

Chiropraktik

Literaturzusammenfassung nach Themen:

Verbesserung Sehschärfe und Sehfeld

- Carrick FR: Changes in brain function after manipulation of the cervical spine. J. Manipulative Physiol Ther. Oct 1997;20(8):529-549
- Wingfield BR, Gorman RF: Treatment of severe glaucomatous visual field deficit by chiropractic spinal manipulation therapy: a prospective case study and discussion. J Manipulative Physiol Ther. 2000;23(6):428-434

Verbesserung der Gelenkpropriozeption

- Haavik H, Murphy B: Subclinical neck pain and the effects of cervical manipulation on elbow joint position sense. Journal of Manipulative & Physiological Therapeutics. 2011; 34:88-97
- Holt K.: Effectiveness of Chiropractic Care in Improving Sensorimotor Function associated with Fall Risk in Older People. Auckland, New Zealand: Department of Population Health, University of Auckland, 2013

Verbesserung der Reaktionszeit

- Kelly SS, Murphy BA, Backhouse DP: Use of mental rotation reaction-time paradigm to measure the effects of upper cervical adjustment on cortical processing: a pilot study. Journal of Manipulative & Physiological Therapeutics. 2000;23(4):246-251

Verbesserung der sensomotorischen Integration im ZNS

- Haavik TH, Murphy B: Cervical spine manipulation alters sensorimotor integration. A somatosensory evoked potential study. Clin Neurophysiol. 2007;118(2):391-402
- Kelly SS, Murphy BA, Backhouse DP: Use of mental rotation reaction-time paradigm to measure the effects of upper cervical adjustment on cortical processing: a pilot study. Journal of Manipulative & Physiological Therapeutics. 2000;23(4):246-251
- Haavik TH, Murphy B.: Altered Central Integration of Dual Somatosensory Input Following Cervical Spine Manipulation. Journal of Manipulative & Physiological Therapeutics.2010;33(3):178-188
- Haavik TH, Murphy B: Altered sensorimotor integration with cervical spine manipulation. Journal of Manipulative & Physiological Therapeutics.2008;31(2):115-126

Verbesserte Erregbarkeit der Rückenmarksreflexe

- Suter E, McMorland G, Herzog W, Bray R: Decrease in quadriceps inhibition after sacroiliac joint manipulation in patients with anterior knee pain. Journal of Manipulative & Physiological Therapeutics.1999;22(3):149-153
- Suter E, McMorland G, Herzog W, Bray R: Conservative lower back treatment reduces inhibition in knee-extensor muscles: a randomized controlled trial. Journal of Manipulative & Physiological Therapeutics. 2000; 23(3):76-80
- Herzog W, Scheele D, Conway PJ: Electromyographic response of back and limb muscles associated with spinal manipulation therapy. Spine. 1999;24(2):146-153
- Murphy B, Dawson N, Slack J: Sacroiliac joint manipulation decreases the H-reflex. Electromyogr Clin Neurophysiol. 1995; 35:87-94

Positive Veränderung spezifischer sensomotorischer Antwortreaktionen des ZNS an den Haltungs- und Bewegungsapparat (Feed Forward u.a.)

- Haavik TH, Murphy B.: Altered sensorimotor integration with cervical spine manipulation. Journal of Manipulative & Physiological Therapeutics.2008;31(2):115-126
- Enebo BA: The effect of cervical spine manipulation on motor control in healthy individuals. A pilot study. Chiropr J Aust. 2003;33(3):93-97
- Marshall P, Murphy B: The Effect of Sacroiliac Joint Manipulation on Feed-Forward Activation Times of the Deep Abdominal Musculature. Journal of Manipulative & Physiological Therapeutics.2006;29(3):196-202

Verbesserung der Kraftentwicklung der Beinmuskulatur

- Nizzi J, Türker K, Flavel S, Kinger M, Duehr J, Haavik H: Increased cortical drive and altered net excitability of low-threshold motor unit levels to the lower limb following spinal manipulation. Paper presented at: World Federation of Chiropractic`s 12th Biennial Congress; April 6-9, 2013, Durban, South Africa
- Hillermann B, Gomes AN, Korporaal C, Jackson D: A pilot study comparing the effects of spinal manipulative Therapy with those of extra-spinal manipulation therapy on quadriceps muscle strength. J Manipulative Physiol Ther. Feb 2006;29(2):145-149

