008). An embarrassment of pain perceptions? Towards an understanding of and explanation for the clinical presentation of CRPS type 1. *Rheumatology (Oxford)* **47**,1612-1616.
- Medina, J., Jax, S.A., Brown, M.J., Coslett, H.B. (2010). Contributions of efference copy to limb localization: evidence from deafferentation. *Brain Res* **1355**,104-111.
- Mel'nichouk, A.P., Bulgakova, N.V., Tal'nov, A.N., Hellstrom, F., Windhorst, U., Kostyukov, A.I. (2007). Movement-dependent positioning errors in human elbow joint movements. *Exp Brain Res* **176**,237-247.

- Melzack, R. (1975). The McGill Pain Questionnaire: major properties and scoring methods. *Pain* **1**,277-299.
- Mense, S. (1993). Nociception from skeletal muscle in relation to clinical muscle pain. *Pain* **54**,241-289.
- Merskey, H., Bogduk, N. (1994). *Classification of chronic pain: descriptions of chronic pain syndromes and definitions of pain terms* (Seattle, WA: IASP Press).
- Miall, R.C., Weir, D.J., Wolpert, D.M., Stein, J.F. (1993). Is the cerebellum a smith predictor? *J Mot Behav* **25**,203-216.
- Millan, M.J. (1999). The induction of pain: an integrative review. *Prog Neurobiol* **57**,1-164.
- Moseley, G.L. (2005). Distorted body image in complex regional pain syndrome. *Neurology* **65**,773.
- Mugge, W., Munts, A.G., Schouten, A.C., van der Helm, F.C. (2012a). Modeling movement disorders--CRPS-related dystonia explained by abnormal proprioceptive reflexes. *J Biomech* **45**,90-98.
- Mugge, W., Schouten, A.C., Bast, G.J., Schuurmans, J., van Hilten, J.J., van der Helm, F.C. (2012b). Stretch reflex responses in Complex Regional Pain Syndrome-related dystonia are not characterized by hyperreflexia. *Clin Neurophysiol* **123**,569-576.
- Mugge, W., van der Helm, F.C., Schouten, A.C. (2013). Integration of sensory force feedback is disturbed in CRPS-related dystonia. *PLoS One* **8**,e60293.
- Munts, A.G., van der Plas, A.A., Voormolen, J.H., Marinus, J., Teepe-Twiss, I.M., Onkenhout, W., van Gerven, J.M., van Hilten, J.J. (2009). Intrathecal glycine for pain and dystonia in complex regional pain syndrome. *Pain* **146**,199-204.
- Munts, A.G., Koehler, P.J. (2010). How psychogenic is dystonia? Views from past to present. *Brain* **133**,1552-1564.
- Munts, A.G., Mugge, W., Meurs, T.S., Schouten, A.C., Marinus, J., Moseley, G.L., van der Helm, F.C., van Hilten, J.J. (2011a). Fixed dystonia in complex regional pain syndrome: a descriptive and computational modeling approach. *BMC Neurol* **11**,53.
- Munts, A.G., van Rijn, M.A., Geraedts, E.J., van Hilten, J.J., van Dijk, J.G., Marinus, J. (2011b). Thermal hypesthesia in patients with complex regional pain syndrome related dystonia. *J Neural Transm* **118**,599-603.
- Murase, N., Duque, J., Mazzocchio, R., Cohen, L.G. (2004). Influence of interhemispheric interactions on motor function in chronic stroke. *Ann Neurol* **55**,400-409.
- Nelson, A.J., Hoque, T., Gunraj, C., Ni, Z., Chen, R. (2010). Impaired interhemispheric inhibition in writer's cramp. *Neurology* **75**,441-447.
- Niddam, D.M., Hsieh, J.C. (2008). Sensory modulation in cingulate motor area by tonic muscle pain: a pilot study. *J Med Biol Eng* **28**,135-138.
- Niehof, S.P., Huygen, F.J., van der Weerd, R.W., Westra, M., Zijlstra, F.J. (2006). Thermography imaging during static and controlled thermoregulation in complex regional pain syndrome type 1: diagnostic value and involvement of the central sympathetic system. *Biomed Eng Online* **5**,30.
- Niehof, S.P., Huygen, F.J., Stronks, D.L., Klein, J., Zijlstra, F.J. (2007). Reliability of observer assessment of thermographic images in complex regional pain syndrome type 1. *Acta Orthop Belg* **73**,31-37.

- Ochoa, J.L., Verdugo, R.J. (1995). Reflex sympathetic dystrophy. A common clinical avenue for somatoform expression. *Neurol Clin* **13**,351-363.
