

## Abstract

### **Ausgewählte fasziale Aspekte in der osteopathischen Praxis**

Paolo Tozzi

Fasziales Gewebe ist eine Bindegewebsform, dessen Aufbau ein dreidimensionales Netzwerk darstellt. Dieses Netzwerk umschließt, umhüllt, befestigt, beschützt und verbindet muskuläre, knöcherne und viszerale Bestandteile des Körpers. Studien deuten darauf hin, dass im Körper eine stetige Neuordnung des faszialen Gewebes stattfindet- im Einklang mit Spannungslinien, die sich im Körper befinden oder von außen auf den Körper einwirken. Diese Neuordnung kann eine fasziale Restriktion bewirken, die körperweite Auswirkungen hat.

Das kann Belastungen von Strukturen zur Folge haben, die von Faszien umschlossen sind, was wiederum mechanische und physiologische Vorgänge beeinflussen kann. Der osteopathische Ansatz sieht vor, fasziale Spannungen mit Hilfe von faszialen Techniken zu lösen und dadurch Schmerzen zu lindern und Funktion wiederherzustellen. Die Erklärung für den Wirkungsmechanismus faszialer Techniken basiert auf einer Vielzahl von Studien, die die plastischen, viskoelastischen und piezoelektrischen Eigenschaften von Bindegewebe untersucht haben. In dieser Arbeit werden einige der oben genannten Gesichtspunkte näher betrachtet und Belege für die therapeutische Wirksamkeit von faszialen Behandlungsansätzen aufgezeigt, um einen ausgewählten Überblick über die Bedeutung des faszialen Systems in der osteopathischen Befundung und Therapie zu verschaffen.

## Abstract

### **Selected Fascial Aspects of Osteopathic Practice**

Paolo Tozzi

Fascia is a connective tissue organised as a three-dimensional network that surrounds, supports, suspends, protects and connects muscular, skeletal and visceral components of the body. Studies suggest that fascia reorganises itself along the lines of tension imposed or expressed in the body, and in a way causes a repercussion of fascial restriction that is bodywide.

This may potentially create stress on any structures enveloped by fascia itself, with consequent mechanical and physiological effects. From an Osteopathic perspective, fascial techniques aim to release such tensions, decrease pain and restore function. The proposed mechanism for fascial techniques is based on various studies that looked at the plastic, viscoelastic and piezoelectric properties of connective tissue. This article will explore some of the features described above, together with evidence supporting the therapeutic efficacy of fascial manipulation, offering a selected overview of the fascial component in Osteopathic assessment and treatment.

## Quellen:

Adams MA, Dolan P 1997 The combined function of spine, pelvis and legs when lifting with a straight back in: Vleeming A et al. Movement, Stability and Low Back Pain: The Essential Role of the Pelvis, Churchill Livingstone, Edinburgh

Allen TW 1993 The Glossary review Committee of the Educational Council on Osteopathic Principles. Glossary of Osteopathic terminology, Ed. AOA Yearbook and Directory of Osteopathic Physicians, Chicago

Anderson RE, Seniscal CA 2006 A comparison of selected osteopathic treatment and relaxation for tension-type headaches. Headache 46:1273-1280

Andersson GB, Lucente T, Davis AM et al. 1999 A comparison of osteopathic spinal manipulation with standard care for patients with low back pain. N Engl J Med. Nov 4;341(19):1426-31

Ashmore EF 1915 Osteopathic mechanics. Journal Printing Co. Kirksville, Mo

Ayres AJ 1979 Sensory integration and learning disorders, Weston Psychological Services, LA

Bach TM, Chapman AE, Calvert TW 1983 Mechanical resonance of the human body during voluntary oscillations about the ankle joint, J Biomechanics, vol.16, n.7, pp.85-90

Bandeen SG 1949 Report covering twenty-five years research on stimulation of pancreas, blood chemical changes. Osteopathic Profession 27(1): 11-15, 38-47

Barnes JF 1996 Myofascial release for craniomandibular pain and dysfunction. Int J Orofacial Myology Nov 22:20-2

Barnes, JF 1990. Myofascial Release. The Search of Excellence. Rehabilitation Services, Paoli, PA

Bartelink DL 1957 The role of abdominal pressure in relieving the pressure on the lumbar intervertebral discs. J Bone Joint Surg Br. Nov; 39-B(4):718-25

Basbaum AI, Levine JD 1991 The contribution of the nervous system to inflammation and inflammatory disease. Can J Physiol Pharmacol. May;69(5):647-51. Review

Bednar DA, Orr FW, Simon GT 1995 Observations on the pathomorphology of the thoracolumbar fascia in chronic mechanical back pain. A microscopic study. Spine (Phila Pa 1976). May 15; 20(10):1161-4

Benjamin M 2009 The fascia of the limbs and back-a review. J Anat 214(1): 1-18

Berry CC, Cacou C, Lee DA et al. 2003 Dermal fibroblasts respond to mechanical conditioning in a strain profile dependent manner. Biorheology 40 (1-3):337-345