Reduzierte Muskelermüdung und verkürzte Regeneration

- Nizzi J, Türker K, Flavel S, Kinger M, Duehr J, Haavik H: Increased cortical drive and altered net excitability of low-threshold motor unit levels to the lower limb following spinal manipulation. Paper presented at: World Federation of Chiropractic's 12th Biennial Congress; April 6-9, 2013, Durban, South Africa

Chiropraktische Justierung verbessert die Wirbelsäulenfunktion

- Martinez-Segura R, Fernandez-de-la-Peras C, Ruiz-Saez M, Lopez-Jimenes C, Rodriguez-Blanco C: Immediate effects on neck pain and active range of motion after a single cervical high-velocity low-amplitude manipulation in subjects presenting with mechanical neck pain: a randomized controlled trial. J Manipulative Physiol Ther. Sep 2006;29(7):511-517
- Nansel D, Jansen R, Cremata E, Dhamsi MS, Holley D: Effects of cervical adjustments on lateral-flexion passive end-range asymmetry and on blood pressure, heart rate, and plasma catecholamine levels. J Manipulative Physiol Ther. 1991;14(8):450-456
- Schiller L.: Effectiveness of spinal manipulation therapy on the treatment of mechanical thoracic spine pain: a pilot randomized clinical trial. J Manipulative Physiol Ther. Feb 1992;15(2):99-105
- Wood TG, Colloca CJ, Matthew R: A pilot randomized clinical trial on the relative effect of instrumental (MFMA) versus manual (HVLA) manipulation in the treatment of cervical spine dysfunction. J Manipulative Physiol Ther. May 2001;24(4):260-271
- Yeomans SG: The assessment of cervical intersegmental mobility before and after spinal manipulative therapy. J Manipulative Physiol Ther. Feb 1992;15(2):106-114

Wirbelsäulendysfunktion führt zu „falscher“ sensomotorischen Information mit „fehlerhafter“ Antwortreaktion ZNS an Haltungs- und Bewegungsapparat

- Michaelson P, Michaelson M, Jaric S, Latash ML, Siolander P, Djupsjobacka M: Vertical posture and Head stability in Patients with Chronic Neck Pain. Journal of Rehabilitation Medicine. 2003;35(5):229-235
- Urhaikup S, Jull C, Sunkarat S, Trealeven J: The influence of neck pain on sensorimotor function in the elderly. Arch Gerontol Geriatr. 2012;55(3):667-672

- Boucher P, Descarreaux M, Normand MC: Postural control in people with osteoarthritis of the cervical spine. *J Manipulative Physiol Ther.* 2008;31(3):184-190
- Branstrom H, Malmgren-Olsson EB, Barnekow-Bergkvist M: Balance performance in patients with Whiplash- Associated Disorders and Patients with prolonged Musculoskeletal Disorders. *Advances in Physiotherapy.* 2001;3:120-127
- Karlberg M, Persson L, Magnusson M: Reduced postural control in patients with chronic cervicobrachial pain syndrom. *Gait and Posture.* 1995;3:241-249
- Okuda T, Ochi M, Tanaka M, Nakanishi K, Adachi N, Kobayashi R.: Knee joint position sense in compression myelopathy. *Spine* 2006;31(4):459-462
- Person L, Karlberg M, Magnusson M: Effects of different treatment on postural performance in patients with cervical root compression: A randomized prospective study assessing the importance of the neck in postural control. *Journal of Vestibular Research.* 1996;6(6),439-453
- Rubin AM, Woolley SM, Dailey VM, Goebel JA.: Postural stability following mild head or whiplash injuries. *The American Journal of Otology.* 1995,16(2):216-221
- Stapley PJ, Beretta MV, Toffola ED, Schlepptati M: Neck muscle fatigue and postural control in patients with whiplash injury. *Cinical Neurophysiology.* 2006/3 2006;117(3):610-622
- Takayama H, Muratsu H, Doita M, Harada T, Kurosaka M, Yoshiya S: Proprioceptive recovery of patients with cervical myelopathy after surgical decompression. *Spine.* 2005;30(9):1039-1044
- Takayama H, Muratsu H, Doita M, Harada T, Yoshiya S, Kurosaka M.: Impaired joint proprioception in patients with cervical myelopathy. *Spine.* 2005;30(1):83-86
- Trealeven J: Sensorimotor disturbances in neck disorders affecting postural stability, head and eye movement control. *Man Ther.* 2008;13(1):2-11