- Oerlemans, H.M., Oostendorp, R.A., de, B.T., Goris, R.J. (1999). Pain and reduced mobility in complex regional pain syndrome I: outcome of a prospective randomised controlled clinical trial of adjuvant physical therapy versus occupational therapy. *Pain* **83**,77-83.
- Oerlemans, H.M., Cup, E.H., DeBoo, T., Goris, R.J., Oostendorp, R.A. (2000a). The Radboud skills questionnaire: construction and reliability in patients with reflex sympathetic dystrophy of one upper extremity. *Disabil Rehabil* **22**,233-245.
- Oerlemans, H.M., Oostendorp, R.A., de, B.T., van der Laan, L., Severens, J.L., Goris, J.A. (2000b). Adjuvant physical therapy versus occupational therapy in patients with reflex sympathetic dystrophy/complex regional pain syndrome type I. *Arch Phys Med Rehabil* **81**,49-56.
- Oldfield, R.C. (1971). The assessment and analysis of handedness: the Edinburgh inventory. *Neuropsychologia* **9**,97-113.
- Oyen, W.J., Arntz, I.E., Claessens, R.M., van der Meer, J.W., Corstens, F.H., Goris, R.J. (1993). Reflex sympathetic dystrophy of the hand: an excessive inflammatory response? *Pain* **55**,151-157.
- Paillard, J., and Brouchon, M. (1968). Active and passive movements in the calibration of position sense. In: *The neuropsychology of spatially oriented behavior*, S.J. Freedman, ed. (Homewood Ill.: Dorsey Press), pp. 37-55.
- Pareés, I., Kassavetis, P., Saifee, T.A., Sadnicka, A., Davare, M., Bhatia, K.P., Rothwell, J.C., Bestmann, S., Edwards, M.J. (2013). Failure of explicit movement control in patients with functional motor symptoms. *Mov Disord* **28**,517-523.
- Park, S., Toole, T., Lee, S. (1999). Functional roles of the proprioceptive system in the control of goal-directed movement. *Percept Mot Skills* **88**,631-647.
- Parkitny, L., McAuley, J.H., Di Pietro, F., Stanton, T.R., O'Connell, N.E., Marinus, J., van Hilten, J.J., Moseley, G.L. (2013). Inflammation in complex regional pain syndrome: a systematic review and meta-analysis. *Neurology* **80**,106-117.
- Peltz, E., Seifert, F., Lanz, S., Muller, R., Maihofner, C. (2011). Impaired hand size estimation in CRPS. *J Pain* **12**,1095-1101.
- Peper, C.L., de Boer, B.J., de Poel, H.J., Beek, P.J. (2008). Interlimb coupling strength scales with movement amplitude. *Neurosci Lett* **437**,10-14.
- Perez, R.S., Roorda, L.D., Zuurmond, W.W., Bannink, I.I., Vranken, J.H., de Lange, J.J. (2002). Measuring perceived activity limitations in lower extremity Complex Regional Pain Syndrome type 1 (CRPS I): test-retest reliability of two questionnaires. *Clin Rehabil* **16**,454-460.
- Peyron, R., Laurent, B., Garcia-Larrea, L. (2000). Functional imaging of brain responses to pain. A review and meta-analysis (2000). *Neurophysiol Clin* **30**,263-288.
- Piercey, M.F., Goldfarb, J. (1974). Discharge patterns of Renshaw cells evoked by volleys in ipsilateral cutaneous and high-threshold muscle afferents and their relationship to reflexes recorded in ventral roots. *J Neurophysiol* **37**,294-302.

- Pierrot-Deseilligny, E., Burke, D. (2005). *The circuitry of the human spinal cord: Its role in motor control and movement disorders* (Cambridge: Cambridge University Press).
- Pincus, T., Burton, A.K., Vogel, S., Field, A.P. (2002). A systematic review of psychological factors as predictors of chronicity/disability in prospective cohorts of low back pain. *Spine (Phila Pa 1976)* **27**,E109-E120.
- Pleger, B., Tegenthoff, M., Schwenkreis, P., Janssen, F., Ragert, P., Dinse, H.R., Volker, B., Zenz, M., Maier, C. (2004). Mean sustained pain levels are linked to hemispherical side-to-side differences of primary somatosensory cortex in the complex regional pain syndrome I. *Exp Brain Res* **155**,115-119.
- Proske, U., Gandevia, S.C. (2012). The proprioceptive senses: their roles in signaling body shape, body position and movement, and muscle force. *Physiol Rev* **92**,1651-1697.