Bhattacharya V, Watts RK, Reddy GR 2005 Live demonstration of microcirculation in the deep fascia and its implication. *Plast Reconstr Surg*. Feb;115(2):458-63

Blanquet M, Domingo T, Ortiz JC et al. 2010 Ultrasound study of thoracolumbar fascia and surrounding tissues in chronic low back pain before and after spinal manipulative therapy. In: 7th Interdisciplinary world congress on low back and pelvic pain, Nov 9-12, LA

Blomberg S 1993 A pragmatic approach to low-back pain including manual therapy and steroid injections: a multicentre study in primary health care [dissertation]. Uppsala, Sweden: Faculty of Medicine, Acta Universitatis Upsaliensis

Bockenbauer SE, Julliard KN, Sing Lo K et al. 2002 Original contribution: Quantifiable effect of osteopathic manipulative techniques on patients with chronic asthma. *J Am Osteopath Assoc* 102(7): 371-375

Boesler D; Warner M; Alpers A et al. 1993 Efficacy of high-velocity low-amplitude manipulative technique in subjects with low-back pain during menstrual cramping, *J Am Osteopath Assoc*, Feb 93: 203

Bogduk N, Macintosh J 1984 The applied anatomy of the thoracolumbar fascia. *Spine* 9:164-170

Bove GM 2008 Epi-perineurial anatomy, innervation, and axonal nociceptive mechanisms. *J Bodyw Mov Ther*. Jul;12(3):185-90. Epub 2008 May 21. Review

Bronfort G, Haas M, Evans R et al. 2010 Effectiveness of manual therapies: the UK evidence report. *Chiropr Osteopat*. Feb 25;18:3

Brown SH, Ward SR, Cook MS et al. 2011 Architectural analysis of human abdominal wall muscles: implications for mechanical function. *Spine (Phila Pa 1976)*. Mar 1;36(5):355-62

Brumagne S, Cordo P, Lysens R et al. 2000 The role of paraspinal muscle spindles in lumbosacral position sense in individuals with and without low back pain. *Spine (Phila Pa 1976)*. Apr 15;25(8):989-94

Busek P, Kemlink D 2005 The influence of the respiratory cycle on the EEG, *Physiol Res* 54:327-33

Campbell JN, Raja SN, Selig DK et al. 1994 Diagnosis and management of sympathetically maintained pain. In: Fields HL, Liebeskind JC, eds. *Progress in Pain Research and Management*. Vol 1 . Seattle, Wash: IASP Press; 1994:85 -100

Chaitow L 1996 Positional release techniques: advanced soft tissue techniques. New York: Churchill Livingstone

Chaudhry H, Schleip R, Ji Z et al. 2008 Three-dimensional mathematical model for deformation of human fasciae in manual therapy. *J Am Osteopath Assoc.* Aug;108(8):379-90

Chen CS, Ingber DE 1999 Tensegrity and mechanoregulation: from skeleton to cytoskeleton. *J Osteoarthritis Research Society International* 7, 81-94

Chen YH, Wang SF 2010 Effect of the thoracolumbar fascia release on the transverses abdominis muscle contractibility. In: 7th Interdisciplinary world congress on low back and pelvic pain, Nov 9-12, LA

Chila A 2010 *Foundations of Osteopathic Medicine*, 3rd Ed. Lippincott Williams & Wilkins

Chiquet M 1999 Regulation of extracellular matrix gene expression by mechanical stress. *Matrix Biol.* Oct;18(5):417-26. Review

Clark BC, Walkowski S, Conaster RR et al. 2009 Muscle functional magnetic resonance imaging and acute low back pain: a pilot study to characterize lumbar muscle activity asymmetries and examine the effects of osteopathic manipulative treatment. *Osteopath Med Prim Care.* 3:7

Coderre TJ, Katz J 1997 Peripheral and central hyperexcitability: differential signs and symptoms in persistent pain. *Behav Brain Sci.* Sep;20(3):404-19; discussion 435-513

Comeaux Z 2002 Robert Fulford DO and the philosopher physician, Eastland press, Seattle

Comeaux Z 2008 *Harmonic Healing: a guide to Facilitated Oscillatory release and other rhythmic myofascial techniques*, North Atlantic Press/Random House

Cook DJ, Mulrow CD, Haynes RB 1997 Systematic reviews: synthesis of best evidence for clinical decisions. *Ann Intern Med* 126,376–380

Courtney R, 2009 The functions of breathing and its dysfunctions and their relationship to breathing therapy, *IJOM*, Sept 12, 3

Crow WT, Gorodinsky L 2009 Does osteopathic manipulative treatment (OMT) improves outcomes in patients who develop postoperative ileus: a retrospective review. *Intern J Osteopath Med.* (12):32-37

Cummings J, Howell J 1990 The role of respiration in the tension production of myofascial tissues. *JAOA* 90(9): 842