Bewegungs- und Haltungskontrollfunktion und sensomotorische Integration im ZNS cranio-cervicalen Übergang wesentlich beeinflusst und gesteuert

- Michaelson P, Michaelson M, Jaric S, Latash ML, Siolander P, Djupsjobacka M: Vertical posture and Head stability in Patients with Chronic Neck Pain. *Journal of Rehabilitation Medicine*. 2003;35(5):229-235
- Urhaikup S, Jull C, Sunkarat S, Trealeven J: The influence of neck pain on sensorimotor function in the elderly. *Arch Gerontol Geriatr*. Nov-Dec 2012;55(3):667-672
- Boucher P, Descarreaux M, Normand MC: Postural control in people with osteoarthritis of the cervical spine. *J Manipulative Physiol Ther*. Mar 2008;31(3):184-190
- Branstrom H, Malmgren-Olsson EB, Barnekow-Bergkvist M: Balance performance in patients with Whiplash-Associated Disorders and Patients with prolonged Musculoskeletal Disorders. *Advances in Physiotherapy*. 2001;3:120-127
- Karlberg M, Persson L, Magnusson M: Reduces postural control in patients with chronic cervicobrachial pain syndrom. *Gait and Posture*. 1995; 3:241-249
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- Rubin AM, Woolley SM, Dailey VM, Goebel JA: Postural stability following mild head or whiplash injuries. *The American Journal of Otology*. 1995,16(2):216-221
- Stapley PJ, Beretta MV, Toffola ED, Schlepatti M: Neck muscle fatigue and postural control in patients with whiplash injury. *Cinical Neurophysiology*. 2006/3 2006;117(3):610-622
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- Trealeven J: Sensorimotor disturbances in neck disorders affecting postural stability, head and eye movement control. *Man Ther*. 2008;13(1):2-11

Veränderung der Haltungskontrolle durch Dysfunktion der Lendenwirbelsäule

- Sohn, MK, Lee SS, Song HT: Effects of acute low back pain on postural control. Ann Rehabil Med. Feb 2013; 37(1):17-25
- Svoboda Z, Janura M, Filipova E.: Assessment of postural stability in subjects with lumbar disc herniation. Br J Sports Med. Jul 2013;47(10):e3

Justierung WS positiver Effekt auf Nacken-, Rücken- und Kopfschmerz

- Bronfort G, Evans R, Andersons AV, Svendsen KH, Bracha Y, Grimm RH: Spinal manipulation, medication or home exercise with advice for acute and subacute neck pain: a randomized trial. Ann Intern Med. Jan 3 2012;156(1PT1):1-10
- Bronfort G, Haas M, Evans RL, Bouter LM: Efficacy of spinal manipulation and mobilization for low back pain and neck pain: a systematic review and best evidence synthesis. Spine Journal. 2004;4(3):335-356
- Kuczynski JJ, Schwietermann B, Columer K, Knupp D, Shaub L, Cook CE: Effectiveness of physical therapist administered spinal manipulation for the treatment of low back pain: a systematic review of the literature. Int J Sports Phys Ther. 2012;7(6):647-662
- Bryans R, Descarreaux M, Duranleau M et. al.: Evidence-based guidelines for the chiropractic treatment of adults with headache. J Manipulative Physiol Ther. 2011;34(5):274-289

Schmerz beeinflusst die sensomotorische Wahrnehmung (afferent) und die sensomotorische Kontrolle / Antwortreaktion (ZNS und efferent)

- Rossi S, della Volpe R, Ginanneschi F et al.: Early somatosensory processing during tonic muscle pain in humans: relation to loss of proprioception and motor „defensive“ strategies. Clin Neurophysiol. 2003;114(7): 1351-1358

Subklinischer Schmerz verändert die sensomotorische Steuerung

- Paulus J, Brumagne S.: Altered interpretation of neck proprioceptive signals in persons with subclinical recurrent neck pain. J Rehab Med. Jun 2008;40(6):426-432

Einmalige Justierung verändert die sensomotorische Steuerung beim subklinischen Schmerz (Verbesserung Muskelkontrolle, Kraft und Ermüdbarkeit)