- Puchalski, P., Zyluk, A. (2005). Complex regional pain syndrome type 1 after fractures of the distal radius: a prospective study of the role of psychological factors. *J Hand Surg Br* **30**,574-580.
- Qerama, E., Fuglsang-Frederiksen, A., Kasch, H., Bach, F.W., Jensen, T.S. (2005). Effects of evoked pain on the electromyogram and compound muscle action potential of the brachial biceps muscle. *Muscle Nerve* **31**,25-33.
- Racine, M., Tousignant-Laflamme, Y., Kloda, L.A., Dion, D., Dupuis, G., Choiniere, M. (2012). A systematic literature review of 10years of research on sex/gender and experimental pain perception - Part 1: Are there really differences between women and men? *Pain* **153**,602-618.
- Rainville, J., Smeets, R.J., Bendix, T., Tveito, T.H., Poiraudau, S., Indahl, A.J. (2011). Fear-avoidance beliefs and pain avoidance in low back pain--translating research into clinical practice. *Spine J* **11**,895-903.
- Reedijk, W.B., van Rijn, M.A., Roelofs, K., Tuijl, J.P., Marinus, J., van Hilten, J.J. (2008). Psychological features of patients with complex regional pain syndrome type I related dystonia. *Mov Disord* **23**,1551-1559.
- Reilmann, R., Bohlen, S., Klopstock, T., Bender, A., Weindl, A., Saemann, P., Auer, D.P., Ringelstein, E.B., Lange, H.W. (2010). Grasping premanifest Huntington's disease - shaping new endpoints for new trials. *Mov Disord* **25**,2858-2862.
- Reilmann, R., Holtbernd, F., Bachmann, R., Mohammadi, S., Ringelstein, E.B., Deppe, M. (2013). Grasping multiple sclerosis: do quantitative motor assessments provide a link between structure and function? *J Neurol* **260**,407-414.
- Ribbers, G.M., Mulder, T., Geurts, A.C., den Otter, R.A. (2002). Reflex sympathetic dystrophy of the left hand and motor impairments of the unaffected right hand: impaired central motor processing? *Arch Phys Med Rehabil* **83**,81-85.
- Ridderikhoff, A., Daffertshofer, A., Peper, C.L., Beek, P.J. (2005a). Mirrored EMG activity during unimanual rhythmic movements. *Neurosci Lett* **381**,228-233.
- Ridderikhoff, A., Peper, C.L., Beek, P.J. (2005b). Unraveling interlimb interactions underlying bimanual coordination. *J Neurophysiol* **94**,3112-3125.
- Ridderikhoff, A., Peper, C.L., Beek, P.J. (2006). Bilateral phase entrainment by movement-elicited afference contributes equally to the stability of in-phase and antiphase coordination. *Neurosci Lett* **399**,71-75.
- Ridderikhoff, A., Peper, C.L., Beek, P.J. (2007). Error correction in bimanual coordination benefits from bilateral muscle activity: evidence from kinesthetic tracking. *Exp Brain Res* **181**,31-48.

- Roby-Brami, A., Bussel, B., Willer, J.C., Le Bars, D. (1987). An electrophysiological investigation into the pain-relieving effects of heterotopic nociceptive stimuli. *Brain* **110**,1497-1508.
- Roerdink, M. (2008). *Anchoring: Moving from theory to therapy* (Amsterdam: VU University).
- Roorda, L.D., Molenaar, I.W., Lankhorst, G.J., Bouter, L.M. (2005a). Improvement of a questionnaire measuring activity limitations in rising and sitting down in patients with lower-extremity disorders living at home. *Arch Phys Med Rehabil* **86**,2204-2210.
- Roorda, L.D., Roebroeck, M.E., van Tilburg, T., Molenaar, I.W., Lankhorst, G.J., Bouter, L.M., Boonstra, A.M., de Laat, F.A., Caron, J.J., Burger, B.J., Heyligers, I.C., Nollet, F., Stover-van Herk, I.E., Perez, R.S., Meijer, J.W., Rijken, P.M. (2005b). Measuring activity limitations in walking: development of a hierarchical scale for patients with lower-extremity disorders who live at home. *Arch Phys Med Rehabil* **86**,2277-2283.
- Rossi, A., Decchi, B. (1995). Cutaneous nociceptive facilitation of Ib heteronymous pathways to lower limb motoneurons in humans. *Brain Res* **700**,164-172.
- Rossi, A., Zalaffi, A., Decchi, B. (1996). Interaction of nociceptive and non-nociceptive cutaneous afferents from foot sole in common reflex pathways to tibialis anterior motoneurons in humans. *Brain Res* **714**,76-86.