Cummings GS, Tillman LJ 1992 Remodeling of dense connective tissue in normal adult tissues. In: Currier DP, Nelson RM, Eds, *Dynamics of human biologic tissues contemporary perspectives in rehabilitation* vol. 8, Davis FA, Philadelphia 1992, pp. 45-73

D'Ambrogio K, Roth G 1997 Positional release therapy: assessment and treatment of musculoskeletal dysfunction. Mosby, St Louis

Daly MdB 1986 Interactions between respiration and circulation. In: Cherniack NS, Widdcombe JG, Eds. Handbook of physiology: the respiratory system. Bethesda, American Physiological Society

Day JA, Stecco C, Stecco A 2009 Application of Fascial Manipulation technique in chronic shoulder pain-anatomical basis and clinical implications. J Bodyw Mov Ther. Apr;13(2):128-35. Epub 2008 Jun 24

Degenhardt BF, Darmani NA, Johnson JC et al. 2007 Role of osteopathic manipulative treatment in altering pain biomarkers: a pilot study. J Am Osteopath Assoc. Sep;107(9):387-400

Deig D 2001 Positional release technique: form a dynamic systems perspectives. Butterworth-Heinemann, Boston

Dickey JL 1989 Postoperative osteopathic manipulative management of median sternotomy patients. J Am Osteopath Assoc. Oct; 89(10):1309-14, 1319-22

DiGiovanna EL, Schiowitz S, Dowling DJ eds. 2004 An osteopathic approach to diagnosis and treatment. 3rd ed. Lippincott Williams & Wilkins, Philadelphia

Dittrich RJ 1964 Lumbodorsal fascia and related structures as factors in disability. Appl Ther. Nov;6:923-7

Dodd JG, Good MM, Nguyen TL et al. 2006 In vitro biophysical strain model for understanding mechanisms of osteopathic manipulative treatment. J Am Osteopath Assoc. 106(3):157-166

Dorman TA, Buchmiller JC, Cohen RE et al. 1993 Energy efficiency during human walking. Journal of orthopaedic medicine 15(3): 64-67

Eagan TS, Meltzer KR, Standley PR 2007 Importance of strain direction in regulating human fibroblast proliferation and cytokine secretion: a useful in vitro model for soft tissue injury and manual medicine treatments. J Manipulative Physiol Ther. Oct;30(8):584-592

Eisenhart AW, Gaeta TJ, Yens DP 2003 Osteopathic manipulative treatment in the emergency dept for patients with acute ankle injuries. JAOA 103:417-421

Ercole B, Antonio S, Julie Ann D et al. 2010 How much time is required to modify a fascial fibrosis? J Bodyw Mov Ther. Oct; 14(4):318-25. Epub 2010 May 20

Fairbank JCT, O'Brien JP 1980 The abdominal cavity and thoracolumbar fascia as stabilisers of the lumbar spine in patients with low back pain. Vol. 2. Engineering aspects of the spine. London: Mechanical Engineering Publications 83-88

Fernandez de las Penas C, Palomeque del Cerro L, Carnero J 2005 Manual treatment of post-whiplash injury. *Journal of Bodywork and Movement Therapies* 9, 109–119

Fratzl P 2008 Collagen structure and mechanics. P. Fratzl Ed, Potsdam, Germany

Fukunaga T, Kawakami Y, Kubo K et al. 2002 Muscle and tendon interaction during human movements. *Exerc Sport Sci Rev*. Jul;30(3):106-10. Review

Gabbiani G 1998 Evolution and clinical implications of the myofibroblast concept. *Cardiovasc Res*. Jun;38(3):545-8. Review

Gamber R, Holland S, Russo DP, Cruser A, Hilsenrath PE 2005 Cost-effective osteopathic manipulative medicine: a literature review of cost-effectiveness analyses for osteopathic manipulative treatment. *J Am Osteopath Assoc*. Aug;105(8):357-67

Gamber RG, Shores JH, Russo DP et al. 2002 Osteopathic manipulative treatment in conjunction with medication relieves pain associated with fibromyalgia syndrome: results of a randomized clinical pilot project. *J Am Osteopath Assoc*. Jun;102(6):321-5

Gashev A 2002 Physiological aspects of lymphatic contractile functions: current perspectives, *Ann N Y Acad Sci* 979:178-87

Gill KP, Callaghan MJ 1998 The measurement of lumbar proprioception in individuals with and without low back pain. *Spine (Phila Pa 1976)*, Feb 1;23(3):371-7

Gracovetsky S, Farfan HF, Lamy C. 1977 A mathematical model of the lumbar spine using an optimized system to control muscles and ligaments. *Orthop Clin North Am*. Jan;8(1):135-53

Gracovetsky S, Farfan HF, Lamy C 1981 The mechanism of the lumbar spine. *Spine* 6: 249-262

