

# THE LUMBOPELVIC COMPLEX: ADVANCES IN EVALUATION AND TREATMENT

Patient Educational Resources for the Spine Patient

Independent Study Course 28.3.6

**W. Gregory Seymour, PT, DPT, OCS**  
University of Delaware  
Newark, DE

**J. Megan Sions, DPT, PhD, OCS**  
University of Delaware  
Newark, DE

**Michael Palmer, PT, DPT, OCS**  
University of Delaware  
Newark, DE

**Tara Jo Manal, PT, DPT, OCS, SCS, FAPTA**  
University of Delaware  
Newark, DE

CONTINUING PHYSICAL THERAPY EDUCATION

ACADEMY OF  
**ORTHOPAEDIC**  
PHYSICAL THERAPY 

 **APTA**  
American Physical Therapy Association

## References

1. Hodges PW, Richardson CA. Contraction of the abdominal muscles associated with movement of the lower limb. *Phys Ther.* 1997;77(2):132-142.
2. Goldby LJ, Moore AP, Doust J, Trew ME. A randomized controlled trial investigating the efficiency of musculoskeletal physiotherapy on chronic low back disorder. *Spine (Phila Pa 1976)*. 2006;31(10):1083-1093.
3. Hides JA, Jull GA, Richardson CA. Long-term effects of specific stabilizing exercises for first-episode low back pain. *Spine (Phila Pa 1976)*. 2001;26(11):E243-E248.
4. Cholewicki J, McGill KC, Shah KR, Lee AS. The effects of a three-week use of lumbosacral orthoses on trunk muscle activity and on the muscular response to trunk perturbations. *BMC Musculoskelet Disord.* 2010;11:154.
5. Basson A, Olivier B, Ellis R, Coppieters M, Stewart A, Mudzi W. The effectiveness of neural mobilization for neuromusculoskeletal conditions: a systematic review and meta-analysis. *J Orthop Sports Phys Ther.* 2017;47(9):593-615. doi: 10.2519/jospt.2017.7117.
6. Neto T, Freitas S, Marques M, Gomes L, Andrade R, Oliveira R. Effects of lower body quadrant neural mobilization in healthy and low back pain populations: A systematic review and meta-analysis. *Musculoskelet Sci Pract.* 2017;27:14-22. doi: 10.1016/j.msksp.2016.11.014.
7. Schafer A, Hall T, Muller G, Briffa K. Outcomes differ between subgroups of patients with low back and leg pain following neural manual therapy: a prospective cohort study. *Eur Spine J.* 2011;20(3):482-490. doi: 10.1007/s00586-010-1632-2.
8. Neto T, Freitas S, Marques M, Gomes L, Andrade R, Oliveira R. Effects of lower body quadrant neural mobilization in healthy and low back pain populations: A systematic review and meta-analysis. *Musculoskelet Sci Pract.* 2017;27:14-22. doi: 10.1016/j.msksp.2016.11.014.
9. Cleland J, Childs J, Palmer JA, Eberhart S. Slump stretching in the management of non-radicular low back pain: A pilot clinical trial. *Man Ther.* 2006;11(4):279-286.
10. Cleland J, Childs J, Palmer JA, Eberhart S. Slump stretching in the management of non-radicular low back pain: A pilot clinical trial. *Man Ther.* 2006;11(4):279-286.
11. MacIntyre DL, Reid WD, McKenzie DC. Delayed muscle soreness. The Inflammatory response to muscle injury and its clinical implications. *Sports Med.* 1995;20(1):24-40.
12. MedicineNet.com, Weil R, Marks JW. Muscle soreness. [www.medicinenet.com/script/main/art.asp?articlekey=78966&page=1](http://www.medicinenet.com/script/main/art.asp?articlekey=78966&page=1). Accessed August 14, 2018.
13. Rossato M, de Souza Bezerra E, de Cesselles Seixas de Silva, et al. Effects of cryotherapy on muscle damage markers and perception of delayed onset muscle soreness after downhill running: a pilot study. *Rev Andal Med Deport.* 2015;8(2):49-53. doi:10.1016/j.ramd.2014.07.003.
14. Hilbert JE, Sforzo GA, Swensen T. The effects of massage on delayed onset muscle soreness. *Br J Sports Med.* 2003;37(1):72-75.
15. Reinold MM, Wilk KE, Reed J, Crenshaw K, Andrews JR. Interval sport programs: guidelines for baseball, tennis, and golf. *J Orthop Sports Phys Ther.* 2002;32(6):293-298. doi:10.2519/jospt.2002.32.6.293.
16. University of Delaware, Delaware Physical Therapy Clinic. Soreness rules. <https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/c/3448/files/2017/07/UD-Soreness-Rules-Jul-28-2017-25les5o.pdf>. Accessed October 26, 2018.
17. Fees M, Decker T, Snyder-Mackler L, Axe MJ. Upper extremity weight-training modifications for the injured athlete. A clinical perspective. *Am J Sports Med.* 1998;26(5):732-742.
18. Axe MJ, Windley TC, Snyder-Mackler L. Data-based interval throwing programs for Collegiate Softball players. *J Athl Train.* 2002;37(2):194-203.
19. Axe MJ, Hurd W, Snyder-Mackler L. Data-based interval throwing programs for baseball players. *Sports Health.* 2009;1(2):145-153.
20. American College of Sports Medicine. *ACSM's Guidelines for Exercise Testing and Prescription*. 9th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2014.
21. US Department of Health and Human Services. 2008 Physical Activity Guidelines for Americans. <http://www>.