- Rossi, A., Decchi, B. (1997). Changes in Ib heteronymous inhibition to soleus motoneurons during cutaneous and muscle nociceptive stimulation in humans. *Brain Res* **774**,55-61.
- Rossi, A., Decchi, B., Groccia, V., Della Volpe, R., Spidalieri, R. (1998). Interactions between nociceptive and non-nociceptive afferent projections to cerebral cortex in humans. *Neurosci Lett* **248**,155-158.
- Rossi, A., Decchi, B., Dami, S., Della Volpe, R., Groccia, V. (1999a). On the effect of chemically activated fine muscle afferents on interneurons mediating group I non-reciprocal inhibition of extensor ankle and knee muscles in humans. *Brain Res* **815**,106-110.
- Rossi, A., Decchi, B., Ginanneschi, F. (1999b). Presynaptic excitability changes of group Ia fibres to muscle nociceptive stimulation in humans. *Brain Res* **818**,12-22.
- Rossi, A., Mazzocchio, R., Decchi, B. (2003a). Effect of chemically activated fine muscle afferents on spinal recurrent inhibition in humans. *Clin Neurophysiol* **114**,279-287.
- Rossi, S., Della Volpe, R., Ginanneschi, F., Olivelli, M., Bartalini, S., Spidalieri, R., Rossi, A. (2003b). Early somatosensory processing during tonic muscle pain in humans: relation to loss of proprioception and motor 'defensive' strategies. *Clin Neurophysiol* **114**,1351-1358.
- Samani, A., Holtermann, A., Sogaard, K., Madeleine, P. (2009). Experimental pain leads to reorganisation of trapezius electromyography during computer work with active and passive pauses. *Eur J Appl Physiol* **106**,857-866.
- Samani, A., Fernández-Carnero, J., Arendt-Nielsen, L., Madeleine, P. (2010). Interactive effects of acute experimental pain in trapezius and sore wrist extensor on the electromyography of the forearm muscles during computer work. *Appl Ergon* **42**,735-740.
- Sandrini, G., Serrao, M., Rossi, P., Romaniello, A., Cruccu, G., Willer, J.C. (2005). The lower limb flexion reflex in humans. *Prog Neurobiol* **77**,353-395.
- Savaş, S., Baloglu, H.H., Ay, G., Cerci, S.S. (2009). The effect of sequel symptoms and signs of Complex Regional Pain Syndrome type 1 on upper extremity disability and quality of life. *Rheumatol Int* **29**,545-550.

- Schilder, J.C., Schouten, A.C., Perez, R.S., Huygen, F.J., Dahan, A., Noldus, L.P., van Hilten, J.J., Marinus, J. (2012). Motor control in complex regional pain syndrome: a kinematic analysis. *Pain* **153**,805-812.
- Schilder, J.C., Sigtermans, M.J., Schouten, A.C., Putter, H., Dahan, A., Noldus, L.P., Marinus, J., van Hilten, J.J. (2013). Pain relief is associated with improvement in motor function in complex regional pain syndrome type 1: Secondary analysis of a placebo-controlled study on the effects of ketamine. *J Pain* **14**,1514-1521.
- Schmit, B.D., Hornby, T.G., Tysseling-Mattiace, V.M., Benz, E.N. (2003). Absence of local sign withdrawal in chronic human spinal cord injury. *J Neurophysiol* **90**,3232-3241.
- Schöner, G., Haken, H., Kelso, J.A. (1986). A stochastic theory of phase transitions in human hand movement. *Biol Cybern* **53**,247-257.
- Schouten, A.C., van de Beek, W.J., van Hilten, J.J., van der Helm, F.C. (2003). Proprioceptive reflexes in patients with reflex sympathetic dystrophy. *Exp Brain Res* **151**,1-8.
- Schrag, A., Trimble, M., Quinn, N., Bhatia, K. (2004). The syndrome of fixed dystonia: an evaluation of 103 patients. *Brain* **127**,2360-2372.
- Schulte, E., Ciubotariu, A., Arendt-Nielsen, L., Disselhorst-Klug, C., Rau, G., Graven-Nielsen, T. (2004). Experimental muscle pain increases trapezius muscle activity during sustained isometric contractions of arm muscles. *Clin Neurophysiol* **115**,1767-1778.
- Schwartzman, R.J., Kerrigan, J. (1990). The movement disorder of reflex sympathetic dystrophy. *Neurology* **40**,57-61.