Gracovetsky S, Farfan H, Helleur C. 1985 The abdominal mechanism. *Spine (Phila Pa 1976)*. May;10(4):317-24

Greenland S 1987 Quantitative methods in the review of epidemiologic literature, *Epidemiol Rev* 9,1 –30

Greenman P 1989 Principles of manual medicine. Williams and Wilkins, Baltimore, MD

Grinnell F. 2008 Fibroblast mechanics in three-dimensional collagen matrices. *J Bodyw Mov Ther*. Jul;12(3):191-3. Epub 2008 May 23. Review

Gupta R, Allen F, Tan V et al. 1998 The effect of shear stress on fibroblasts derived from Duputyren's tissue and normal palmar fascia. *J Hand Surg Am* 23(5):945-950

Hazzard, C 1905 The practice and applied therapeutics of osteopathy, (3rd Ed.). Kirksville, MO: Journal Printing Company

Hellström F, Roatta S, Thunberg J et al. 2005 Responses of muscle spindles in feline dorsal neck muscles to electrical stimulation of the cervical sympathetic nerve. *Exp Brain Res*. Sep;165(3):328-42. Epub 2005 May 10. Erratum in: *Exp Brain Res*. 2006 Jan;168(1-2):312

Henley CE, Ivins D, Mills M et al. 2008 Osteopathic manipulative treatment and its relationship to autonomic nervous system activity as demonstrated by heart rate variability: a repeated measures study. *Osteopathic Medicine and Primary Care* 2008; 2:7

Hinz B, Pitter P, Smith-Clerc J et al. 2004 Myofibroblast development is characterized by specific cell-cell adherens junctions. *Mol Biol Cell* 15(9):4310-4320

Hodge L, Bearden M, King HH et al. 2007 Abdominal lymphatic pump treatment increases leukocyte count and flux in thoracic duct lymph. *Lymphatic Research and Biology* 5:127-133

Hogbarth KE, Eklund G 1969 The muscle vibrator: a useful tool in neurological therapeutic work, *Scan J Rehab Med*, vol.1, pp.26-34

Hoheisel U, Taguchi T, Treede RD et al. 2011 Nociceptive input from the rat thoracolumbar fascia to lumbar dorsal horn neurones. *Eur J Pain*. Feb 15

Hornberger TA, Armstrong DD, Koh TJ et al. 2005 Intracellular signaling specificity in response to uniaxial vs. multiaxial stretch: implications for mechanotransduction. *Am J Physiol Cell Physiol* 288(1):C185-C194

Huard Y 2005 Influence of the venous sinus technique on cranial hemodynamics. In King HH. (Ed.) *Proceedings of Int. Res. Conf.: Osteopathy in Pediatrics at the O.C.C. in San Diego, CA 2002*. Indianapolis, IN: American Academy of Osteopathy 32-36

Huijing PA 2009 Epimuscular myofascial force transmission: a historical review and implications for new research. *J Biomech*. Jan 5;42(1):9-21. Epub 2008 Nov 29

Hukins DW, Aspden RM, Hickey DS 1990 Thoracolumbar fascia can increase the efficiency of the erector spinae muscles. *Clin. Biomech* 5:30-34

Johnson S, Kurtz M 2003 Osteopathic manipulative treatment techniques preferred by contemporary osteopathic physicians. *J Am Osteopath Assoc* 103(5):219-224

Jones LH 1964 Spontaneous release by positioning. *The DO JAn*:109-116

Jones LH 1981 *Strain and counterstrain*. Colorado: AAO

Kamkin A, Kiseleva I, Isenberg G 2003 Activation and inactivation of a non-selective cation conductance by local mechanical deformation of acutely isolated cardiac fibroblasts. *Cardiovasc Res* 57(3):793-803

Kassolik K, Jaskólska A, Kisiel-Sajewicz K et al. 2009 Tensegrity principle in massage demonstrated by electro- and mechanomyography. *J Bodyw Mov Ther.* Apr;13(2):164-70. Epub 2007 Dec 21

Keller TS, Colloca CJ 2002 A rigid body model of the dynamic posteroanterior motion response of the human lumbar spine, *J Manip Phys Ther* Oct 25(8):485-96

Kisselkova G 1976 *Applied Physiology* 46: 1093-1095

Klingler W, Schlegel C, Schleip R 2007 The role of fascia in resting muscle tone and heat induced relaxation. In: *Fascia Research*, Elsevier Urban & Fischer

Kuchera ML 2007 Applying Osteopathic Principles to formulate treatment for patients with chronic pain *JAOA* Vol107, No.6, Nov28-38

Kuchera ML, Kuchera WA 1994a *Osteopathic Considerations in Systemic Dysfunction*. 2<sup>nd</sup> ed. Columbus, Ohio, Greyden Press

Kuchera WA, Kuchera ML. 1994b *Osteopathic Principles in Practice*. 2nd ed. Columbus, Ohio: Greyden Press 463 -512