- Haavik TH, Murphy B: Exploring the neuromodulatory effects of the vertebral subluxation and chiropractic care. Chiropractic Journal of Australia, 2010;40(1):37-44
- Haavik TH, Murphy B: Cervical spine manipulation alters sensomotor integration. A sensomotory evoked potential study. Clin. Neurophysiol. 2007;118(2):391-402
- Haavik TH, Murphy B: Altered Central Integration of Dual Sensomotory Input following Cervical Spine Manipulation. Journal of Manipulative & Physiological Therapeutics. 2010;33(3):178-188
- Haavik TH, Murphy B: The effect of spinal manipulation on central integration of dual sensomotory input observed following motor training. A crossover study. Journal of Manipulative & Physiological Therapeutics. 2010;33(4):261-272
- Haavik TH, Murphy B: Transient modulation of intracortical inhibition following spinal manipulation. Chiropractic Journal of Australia, 2007;37:106-116
- Haavik TH, Murphy B: Altered sensorimotor integration with cervical spine manipulation. Journal of Manipulative & Physiological Therapeutics. 2008;31(2):115-126
- Nizzi J, Türker K, Flavel S, King M, Duehr J, Haavik H: Increased cortical drive and altered net excitability of low-threshold motor unit levels to the lower limb following spinal manipulation. Paper presented at: World Federation of Chiropractic's 12th Biennial Congress; April 6-9, 2013, Durban, South Africa

Einfluss der Justierung auf die periphere Schmerz Wahrnehmung (positiv)

- Fernandez-Carnero J, Cleland JA, Arbizu RLT: Examination of motor and hypoalgesic effects of cervical vs. thoracic spine manipulation in patients with lateral epicondylalgia: a clinical trial. J Manipulative Physiol Ther. 2011;34(7):432-440

Einfluss der Justierung auf die Reflexaktivität des Rückenmarks (positiv)

- Fryer G, Pearce AJ: The effect of lumbo-sacral manipulation on corticospinal and spinal reflex excitability on asymptomatic participants. J Manipulative Physiol Ther. 2012;35(2):86-93

Keine neurophysiologische Veränderung bei langsamer Muskeldehnung (im Gegensatz zur Justierung)

- Soon BT, Schmid AB, Fridriksson EJ, Gresslos E, Cheong P, Wright A: A crossover study on the effect of cervical mobilisation on motor function and pressure pain threshold in pain-free individuals. J Manipulative Physiol Ther. 2010;33(9):652-658

Justierung (HVLA) bewirkt reflektorische Veränderung im ZNS

- Triano JJ: Studies on the Biomechanical Effect of a Spinal Adjustment. Journal of Manipulative and Physiological Therapeutics. 1992;15(1):71-75
- Triano JJ, Descarreaux M, Dugas C: Biomechanics – Review of approaches for performance training in spinal manipulation. J. Electromyogr Kinesiol. Apr. 28 2012
- Descarreaux M, Dugas C: Learning spinal manipulation skills: assessments of biomechanical parameters in a 5 year longitudinal study. J Manipulative Physiol Ther. 2010;33(3):226-230

Veränderung der Wahrnehmung im ZNS durch sensorische Impulse

- Moseley GL, Gallace A, Spencer B: Bodily illusion in health and disease: physiological and clinical
- perspectives and the concept of a cortical „body matrix“. Neurosci Biobehav Rev. Jan 2012;36(1):34-46

Schmerz verändert Aktivierungsmuster des Haltungs- und Bewegungsapparates bei funktionalen Bewegungsabläufen

- Suter E, McMorland G, Herzog W, Bray R: Decrease in quadriceps inhibition after sacroiliac joint manipulation in patients with anterior knee pain. Journal of Manipulative & Physiological Therapeutics. 1999;22(3) 149-153
- Suter E, McMorland G, Herzog W, Bray R: Conservative lower back treatment reduces inhibition in knee-extensor muscles: a randomized controlled trial. Journal of Manipulative & Physiological Therapeutics. 2000;23(3):76-80
- Suter E, McMorland G: Decrease in Elbow flexor inhibition after cervical spine manipulation in patients with chronic neck pain. Clinical Biomechanics. 2002;17(2):541-544 Hodges PW, Moseley GL, Gabrielsson

A, Gandevia SC: Experimental muscle pain changes feedforward postural response of the trunk muscles. *Experimental Brain Research*. 2003;15(2):262-271

Schmerz führt zu dysfunktioneller Sequenz der Muskelaktivierung (fehlende und/oder falsche Feedforward Reaktion / Reihenfolge der Muskelaktivierung)