- Schwartzman, R.J., Alexander, G.M., Grothusen, J.R., Paylor, T., Reichenberger, E., Perreault, M. (2009). Outpatient intravenous ketamine for the treatment of complex regional pain syndrome: a double-blind placebo controlled study. *Pain* **147**,107-115.
- Schwenkreis, P., Janssen, F., Rommel, O., Pleger, B., Volker, B., Hosbach, I., Dertwinkel, R., Maier, C., Tegenthoff, M. (2003). Bilateral motor cortex disinhibition in complex regional pain syndrome (CRPS) type I of the hand. *Neurology* **61**,515-519.
- Schwenkreis, P., Maier, C., Tegenthoff, M. (2009). Functional imaging of central nervous system involvement in complex regional pain syndrome. *AJNR Am J Neuroradiol* **30**,1279-1284.
- Schwingschuh, P., Katschnig, P., Seiler, S., Saifee, T.A., Aguirregomez, M., Cordvari, C., Schmidt, R., Rothwell, J.C., Bhatia, K.P., Edwards, M.J. (2011). Moving toward "laboratory-supported" criteria for psychogenic tremor. *Mov Disord* **26**,2509-2515.
- Seifert, F., Maihöfner, C. (2009). Central mechanisms of experimental and chronic neuropathic pain: findings from functional imaging studies. *Cell Mol Life Sci* **66**,375-390.
- Serrao, M., Rossi, P., Sandrini, G., Parisi, L., Amabile, G.A., Nappi, G., Pierelli, F. (2004). Effects of diffuse noxious inhibitory controls on temporal summation of the RIII reflex in humans. *Pain* **112**,353-360.
- Serrao, M., Arendt-Nielsen, L., Ge, H.Y., Pierelli, F., Sandrini, G., Farina, D. (2007). Experimental muscle pain decreases the frequency threshold of electrically elicited muscle cramps. *Exp Brain Res* **182**,301-308.
- Shortland, A.P., Harris, C.A., Gough, M., Robinson, R.O. (2002). Architecture of the medial gastrocnemius in children with spastic diplegia. *Dev Med Child Neurol* **44**,158-163.

- Sigtermans, M.J., van Hilten, J.J., Bauer, M.C., Arbous, M.S., Marinus, J., Sarton, E.Y., Dahan, A. (2009). Ketamine produces effective and long-term pain relief in patients with Complex Regional Pain Syndrome Type 1. *Pain* **145**,304-311.
- Slater, H., Arendt-Nielsen, L., Wright, A., Graven-Nielsen, T. (2003). Experimental deep tissue pain in wrist extensors: a model of lateral epicondylalgia. *Eur J Pain* **7**,277-288.
- Slater, H., Arendt-Nielsen, L., Wright, A., Graven-Nielsen, T. (2005). Sensory and motor effects of experimental muscle pain in patients with lateral epicondylalgia and controls with delayed onset muscle soreness. *Pain* **114**,118-130.
- Slifkin, A.B., Vaillancourt, D.E., Newell, K.M. (2000). Intermittency in the control of continuous force production. *J Neurophysiol* **84**,1708-1718.
- Smith, R., Pearce, S.L., Miles, T.S. (2006). Experimental muscle pain does not affect fine motor control of the human hand. *Exp Brain Res* **174**,397-402.
- Soderberg, G.L., Knutson, L.M. (2000). A guide for use and interpretation of kinesiological electromyographic data. *Phys Ther* **80**,485-498.
- Sonnenborg, F.A., Andersen, O.K., Arendt-Nielsen, L., Treede, R.D. (2001). Withdrawal reflex organisation to electrical stimulation of the dorsal foot in humans. *Exp Brain Res* **136**,303-312.
- Spijkers, W., Heuer, H. (1995). Structural constraints on the performance of symmetrical bimanual movements with different amplitudes. *Q J Exp Psychol A: Hum Exp Psychol* **48**,716-740.
- Stahl, C., Drewes, A.M. (2004). Experimental human pain models: a review of standardised methods for preclinical testing of analgesics. *Basic Clin Pharmacol Toxicol* **95**,97-111.
- Stanton-Hicks, M.D., Burton, A.W., Bruehl, S.P., Carr, D.B., Harden, R.N., Hassenbusch, S.J., Lubenow, T.R., Oakley, J.C., Racz, G.B., Raj, P.P., Rauck, R.L., Rezai, A.R. (2002). An updated interdisciplinary clinical pathway for CRPS: report of an expert panel. *Pain Pract* **2**,1-16.
- Steenbergen, B., Hulstijn, W., de, V.A., Berger, M. (1996). Bimanual movement coordination in spastic hemiparesis. *Exp Brain Res* **110**,91-98.