Kuchera ML, McPartland J 2003 Myofascial trigger points as somatic dysfunction. In: Ward RC, ed. *Foundations for Osteopathic Medicine*. 2nd ed. Baltimore, Md: Lippincott, Williams & Wilkins, 1034-1050

Langevin HM 2006 Connective tissue: a body-wide signaling network? *Med Hypotheses*. 66(6):1074-7. Epub Feb 17

Langevin HM, Sherman KJ 2007 Pathophysiological model for chronic low back pain integrating connective tissue and nervous system mechanisms. *Med Hypotheses*. 68(1):74-80. Epub 2006 Aug 21

Langevin HM, Stevens-Tuttle D, Fox JR et al. 2009 Ultrasound evidence of altered lumbar connective tissue structure in human subjects with chronic low back pain. *BMC Musculoskelet. Disord.* Dec 3;10:151

LeBauer A, Brtalik R, Stowe K 2008 The effect of myofascial release (MFR) on an adult with idiopathic scoliosis. *J Bodyw Mov Ther.* 12, 356–363

Lederman E 1990 *Harmonic Technique*, Churchill Livingstone

Lederman E 1997 *Fundamentals of manual therapy*, Churchill Livingstone, London

Lee PR 2006 Still's concept of connective tissue: lost in "translation"? *JAOA*, Vol 106, No 4 April 176-177

Levine JD, Fields HL, Basbaum AI 1993 Peptides and the primary afferent nociceptor. *J Neurosci.* Jun;13(6):2273-86. Review

Licciardone JC, Brimhall AK, King LN 2005 Osteopathic manipulative treatment for low back pain: a systematic review and meta-analysis of randomized controlled trials. BMC Musculoskelet. Disord. Aug 4;6:43. Review

Licciardone JC, Buchanan S, Hensel KL et al. 2010 Osteopathic manipulative treatment of back pain and related symptoms during pregnancy: a randomized controlled trial. American Journal of Obstetrics & Gynecology, Vol 202, 1, Jan.43.e1-43.e8

Licciardone, J.C., Russo, D.P., 2006. Blinding protocols, treatment credibility, and expectancy: methodologic issues in clinical trials of osteopathic manipulative treatment (Aug). J Am Osteopath Assoc. 106 (8), 457-63

Lombardini R, Marchesi S, Collebrusco L et al. 2009 The use of osteopathic manipulative treatment as adjuvant therapy in patients with peripheral arterial disease. Man Ther. Aug;14(4):439-43

- Lum L 1987 Hyperventilation syndromes in medicine and psychiatry. Journal of the Royal Society of Medicine 229-231

Lund I, Ge Y, Yu LC et al. 2002 Repeated massage-like stimulation induces long-term effects on nociception: contribution of oxytocinergic mechanisms. Eur J Neurosci 16:330-8

Lundon K 2007 The effect of mechanical load on soft connective tissues. In: Functional Soft-Tissue Examination and treatment by manual methods. Boston, MA: Bartlett and Jones Publishers 15-30

Magoun H 1976 Osteopathy in the cranial field, 3rd Edition, Journal Printing Company

Manheim C J 2001 The Myofascial Release Manual. 3rd Ed, Slack Incorporated, New Jersey, USA

Mannino JR 1979 The application of neurologic reflexes to the treatment of hypertension. JAOA 79:225-230

- Martin MM 2009 Effects of the myofascial release in diffuse systemic sclerosis. J Bodyw Mov Ther., Oct 13(4):320-7. Epub 2008 Jun 17

Martin RB 2004 Osteopathic approach to sexual dysfunction: holistic care to improve patient satisfaction and prevent mortality and morbidity. J Am Osteopath Assoc. Jan;104(1 Suppl 1):S1-8

McConnell CP 1900 The practice of Osteopathy, 2nd Ed. The Hammond Press

McPartland JM, Giuffrida A, King J et al. 2005 Cannabimimetic effects of osteopathic manipulative treatment. J Am Osteopath Assoc. Jun;105(6):283-91

Melrose J, Ghosh P 1988 The noncollagenous proteins of the intervertebral disc. IN: Ghosh P ed. The Biology of the Intervertebral disc, Vol.1. Boca Raton: CRC Press, Ch. 8, 189-237

Meltzer KR, Standley PR 2007 Modeled repetitive motion strain and indirect osteopathic manipulative techniques in regulation of human fibroblast proliferation and interleukin secretion. J Am Osteopath Assoc. Dec;107(12):527-36

Melzack R,Coderre TJ, Katz J et al. 2001 Central neuroplasticity and pathological pain. Ann N Y Acad Sci. Mar;933:157-74. Review

Mense S 1983 Basic neurobiologic mechanisms of pain and analgesia. Am J Med 75:4-14

Mesina J, Hampton D, Evans R et al. 1998 Transient basophilia following the application of lymphatic pump techniques: a pilot study. JAOA Vol 98, Issue 2, 91-91  
• Mitchell F 1995 The Muscle Energy Manual, vol. 2, East Lansing, Michigan, MET Press