- Hodges PW, Moseley GL, Gabrielsson A, Gandevia SC: Experimental muscle pain changes feedforward postural response of the trunk muscles. *Experimental Brain Research*. 2003;15(2):262-271
- Hodges PW, Richardson CA: Inefficient muscular stabilization of the lumbar spine associated with low back pain. A motor control evaluation of transversus abdominis. *Spine*. 1992;21(22):2640-2650
- Hodges PW, Richardson CA: Altered trunk muscle recruitment in people with low back pain with upper limb movement at different speed. *Archives of Physical Medicine & Rehabilitation*. 1999;80(9):1005-1012
- Hungerford B, Gillard W, Hodges P: Evidence of altered lumbopelvic muscle recruitment on the presence of sacroiliac joint pain. *Spine*. 2003;28(14):1593-1600

Ungleichgewicht der antagonistischen Muskelgruppen durch Schmerzen

- Jull G, Barrett C, Magee R, Ho P: Further clinical clarification of the muscle dysfunction in cervical headache. *Cephalalgia*. 1999;19(3):179-185
- Watson DH, Trott PH: Cervical headache: an investigation of natural head posture and upper cervical flexor muscle performance. *Cephalalgia*. 1993;13(4):272-284

Schmerzen als Ursache für abnorme Muskelkontrolle

- Hodges PW, Mosley GL: Pain and motor control of the lumbopelvic region: effect and possible mechanism. *Journal of Electromyography & Kinesiology*. 2003;13(4):361-370

„Beschädigte“ neurale Muskelreflexe prädisponieren für Schmerzen

- Henderson CN: The basis for spinal manipulation: Chiropractic perspective of indications and theory. *J Electromyogr Kinesiol*. Apr 16 2012;22(5):632-642

- Marshall P, Murphy B: The Effect of Sacroiliac Joint Manipulation on Feed-Forward Activation Times of the Deep Abdominal Musculature. Journal of Manipulative & Physiological Therapeutics. 2006;29(3):196-202
- Lee JH, Hoshino Y, Nakamura K, Kariya Y, Saita K, Ito K: Trunk muscle weakness as a risk factor for lumbar low back pain. A 5-year prospective study. Spine. 1999;24(1):54-57
- Lee HM, Nicholson LLP, Adams RDP, Bae S-SP: Proprioception and Rotation Range Sensitization Associated with Subclinical Neck Pain. Spine. 2005;30(3):E60-E67
- Lee H-Y, Wang Y-D, Yao G, Wang S-F: Association between cervicocephalic kinesthetic sensibility and frequency of subclinical neck pain. Manual Therapy. 2008;3:419-425

Verändertes Ansprechen Rumpfmuskulatur erhöht Verletzungsrisiko der LWS

- Cholewicki J, Silfies S, Shah R, et al.: Delayed trunk muscle reflex responses increase the risk of low back injuries. Spine. (Phila Pa 1976) 2005;30(23):2614-2620

Chiropraktische Justierung verbessert die Muskelfunktion/-kontrolle

- Haavik TH., Murphy B: Altered Central Integration of Dual Sensomotory Input following Cervical Spine Manipulation. Journal of Manipulative & Physiological Therapeutics. 2010;33(3):178-188
- Haavik TH., Murphy B: Transient modulation of intracortical inhibition following spinal manipulation. Chiropractic Journal of Australia, 2007;37:106-116
- Hillermann B, Gomes AN, Korporaal C, Jackson D: A pilot study comparing the effects of spinal manipulative therapy with those of extra-spinal manipulation therapy on quadriceps muscle strength. J. Manipulative Physiol Ther. Feb 2006;29(2):145-149

Chiropraktische Justierung verbessert die Muskelfunktion bei Schmerzen

- Suter E, McMorland G, Herzog W, Bray R: Decrease in quadriceps inhibition after sacroiliac joint manipulation in patients with anterior knee pain. Journal of Manipulative & Physiological Therapeutics. 1999;22(3):149-153.

Justierung dysfunktioneller Wirbelsäulensegmente verbessert Funktion der Wirbelsäule, resultierend sensomotorische Integration ZNS / Muskelkontrolle (Feedforward etc.)