- Steenbergen, B., Charles, J., Gordon, A.M. (2008). Fingertip force control during bimanual object lifting in hemiplegic cerebral palsy. *Exp Brain Res* **186**,191-201.
- Sterling, M., Jull, G., Wright, A. (2001). The effect of musculoskeletal pain on motor activity and control. *J Pain* **2**,135-145.
- Sudeck, P. (1900). Über die akute untzünftliche Knochenatrophie. *Arch Klin Chir* **62**,147-156.
- Svensson, P., Graven-Nielsen, T., Matre, D., Arendt-Nielsen, L. (1998). Experimental muscle pain does not cause long-lasting increases in resting electromyographic activity. *Muscle Nerve* **21**,1382-1389.
- Svensson, P., Miles, T.S., McKay, D., Ridding, M.C. (2003). Suppression of motor evoked potentials in a hand muscle following prolonged painful stimulation. *Eur J Pain* **7**,55-62.
- Swart, C.M., Stins, J.F., Beek, P.J. (2009). Cortical changes in complex regional pain syndrome (CRPS). *Eur J Pain* **13**,902-907.

- Takakura, N., Yajima, H., Homma, I. (2004). Inhibitory effect of pain-eliciting transcutaneous electrical stimulation on vibration-induced finger flexion reflex in the human upper limb. *Jpn J Physiol* **54**,243-248.
- Tamburin, S., Manganotti, P., Zanette, G., Fiaschi, A. (2001). Cutaneomotor integration in human hand motor areas: somatotopic effect and interaction of afferents. *Exp Brain Res* **141**,232-241.
- Tan, E.C., Janssen, A.J., Roestenberg, P., van den Heuvel, L.P., Goris, R.J., Rodenburg, R.J. (2011). Mitochondrial dysfunction in muscle tissue of complex regional pain syndrome type I patients. *Eur J Pain* **15**,708-715.
- Tarkka, I.M., Treede, R.D., Bromm, B. (1992). Sensory and movement-related cortical potentials in nociceptive and auditory reaction time tasks. *Acta Neurol Scand* **86**,359-364.
- Terkelsen, A.J., Andersen, O.K., Hansen, P.O., Jensen, T.S. (2001). Effects of heterotopic- and segmental counter-stimulation on the nociceptive withdrawal reflex in humans. *Acta Physiol Scand* **172**,211-217.
- Theunissen, M., Peters, M.L., Bruce, J., Gramke, H.F., Marcus, M.A. (2012). Preoperative anxiety and catastrophizing: a systematic review and meta-analysis of the association with chronic postsurgical pain. *Clin J Pain* **28**,819-841.
- Travell, J., Rinzler, S., Hermann, M. (1942). Pain and disability of the shoulder and arm. *J Am Med Assoc* **120**,417-422.
- Tucker, K., Butler, J., Graven-Nielsen, T., Riek, S., Hodges, P. (2009). Motor unit recruitment strategies are altered during deep-tissue pain. *J Neurosci* **29**,10820-10826.
- Tucker, K.J., Hodges, P.W. (2009). Motoneurone recruitment is altered with pain induced in non-muscular tissue. *Pain* **141**,151-155.
- Tucker, K.J., Hodges, P.W. (2010). Changes in motor unit recruitment strategy during pain alters force direction. *Eur J Pain* **14**,932-938.
- Tucker, K., Larsson, A.K., Oknelid, S., Hodges, P. (2012). Similar alteration of motor unit recruitment strategies during the anticipation and experience of pain. *Pain* **153**,636-643.
- Turner-Stokes, L., Goebel, A. (2011). Complex regional pain syndrome in adults: concise guidance. *Clin Med* **11**,596-600.
- Uncini, A., Kujirai, T., Gluck, B., Pullman, S. (1991). Silent period induced by cutaneous stimulation. *Electroencephalogr Clin Neurophysiol* **81**,344-352.
- Urban, P.P., Solinski, M., Best, C., Rolke, R., Hopf, H.C., Dieterich, M. (2004). Different short-term modulation of cortical motor output to distal and proximal upper-limb muscles during painful sensory nerve stimulation. *Muscle Nerve* **29**,663-669.
- Vaillancourt, D.E., Russell, D.M. (2002). Temporal capacity of short-term visuomotor memory in continuous force production. *Exp Brain Res* **145**,275-285.
- Valeriani, M., Restuccia, D., Di Lazzaro, V., Oliviero, A., Profice, P., Le Pera, D., Saturno, E., Tonali, P. (1999). Inhibition of the human primary motor area by painful heat stimulation of the skin. *Clin Neurophysiol* **110**,1475-1480.