Mohanty MJ, Li X 2002 Stretch-induced Ca(2+) release via an IP(3)-insensitive Ca(2+) channel Am J Physiol Cell Physiol 283(2):C456-C462

Mosler E, Folkhard W, Knorz E et al. 1985 Stress-induced molecular arrangement in tendon collagen. J Mol Biol 182: 589-596

Nakao K, Ohgushi M, Yoshimura M et al. 1997 Hyperventilation as a specific test for diagnosis of coronary artery spasm. American Journal of Cardiology 80(5): 545-549

Newham DJ, Lederman E 1997 Effect of manual therapy techniques on the stretch reflex in normal human quadriceps, Disabil.Rehab., Aug19(8):326-31

Noll D, Shores J, Gamber R 2000 Benefits of osteopathic manipulative treatment for hospitalized elderly patients with pneumonia. JAOA 100(12): 776-782

O'Sullivan PB, Burnett A, Floyd AN et al. 2003 Lumbar repositioning deficit in a specific low back pain population. Spine (Phila Pa 1976). May 15;28(10):1074-9

O-Yurvati AH, Carnes MS, Clearfield MB et al. 2005 Hemodynamic effects of osteopathic manipulative treatment immediately after coronary artery bypass graft surgery. J Am Osteopath Assoc 105:475-481

Ohshima H, Urban JP 1992 The effect of lactate and pH on proteoglycan and protein synthesis rates in the intervertebral disc. Spine (Phila Pa 1976). Sep;17(9):1079-82  
Panjabi MM 2006 A hypothesis of chronic back pain: ligament subfailure injuries lead to muscle control dysfunction. Eur Spine J. May;15(5):668-76. Epub 2005 Jul 27.  
Review

Patterson MM 2002 Neural mechanisms of the strain-counterstrain technique. L'Osteopathie, Winter 8:5-9

Pedrelli A, Ramilli L, Stecco C 2009 How much force is required to treat the lumbar fasciae? In: Fascia Research II, Basic Science and Implications for conventional and complementary health care. Elsevier, pp. 307-308

Pilat A. 2003 Inducción Miofascial, McGraw Hill Interamericana, Madrid

Plotkin BJ, Rodos JJ, Kappler R et al. 2001 Adjunctive osteopathic manipulative treatment in women with depression: a pilot study. J Am Osteopath Assoc. Sep;101(9):517-23

Pohl H 2010 Changes in the structure of collagen distribution in the skin caused by a manual technique. J Bodyw Mov Ther. Jan;14(1):27-34

Queré N, Noël E, Lieutaud A et al. 2009 Fasciatherapy combined with pulsology touch induces changes in blood turbulence potentially beneficial for vascular endothelium. J Bodyw Mov Ther. 2009 Jul;13(3):239-45. Epub 2008 Aug 12

• Radjieski J, Lumley M, Cantieri M 1998 Effect of Osteopathic manipulative treatment on length of stay for pancreatitis: a randomized pilot study. JAOA 98(5): 264-272

Rivers WE; Treffer KD; Glaros AG et al. 2008 Short-term hematologic and hemodynamic effects of osteopathic lymphatic techniques: a pilot crossover trial. JAOA Nov 108: 646 – 651

Roatta S, Windhorst U, Ljubisavljevic M et al. 2002 Sympathetic modulation of muscle spindle afferent sensitivity to stretch in rabbit jaw closing muscles. J Physiol. Apr 1;540(Pt 1):237-48

Roberts WJ, Kramis RC 1990 Sympathetic nervous system influence on acute and chronic pain. In: Fields HL (ed) Pain syndromes in neurology. Butterworth Heineman, Oxford, pp 85-106

Saggio G, Docimo S, Pilc J et al. 2011 Impact of osteopathic manipulative treatment on secretory immunoglobulin A levels in a stressed population. JAOA Vol 111, No 3, March 143-147

Saíz-Llamasas JR, Fernández-Pérez AM, Fajardo-Rodríguez MF et al. 2009 Changes in neck mobility and pressure pain threshold levels following a cervical myofascial induction technique in pain-free healthy subjects. J Manipulative Physiol Ther. Jun;32(5):352-7

Sampson S, Meng M, Schulte A et al. 2011 Management of Dupuytren contracture with ultrasound-guided lidocaine injection and needle aponeurotomy coupled with osteopathic manipulative treatment. JAOA Feb;111(2):113-6

Sasaki N, Odajima S 1996 Elongation mechanism of collagen fibrils and force-strain relations of tendon at each level of structural hierarchy. J Biomech 29: 1131-1136

Schleip R 2003a Fascial plasticity - a new neurobiological explanation. part 1. J Bodyw Mov Ther 7(1): 11-19

Schleip R 2003b Fascial plasticity - a new neurobiological explanation. part 2. J Bodyw Mov Ther 7(2): 104-116