- health.gov/paguidelines/pdf/paguide.pdf. Accessed October 26, 2018.
22. Garber CE, Blissmer B, Deschenes MR, et al. American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. *Med Sci Sports Exerc.* 2011;43(7):1334-1359. doi: 10.1249/MSS.0b013e318213feff.
  23. Herbert RD, Gabriel M. Effects of stretching before and after exercising on muscle soreness and risk of injury: systematic review. *BMJ.* 2002;325(7362):468.
  24. Thacker SB, Gilchrist J, Stroup DF, Kimsey CD Jr. The impact of stretching on sports injury risk: a systematic review of the literature. *Med Sci Sports Exerc.* 2004;36(3):371-378.
  25. McCrary JM, Ackermann BJ, Halaki M. A systematic review of the effects of upper body warm-up on performance and injury. *Br J Sports Med.* 2015;49(14):935-942. doi:10.1136/bjsports-2014-094228.
  26. Fradkin AJ, Gabbe BJ, Cameron PA. Does warming up prevent injury in sport? The evidence from randomised controlled trials. *J Sci Med Sport.* 2006;9(3):214-220.
  27. Jones I, Johnson MI. Transcutaneous electrical nerve stimulation. *Continuing Education in Anaesthesia Critical Care & Pain.* 2009;9(4):130-135. <https://doi.org/10.1093/bjaccp/mkp021>.
  28. Facci LM, Nowotny JP, Tormem F, Trevisani VF. Effects of transcutaneous electrical nerve stimulation (TENS) and interferential currents (IFC) in patients with nonspecific chronic low back pain: randomized clinical trial. *Sao Paulo Med J.* 2011;129(4):206-216.
  29. Nadler SE, Weingand K, Kruse RJ. The physiologic basis and clinical applications of cryotherapy and thermotherapy for the pain practitioner. *Pain Physician.* 2004;7(3):395-399.
  30. Davis KD, Kwan CL, Crawley AP. Functional brain MRI study of thalamic and cortical activations evoked by cutaneous heat, cold, and tactile stimuli. *J Neurophysiol.* 1998;80(3):1533-1546.
  31. Rehab Management. Seidenburg M. The role of modalities in chronic low back pain. <http://www.rehabpub.com/2014/02/role-modalities-chronic-low-back-pain/>. Accessed August 24, 2018.
  32. Soliman HAG, Barchi S, Parent S, Maurais G, Jodoin A, Mac-Thiong JM. Early impact of postoperative bracing on pain and quality of life after posterior instrumented fusion for lumbar degenerative conditions: a randomized trial. *Spine (Phila Pa 1976).* 2018;43(3):155-160. doi: 10.1097/BRS.0000000000002292.
  33. van Duijvenbode IC, Jellema P, van Poppel MN, van Tulder MW. Lumbar supports for prevention and treatment of low back pain. *Cochrane Database Syst Rev.* 2008;(2):CD001823. doi: 10.1002/14651858.CD001823.pub3.
  34. van Poppel MN, Koes BW, Deville W, Smid T, Bouter LM. Risk factors for back pain incidence in industry: a prospective study. *Pain.* 1998;77(1):81-86.
  35. Negrini S, Minozzi S, Bettany-Saltikov J, et al. Braces for idiopathic scoliosis in adolescents. *Spine (Phila Pa 1976).* 2016;41(23):1813-1825.
  36. Thompson RM, Hubbard EW, Jo CH, Virostek D, Karol LA. Brace success is related to curve type in patients with adolescent idiopathic scoliosis. *J Bone Joint Surg Am.* 2017;99(11):923-928. doi: 10.2106/JBJS.16.01050
  37. Morrisette DC, Cholewicki J, Logan S, Seif G, McGowan S. A randomized clinical trial comparing extensible and inextensible lumbosacral orthoses and standard care alone in the management of lower back pain. *Spine (Phila Pa 1976).* 2014;39(21):1733-1742. doi: 10.1097/BRS.0000000000000521.
  38. Calmels P, Queneau P, Hamonet C, et al. Effectiveness of a lumbar belt in subacute low back pain: an open, multicentric, and randomized clinical study. *Spine (Phila Pa 1976).* 2009;34(3):215-220. doi: 10.1097/BRS.0b013e31819577dc.
  39. Roelofs PD, Bierma-Zeinstra SM, van Poppel MN, van Mechelen W, Koes BW, van Tulder MW. Cost-effectiveness of lumbar supports for home care workers with recurrent low back pain: an economic evaluation alongside a randomized-controlled trial. *Spine (Phila Pa 1976).* 2010;35(26):E1619-1626. doi: 10.1097/BRS.0b013e3181cf7244.
  40. Zaina F, Tomkins-Lane C, Carragee E, Negrini S. Surgical versus non-surgical treatment for lumbar spinal stenosis. *Cochrane Database Syst Rev.* 2016;(1):CD010264. doi: 10.1002/14651858.CD010264.pub2.
  41. Amundsen T, Weber H, Nordal HJ, Magnaes B, Abdelnoor M, Lilleas F. Lumbar spinal stenosis: conservative or surgical management?: A prospective 10-year study. *Spine (Phila Pa 1976).* 2000;25(11):1424-1435; discussion 1435-1426.
  42. Rzewuska M, Ferreira M, McLachlan AJ, Machado AC, Maher CG. The efficacy of conservative treatment of osteoporotic compression fractures on acute pain relief: a systematic review with meta-analysis. *Eur Spine J.* 2015;24(4):702-714. doi: 10.1007/s00586-015-3821-5.
  43. Pfeifer M, Kohlwey L, Begerow B, Minne HW. Effects of two newly developed spinal orthoses on trunk muscle strength, posture, and quality-of-life in women with postmenopausal osteoporosis: a randomized trial. *Am J Phys Med Rehabil.* 2011;90(10):805-815. doi: 10.1097/PHM.0b013e31821f6df3.
  44. Pfeifer M, Begerow B, Minne HW. Effects of a new spinal orthosis on posture, trunk strength, and quality of life in