- van de Beek, W.J., Vein, A., Hilgevoord, A.A., van Dijk, J.G., van Hilten, B.J. (2002). Neurophysiologic aspects of patients with generalized or multifocal tonic dystonia of reflex sympathetic dystrophy. *J Clin Neurophysiol* **19**,77-83.
- van de Meent, H., Oerlemans, M., Bruggeman, A., Klomp, F., van, D.R., Oostendorp, R., Frolke, J.P. (2011). Safety of "pain exposure" physical therapy in patients with complex regional pain syndrome type 1. *Pain* **152**,1431-1438.
- van Delden, A.L., Peper, C.L., Harlaar, J., Daffertshofer, A., Zijp, N.I., Nienhuys, K., Koppe, P., Kwakkel, G., Beek, P.J. (2009). Comparing unilateral and bilateral upper limb training: the ULTRA-stroke program design. *BMC Neurol* **9**,57.
- van Delden, A.L., Peper, C.L., Nienhuys, K.N., Zijp, N.I., Beek, P.J., Kwakkel, G. (2013). Unilateral versus bilateral upper limb training after stroke: the upper limb training after stroke clinical trial. *Stroke* **44**,2613-2616.
- van der Laan, L., ter Laak, H.J., Gabreels-Festen, A., Gabreels, F., Goris, R.J. (1998). Complex regional pain syndrome type I (RSD): pathology of skeletal muscle and peripheral nerve. *Neurology* **51**,20-25.
- van Hilten, B.J., van de Beek, W.J., Hoff, J.I., Voormolen, J.H., Delhaas, E.M. (2000). Intrathecal baclofen for the treatment of dystonia in patients with reflex sympathetic dystrophy. *N Engl J Med* **343**,625-630.
- van Hilten, J.J., van de Beek, W.J., Vein, A.A., van Dijk, J.G., Middelkoop, H.A. (2001). Clinical aspects of multifocal or generalized tonic dystonia in reflex sympathetic dystrophy. *Neurology* **56**,1762-1765.
- van Hilten, J.J., Blumberg, H., and Schwartzman, R.J. (2005). Factor IV: Movement disorders and dystrophy - Pathophysiology and measurement. In: CRPS: Current Diagnosis and Therapy, P. Wilson, M. Stanton-Hicks, and R.N. Harden, eds. (Seattle: IASP Press), pp. 119-137.
- van Hilten, J.J. (2010). Movement disorders in complex regional pain syndrome. *Pain Med* **11**,1274-1277.
- van Rijn, M.A., Marinus, J., Putter, H., van Hilten, J.J. (2007). Onset and progression of dystonia in complex regional pain syndrome. *Pain* **130**,287-293.
- van Rijn, M.A., Munts, A.G., Marinus, J., Voormolen, J.H., de Boer, K.S., Teepe-Twiss, I.M., van Dasselaar, N.T., Delhaas, E.M., van Hilten, J.J. (2009). Intrathecal baclofen for dystonia of complex regional pain syndrome. *Pain* **143**,41-47.
- van Rijn, M.A., Marinus, J., Putter, H., Bosselaar, S.R., Moseley, G.L., van Hilten, J.J. (2011). Spreading of complex regional pain syndrome: not a random process. *J Neural Transm* **118**,1301-1309.
- van Rooijen, D.E., Geraedts, E.J., Marinus, J., Jankovic, J., van Hilten, J.J. (2011). Peripheral trauma and movement disorders: a systematic review of reported cases. *J Neurol Neurosurg Psychiatry* **82**,892-898.
- van Rooijen, D.E., Marinus, J., Schouten, A.C., Noldus, L.P., van Hilten, J.J. (2013a). Muscle hyperalgesia correlates with motor function in complex regional pain syndrome type 1. *J Pain* **14**,446-454.
- van Rooijen, D.E., Marinus, J., van Hilten, J.J. (2013b). Muscle hyperalgesia is widespread in patients with complex regional pain syndrome. *Pain* doi: 10.1016/j.pain.2013.08.004
- Vas, L.C., Pai, R., Radhakrishnan, M. (2013). Ultrasound Appearance of Forearm Muscles in 18 Patients With Complex Regional Pain Syndrome 1 of the Upper Extremity. *Pain Pract* **13**,76-88.
- Veldman, P.H., Reynen, H.M., Arntz, I.E., Goris, R.J. (1993). Signs and symptoms of reflex sympathetic dystrophy: prospective study of 829 patients. *Lancet* **342**,1012-1016.