- Martinez-Segura R, Fernandez-de-la-Peras C, Ruiz-Saez M, Lopez-Jimenes C, Rodriguez-Blanco C: Immediate effects on neck pain and active range of motion after a single cervical high-velocity low-amplitude manipulation in subjects presenting with mechanical neck pain: a randomized controlled trial. *J Manipulative Physiol Ther.* Sep 2006;29(7):511-517
- Nansel D, Jansen R, Cremata E, Dhimi MS, Holley D: Effects of cervical adjustments on lateral-flexion passive end-range asymmetry and on blood pressure, heart rate, and plasma catecholamine levels. *J Manipulative Physiol Ther.* 1991;14(8):450-456
- Nansel DD, Peneff A, Quitariano J: Effectiveness of upper versus lower cervical adjustment with respect to the amelioration of passive rotational versus lateral-flexion end-range asymmetries in otherwise asymptomatic subjects. *J Manipulative Physiol Ther.* Feb 1992;15(2):99-105
- Schiller L: Effectiveness of spinal manipulation therapy on the treatment of mechanical thoracic spine pain: a pilot randomized clinical trial. *J Manipulative Physiol Ther.* Feb 1992;15(2):99-105
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- Yeomans SG: The assessment of cervical intersegmental mobility before and after spinal manipulative therapy. *J Manipulative Physiol Ther.* Feb 1992;15 (2):106-114
- Haavik H, Murphy B: The role of spinal manipulation in addressing disordered sensorimotor integration and altered motor control. *J Electromyogr Kines.* October 2012;2012(5):768-776

Verbesserung muskuläre Kontrolle/Muskelkraft nach 1x Justierung entspricht einem 3-wöchigem Training

- Vila-Cha C, Falla D, Correia MV, Farina D: Changes in H-reflex and V-wave following short-term endurance and strength training. *Journal of Applied Physiology.* January 1, 2012;2012(1):54-63

Intensives Training beeinflusst die muskuläre und sensomotorische Ansprechbarkeit und Steuerung (Neuroplastizität)

- Sysoeva OV, Wittmann M, Mierau A, Polikanova I, Struder HK, Tonnevitsky A: Physical exercise speeds up motor timing. *Front Psychol.* 2013;4:612
- Schlaffke L, Lissek S, Lenz M et al.: Sports and brain morphology – A voxel based morphometry study with endurance athletes and martial artists. *Neuroscience.* Dec 1 2013;259C:35-42
- Laudner KG: Upper extremity sensorimotor control among collegiate football players. *J Strength Cond Res.* Mar 2012;26(3):672-676

Vermindertes Verletzungsrisiko durch Wirbelsäulenjustierung:

- Marshall P, Murphy B: The Effect of Sacroiliac joint manipulation on Feed-Forward Activation Times of the Deep Abdominal Musculature. *Journal of Manipulative and Physiological Therapeutics.* 2006;29(3):196-202

Verbesserung der propriozeptiven Fähigkeiten

- Haavik H., Murphy B.: Subclinical neck pain and the effects of cervical manipulation on elbow joint position sense. *Journal of Manipulative & Physiological Therapeutics.* 2011;34:88-97
- Holt K.: Effectiveness of Chiropractic Care in Improving Sensorimotor Function associated with Fall Risk in Older People. Auckland, New Zealand: Department of Population Health, University of Auckland, 2013

Verbesserung der sensomotorischen Integration und Muskelsteuerung

- Haavik TH., Murphy B: Altered sensorimotor integration with cervical spine manipulation. *Journal of Manipulative & Physiological Therapeutics.* 2008;31(2):115-126
- Marshall P, Murphy B: The Effect of Sacroiliac joint manipulation on Feed-Forward Activation Times of the Deep Abdominal Musculature. *Journal of Manipulative and Physiological Therapeutics.* 2006;29(3):196-202
- Enebo BA: The effect of cervical spine manipulation on motor control in healthy individuals. A pilot study. *Chiropr J Aust.* 2003;33(3):93-97

Beeinflussung der sensorimotorischen Muskelsteuerung

- Haavik TH., Murphy B: Altered sensorimotor integration with cervical spine manipulation. *Journal of Manipulative & Physiological Therapeutics.* 2008;31(2):115-126

- Nizzi J, Türker K, Flavel S, Kinger M, Duehr J, Haavik H: Increased cortical drive and altered net excitability of low-threshold motor unit levels to the lower limb following spinal manipulation. Paper presented at: World Federation of Chiropractic's 12th Biennial Congress; April 6-9, 2013, Durban, South Africa