Schleip R, Klingler W, Lehmann-Horn F 2005 Active fascial contractility: Fascia may be able to contract in a smooth muscle-like manner and thereby influence musculoskeletal dynamics. Med Hypotheses. 65(2):273-7

Schleip R, Vleeming A, Lehmann-Horn F et al. 2007 Letter to the Editor concerning "A hypothesis of chronic back pain: ligament subfailure injuries lead to muscle control dysfunction" (M. Panjabi). Eur Spine J. Oct;16(10):1733-5; author reply 1736. Epub 2007 Mar 7

Schultz RL, Feltis R 1996 The endless web: fascial anatomy and physical reality. In: North Atlantic Books. Berkeley, CA

Schwartz H 1986 The use of counterstrain in an acutely ill in-hospital population. JAOA 86(7): 433-442

Seffinger MA, Buser BR, Licciardone JC et al. 2010 American Osteopathic Association guidelines for osteopathic manipulative treatment (OMT) for patients with low back pain. Clinical Guideline Subcommittee on Low Back Pain; AOA. JAOA Nov;110(11):653-66

Sernay RA 1975 Concepts problems and solutions in general physical, W.B.Saunders Company, Philadelphia

Shirado O, Ito T, Kaneda K et al. 1995 Flexion-relaxation phenomenon in the back muscles. A comparative study between healthy subjects and patients with chronic low back pain. Am J Phys Med Rehabil. Mar-Apr;74(2):139-44

Snijders CJ, Vleeming A, Stoeckart R 1993 Transfer of lumbosacral load to iliac bones and legs Part I: Biomechanics of self-bracing of the sacroiliac joints and its significance for treatment and exercise. Clinical Biomechanics 8: 285-294

Snyder G 1956 Fascia-applied anatomy and physiology. In: Academy of Applied Osteopathy Yearbook

Song SH, Lehrer P 2003 The effects of specific respiratory rates on heart rate and heart rate variability. Appl Psychophysiol Biofeedback 28:13-23

Standring S 2004 ed. Gray's Anatomy: The Anatomical Basis of Clinical Practice, 39th edn. Edinburgh: Churchill Livingstone

Staubesand J, Li Y 1996 Zum Feinbau der fascia cruris mit besonderer Berücksichtigung epi-und intrafaszialer nerven. Manuelle Medizin 34: 196-200

Staubesand J, Li Y 1997 Begriff and Substrat der Faziensklerose bei chronisch-venöser Insuffizienz. *Phlebologie* 26: 72-79

Stecco C, Gagey O, Belloni A et al. 2007 Anatomy of the deep fascia of the upper limb. Second part: study of innervation. *Morphologie*. Mar;91(292):38-43

Stecco A, Macchi V, Stecco C et al. 2009 Anatomical study of myofascial continuity in the anterior region of the upper limb. *J Bodyw Mov Ther*. Jan;13(1):53-62. Epub 2007 Jun 28

Stecco C, Macchi V, Porzionato A et al. 2010 The ankle retinacula: morphological evidence of the proprioceptive role of the fascial system. *Cells Tissues Organs*. 192(3):200-10. Epub 2010 Feb 27

Stiles E 1976 Osteopathic manipulation in a hospital environment. *JAOA* 76: 243-258

Still AT 1902 *The Philosophy and Mechanical Principles of Osteopathy*. Kansas City, Mo: Hudson-Kimberly Publication Co

Stilwell DL 1956 The nerve supply of the vertebral column and its associated structures in the monkey. *Anat Rec* 125:139-169

Stilwell DL 1957 Regional variations in the innervations of deep fasciae and aponeuroses. *Anat Rec* 1957; 127:635-653

Sucher BM 1993 Myofascial manipulative release of carpal tunnel syndrome: documentation with magnetic resonance imaging. *JAOA* 93, 1273-1278

Sutherland WG 1949 *Osteopathic Technique of W.G.Sutherland*. Yearbook of Academy of Applied Osteopathy

Sutherland WG 1950 *Teaching in the Science of Osteopathy*. A.S. Sutherland & A.L.Wales (Ed), The Sutherland Cranial Teaching Foundation, Ruda Press, Portland, OR 1990

Sutherland WG 1967 *Contributions of thought*. A.S. Sutherland & A.L.Wales (Ed), The Sutherland Cranial Teaching Foundation, Ruda Press, Portland, OR, 1998

Swartz MA, Tschumperlin DJ, Kamm RD et al. 2001 Mechanical stress is communicated between different cell types to elicit matrix remodeling. *Proc Natl Acad Sci USA*. May 22;98(11):6180-5. Epub 2001 May 15

Thomas GD, Segal SS 2004 Neural control of muscle blood flow during exercise. *J Appl Physiol*. Aug;97(2):731-8. Review

Tozzi P, Bongiorno D, Vitturini C 2011a Fascial release effects on patients with nonspecific cervical or lumbar pain, *J Bodyw Mov Ther*, Oct 15(4):405-416