- Verdugo, R.J., Ochoa, J.L. (2000). Abnormal movements in complex regional pain syndrome: assessment of their nature. *Muscle Nerve* **23**,198-205.
- Vlaeyen, J.W.S., Linton, S.J. (2000). Fear-avoidance and its consequences in chronic musculoskeletal pain: a state of the art. *Pain* **85**,317-332.
- Vuillerme, N., Pinsault, N. (2009). Experimental neck muscle pain impairs standing balance in humans. *Exp Brain Res* **192**,723-729.
- Wasner, G., Schattschneider, J., Heckmann, K., Maier, C., Baron, R. (2001). Vascular abnormalities in reflex sympathetic dystrophy (CRPS I): mechanisms and diagnostic value. *Brain* **124**,587-599.
- Wasner, G. (2010). Vasomotor disturbances in complex regional pain syndrome--a review. *Pain Med* **11**,1267-1273.
- Weerakkody, N.S., Percival, P., Canny, B.J., Morgan, D.L., Proske, U. (2003). Force matching at the elbow joint is disturbed by muscle soreness. *Somatosens Mot Res* **20**,27-32.
- Weerakkody, N.S., Blouin, J.S., Taylor, J.L., Gandevia, S.C. (2008). Local subcutaneous and muscle pain impairs detection of passive movements at the human thumb. *J Physiol* **586**,3183-3193.
- Wesseldijk, F., Huygen, F.J., Heijmans-Antonissen, C., Niehof, S.P., Zijlstra, F.J. (2008). Tumor necrosis factor-alpha and interleukin-6 are not correlated with the characteristics of Complex Regional Pain Syndrome type 1 in 66 patients. *Eur J Pain* **12**,716-721.
- Willer, J.C., Roby, A., le Bars, D. (1984). Psychophysical and electrophysiological approaches to the pain-relieving effects of heterotopic nociceptive stimuli. *Brain* **107**,1095-1112.
- Willer, J.C., de Broucker, T., le Bars, D. (1989). Encoding of nociceptive thermal stimuli by diffuse noxious inhibitory controls in humans. *J Neurophysiol* **62**,1028-1038.
- Whitall, J., McCombe, W.S., Silver, K.H., Macko, R.F. (2000). Repetitive bilateral arm training with rhythmic auditory cueing improves motor function in chronic hemiparetic stroke. *Stroke* **31**,2390-2395.
- Williams, A.C., Eccleston, C., Morley, S. (2012). Psychological therapies for the management of chronic pain (excluding headache) in adults. *Cochrane Database Syst Rev* **11**,CD007407.
- Wolpert, D.M., Kawato, M. (1998). Multiple paired forward and inverse models for motor control. *Neural Netw* **11**,1317-1329.
- Wolpert, D.M., Ghahramani, Z. (2000). Computational principles of movement neuroscience. *Nat Neurosci* **3 Suppl**,1212-1217.
- Woolf, C.J., Thompson, S.W. (1991). The induction and maintenance of central sensitization is dependent on N-methyl-D-aspartic acid receptor activation; implications for the treatment of post-injury pain hypersensitivity states. *Pain* **44**,293-299.
- Woolf, C.J. (2011). Central sensitization: implications for the diagnosis and treatment of pain. *Pain* **152**,S2-15.
- Xu, Y.M., Ge, H.Y., Arendt-Nielsen, L. (2010). Sustained nociceptive mechanical stimulation of latent myofascial trigger point induces central sensitization in healthy subjects. *J Pain* **11**,1348-1355.

- Yang, J.L., Chen, S., Jan, M.H., Lin, Y.F., Lin, J.J. (2008). Proprioception assessment in subjects with idiopathic loss of shoulder range of motion: joint position sense and a novel proprioceptive feedback index. *J Orthop Res* **26**,1218-1224.
- Yao, J., Acosta, A.M., Dewald, J. (2004). Muscle focus: a new biomechanical-based index on the selectivity of EMG activity and its application in quantifying the muscle coactivation patterns during isometric torque generation at the elbow and shoulder. *Conf Proc IEEE Eng Med Biol Soc* **7**,4677-4679.
- Zale, E.L., Lange, K.L., Fields, S.A., Ditre, J.W. (2013). The relation between pain-related fear and disability: a meta-analysis. *J Pain* **14**,1019-1030.
- Ziemann, U. (2004). TMS and drugs. *Clin Neurophysiol* **115**,1717-1729.
- Zyluk, A. (2001). The sequelae of reflex sympathetic dystrophy. *J Hand Surg Br* **26**,151-154.