Physiologie der neuronalen Muskelsteuerung der Unterarmmuskulatur

- Benwell NM, Mastaglia FL, Thickbrown GW: Differential changes in long-interval intracortical inhibition and silent period duration fatiguing hand exercise. *Exp Brain Res.* 2006; in press
- Aimonetti JM, Nielsen JB: Cortical excitability and motor task in man: an investigation of the wrist extensor area. *Exp Brain Res.* 2002;143(4):431-439
- Reynolds C, Ashby P: Inhibition in the human motor cortex is reduced just before a voluntary contraction. *Neurology.* Sep 11 1995;53(4):730-735
- Begum T, Mima T, Oga T, et al.: Cortical mechanism of unilateral voluntary motor inhibition in humans. *Neuroscience Research.* 2005/12 2005;53(4):428-435
- Floether MK, Rotwell J: Releasing the brakes before pressing the gas pedal. *Neurology.* 1999;53(4):664-665

Multisensorische Integration

- Shimojo S, Shams L: Sensory modalities are not separate modalities: Plasticity and Interactions. *Curr Opin Neurobiol.* Aug 2001;11(4):505-509
- Bolognini N, Rosetti A, Casati C, Mancini F, Vallar G: Neuromodulation of multisensory perception: a tDCS study of the sound-induced flash illusion. *Neuropsychologia.* Jan 2011;49(2):231-237
- Lovelace CT, Stein BE, Wallace MT: An irrelevant light enhances auditory detection in humans: a psychological analysis of multisensory integration in stimulus detection. *Cognitive Brain Research.* 7/15/2003; 17(2):447-453
- Stevenson RA, Zentsov RK, Wallace MT: Individual differences in the multisensory temporal binding window predict susceptibility to audiovisual illusion. *J Exp Psychol Hum Percept Perform.* Dec 2012;38(6):1517-1529

Verbesserung der sensormotorischen Integration führt zur besseren Wahrnehmung des Körpers und der Umwelt (Basalganglien / Kleinhirn)

- Lovelace CT, Stein BE, Wallace MT: An irrelevant light enhances auditory detection in humans: a psychological analysis of multisensory integration in stimulus detection. *Cognitive Brain Research*. 2003;17(2):447-453
- Stevenson RA, Zentsov RK, Wallace MT: Individual differences in the multisensory temporal binding window predict susceptibility to audiovisual illusion. *J Exp Psychol Hum Percept Perform*. 2012;38(6):1517-1529
- Diederich A, Colonius B: Bimodal and Trimodal multisensory enhancement: effects of stimulus onset and intensity on reaction time. *Percept Psychophys*. 2004;66(8):1388-1404
- Mahoney JR, Li PC, Oh-Park M, Verghese J, Holtzer R: Multisensory Integration across the senses in young and old adults. *Brain Res*. 2011;1426:43-53
- Paris Cesare V, Spence C, Ernst MO: When Correlation Implies Causation in Multisensory Integration. *Current Biology*. 1/10/2012;22(1):46-49

Sensormotorische Integration und Erfahrung verbessert Wahrnehmung

- Ernst MO, Bulthoff HH: Merging the senses into a robust percept. *Trends Cogn Sci*. 2004;8(4):162-169

Integrativer Sinnesleistung abhängig von Funktionsfähigkeit Einzelorgane

- Mozolic JL, Hugenschmidt CE, Peiffer AM, Laurienti PJ: Multisensory Integration and Aging: The neural bases of multisensory Process. Boca Raton FL:L1C:2012

Anlegen sensomotorischer Engramme mit regelmäßiger Modifikation

- Kaji R, Shibasaki H, Kimura J: Writer`s cramp: a disorder of motor subroutines? *Ann Neurol*. 1995;38(6):837-838

Engramme wesentlicher Bestandteil des Lernens

- Costa RM, Cohen D, Nicolelis MA: Differential Corticostriatal plasticity during fast and slow motor skill learning in mice. *Current Biology*. 2004;14(13):1124-1134
- Hikosaka O, Nakamura K, Sakai K, Nakahara H: Central mechanism of motor skill learning. *Current Opinion in Neurobiology*. 2001;12(2):217-222

- Doyon J, Penhune V, Ungerleider LG: Distinct contribution of the cortico-striatal and cortico-cerebellar systems to motor skill learning. *Neuropsychologia*. 2003;41(3):252-262

Basalganglien filtern sensorische Information

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