- Tozzi P, Bongiorno D, Vitturini C 2011b Low back pain and kidney mobility: local osteopathic fascial manipulation decreases pain perception and improves renal mobility, *J Bodyw Mov Ther*, article under revision
- Tsuzaki M, Bynum D, Almekinders L et al. 2003 ATP modulates load-inducible IL-1beta, COX 2, and MMP-3 gene expression in human tendon cells *J Cell Biochem* 89(3):556-562
- Vagedes J, Gordon CM, Beutinger D et al. 2009 Myofascial release in combination with trigger point therapy and deep breathing training improves low back pain. In: *Fascia Research II, Basic Science and Implications for conventional and complementary health care*. Elsevier, pp. 249-249
- Van Buskirk RL 1990 Nociceptive reflexes and the somatic dysfunction: a model. *JAOA* 90:792-794, 797-809
- Van Buskirk RL 2006 *The Still Technique Manual*. 2nd Ed. Indianapolis, IN: The American Academy of Osteopathy
- Vandenplas Y, Denayer E, Vandenbossche T et al. 2008 Osteopathy may decrease obstructive apnea in infants: a pilot study. *Ost. Med. and Primary Care* 2: 8
- Vick DA, McKay C, Zengerle CR 1996 The safety of manipulative treatment: review of the literature from 1925 to 1993. *JAOA* 96:113 -115
- Vleeming A, Pool-Goudzwaard AL, Stoeckart R et al. 1995 The posterior layer of the thoracolumbar fascia: its function in load transfer from spine to legs. *Spine* 20:753-758
- Walsh EG 1971 Ankle clonus: an autonomous central pace-maker, *J of Physiology*, vol.212, pp.38-39
- Wang Y, Botvinick EL, Zhao Y et al. 2005 Visualizing the mechanical activation of Src. *Nature* 434(7036):1040-1045
- Walton A 2008 Efficacy of myofascial release techniques in the treatment of primary Raynaud's phenomenon. *J Bodyw Mov Ther*. Jul 12(3):274-80. Epub 2008 Mar 5
- Ward RC 2003 *Fondamenti di medicina osteopatica*, Casa Editrice Ambrosiana, Pavia, Italia
- Weidenbaum M, Farcy J-P 1990 Pain syndromes of the lumbar spine. IN: Floman Y (ed) *Disorders of the lumbar spine*. Aspen. Publishing, Rockville, MD, pp 85-115
- Wells PE 1985 *Manipulative procedure. The motor system in neurobiology*, Biomedical Press, Oxford

Willard FH 1995 Neuro-endocrine-immune network, nociceptive stress, and the general adaptive response. In: Everett T, Dennis M, Ricketts E (eds) *Physiotherapy in mental health: a practical approach*. Butterworth

Willard FH 1997 The muscular, ligamentous and neural structure of the low back and its relation to back pain In: Vleeming A, Mooney V et al. *Movement, Stability and Low Back Pain: The Essential Role of the Pelvis*, Churchill Livingstone, Edinburgh

Williams PL 1995 ed. *Gray's Anatomy*, 38th edn, Edinburgh: Churchill Livingstone

Williams NH, Wilkinson C, Russell I et al. 2003 Randomized osteopathic manipulation study (ROMANS): pragmatic trial for spinal pain in primary care. *Fam Pract*. Dec;20(6):662-9

Xu WX, Li Y, Wu LR et al. 2000 Effects of different kinds of stretch on voltage-dependent calcium current in antrial circular smooth muscle cells of the guinea-pig. *Sheng Li Xue Bao* 52(1):69-74

Yahia L, Newman N 1993 A scanning electron microscopic and immunohistochemical study of spinal ligaments innervation. *Ann Anat*. Apr;175(2):111-4

Yahia L, Rhalmi S, Newman N et al. 1992 Sensory innervation of human thoracolumbar fascia. An immunohistochemical study. *Acta Orthop Scand*. Apr;63(2):195-7

Yahia L, Pigeon P, DesRosiers E 1993 Viscoelastic properties of the human lumbodorsal fascia. *Journal of Biomedical Engineering* 15:425-429

Yang G, Crawford RC, Wang JH 2004 Proliferation and collagen production of human patellar tendon fibroblasts in response to cyclic uniaxial stretching in serum-free conditions *J Biomech* 37(10):1543-1550

Yates HA, Vardy TC, Kuchera ML et al. 2002 Effects of osteopathic manipulative treatment and concentric and eccentric maximal-effort exercise on women with multiple sclerosis: a pilot study. *J Am Osteopath Assoc*. May;102(5):267-75

Zaphiris A, Mills MV, Jewell NP et al. 2004 Osteopathic manipulative treatment and otitis media: does improving somatic dysfunction improve clinical outcomes? *JAOA* Jan 104: 11

Zink JG, Lawson WB 1979 An osteopathic structural examination and functional interpretation of the soma. *Osteopath Ann* 7:12 -19