- women with postmenopausal osteoporosis: a randomized trial. *Am J Phys Med Rehabil*. 2004;83(3):177-186.
45. Li M, Law SW, Cheng J, Kee HM, Wong MS. A comparison study on the efficacy of SpinoMed(R) and soft lumbar orthosis for osteoporotic vertebral fracture. *Prosthet Orthot Int*. 2015;39(4):270-276. doi: 10.1177/0309364614528204.
  46. Meccariello L, Muzii VF, Falzarano G, et al. Dynamic corset versus three-point brace in the treatment of osteoporotic compression fractures of the thoracic and lumbar spine: a prospective, comparative study. *Aging Clin Exp Res*. 2017;29(3):443-449. doi: 10.1007/s40520-016-0602-x.
  47. Alcala-Cerra G, Paternina-Caicedo AJ, Diaz-Becerra C, Moscote-Salazar LR, Fernandes-Joaquim A. Orthosis for thoracolumbar burst fractures without neurologic deficit: A systematic review of prospective randomized controlled trials. *J Craniovertebr Junction Spine*. 2014;5(1):25-32. doi: 10.4103/0974-8237.135213.
  48. Chang V, Holly LT. Bracing for thoracolumbar fractures. *Neurosurg Focus*. 2014;37(1):E3. doi: 10.3171/2014.4.FOCUS1477.
  49. Piazza M, Sinha S, Agarwal P, et al. Post-operative bracing after pedicle screw fixation for thoracolumbar burst fractures: A cost-effectiveness study. *J Clin Neurosci*. 2017;45:33-39. doi: 10.1016/j.jocn.2017.07.038
  50. Dailey AT, Ghogawala Z, Choudhri TF, et al. Guideline update for the performance of fusion procedures for degenerative disease of the lumbar spine. Part 14: brace therapy as an adjunct to or substitute for lumbar fusion. *J Neurosurg Spine*. 2014;21(1):91-101. doi: 10.3171/2014.4.SPINE14282.
  51. Kawchuk GN, Edgecombe TL, Wong AY, Cojocarua A, Prasad N. A non-randomized clinical trial to assess the impact of nonrigid, inelastic corsets on spine function in low back pain participants and asymptomatic controls. *Spine J*. 2015;15(10):2222-2227. doi: 10.1016/j.spinee.2015.06.047.
  52. Azadinia F, Ebrahimi ET, Kamyab M, Parnianpour M, Cholewicki J, Maroufi N. Can lumbosacral orthoses cause trunk muscle weakness? A systematic review of literature. *Spine J*. 2017;17(4):589-602. doi: 10.1016/j.spinee.2016.12.005.
  53. Lavender SA, Shakeel K, Andersson GB, Thomas JS. Effects of a lifting belt on spine moments and muscle recruitments after unexpected sudden loading. *Spine (Phila Pa 1976)*. 2000;25(12):1569-1578.
  54. Rostami M, Noormohammadpour P, Sadeghian AH, Mansournia MA, Kordi R. The effect of lumbar support on the ultrasound measurements of trunk muscles: a single-blinded randomized controlled trial. *PM R*. 2014;6(4):302-308; quiz 308. doi: 10.1016/j.pmrj.2013.09.014.
  55. McGorry RW, Hsiang SM. The effect of industrial back belts and breathing technique on trunk and pelvic coordination during a lifting task. *Spine (Phila Pa 1976)*. 1999;24(11):1124-1130.
  56. Giorcelli RJ, Hughes RE, Wassell JT, Hsiao H. The effect of wearing a back belt on spine kinematics during asymmetric lifting of large and small boxes. *Spine (Phila Pa 1976)*. 2001;26(16):1794-1798.
  57. Mens JM, Damen L, Snijders CJ, Stam HJ. The mechanical effect of a pelvic belt in patients with pregnancy-related pelvic pain. *Clin Biomech (Bristol, Avon)*. 2006;21(2):122-127.
  58. Damen L, Spoor CW, Snijders CJ, Stam HJ. Does a pelvic belt influence sacroiliac joint laxity? *Clin Biomech (Bristol, Avon)*. 2002;17(7):495-498.
  59. Hammer N, Mobius R, Schleifenbaum S, et al. Pelvic belt effects on health outcomes and functional parameters of patients with sacroiliac joint pain. *PLoS One*. 2015;10(8):e0136375. doi: 10.1371/journal.pone.0136375.
  60. Mens JM, Vleeming A, Snijders CJ, Koes BW, Stam HJ. Reliability and validity of the active straight leg raise test in posterior pelvic pain since pregnancy. *Spine (Phila Pa 1976)*. 2001;26(10):1167-1171.
  61. Pellicchia GL. Lumbar traction: a review of the literature. *J Orthop Sports Phys Ther*. 1994;20(5):262-267.
  62. Krause M, Refshauge KM, Dessen M, Boland R. Lumbar spine traction: evaluation of effects and recommended application for treatment. *Man Ther*. 2000;5(2):72-81.
  63. Judovich BD. Lumbar traction therapy; elimination of physical factors that prevent lumbar stretch. *J Am Med Assoc*. 1955;159(6):549-550.
  64. Lee RY, Evans JH. Loads in the lumbar spine during traction therapy. *Aust J Physiother*. 2001;47(2):102-108.
  65. Colachis SC, Strohm BR. Effects of intermittent traction on separation of lumbar vertebrae. *Arch Phys Med Rehabil*. 1969;50(5):251-258.
  66. Harte AA, Baxter GD, Gracey JH. The efficacy of traction for back pain: a systematic review of randomized controlled trials. *Arch Phys Med Rehabil*. 2003;84(10):1542-1553.
  67. Apfel CC, Cakmakkaya OS, Martin W, et al. Restoration of disk height through non-surgical spinal decompression is associated with decreased discogenic low back pain: a retrospective cohort study. *BMC Musculoskelet Disord*. 2010;11:155. doi: 10.1186/1471-2474-11-155.
  68. Twomey LT. Sustained lumbar traction. An experimental study of long spine segments. *Spine (Phila Pa 1976)*. 1985;10(2):146-149.
  69. Chow DHK, Yuen EMK, Xiao L, Leung MPC. Mechanical effects of traction on lumbar intervertebral discs: A magnetic resonance imaging study.

- Musculoskelet Sci Pract.* 2017;29:78-83. doi: 10.1016/j.msksp.2017.03.007.
70. Mitchell UH, Beattie PF, Bowden J, Larsson R, Wang H. Age-related differences in the response of the L5-S1 intervertebral disc to spinal traction. *Musculoskelet Sci Pract.* 2017;31:1-8. doi: 10.1016/j.msksp.2017.06.004.
  71. Mitchell UH, Helgeson K, Mintken P. Physiological effects of physical therapy interventions on lumbar intervertebral discs: A systematic review. *Physiother Theory Pract.* 2017;33(9):695-705. doi: 10.1080/09593985.2017.1345026.
  72. Andersson GB, Schultz AB, Nachemson AL. Intervertebral disc pressures during traction. *Scand J Rehabil Med Suppl.* 1983;9:88-91.
  73. Reilly JP, Gersten JW, Clinkingbeard JR. Effect of pelvic-femoral position on vertebral separation produced by lumbar traction. *Phys Ther.* 1979;59(3):282-286.
  74. Saunders HD. Lumbar traction. *J Orthop Sports Phys Ther.* 1979;1(1):36-45.
  75. Almeida M, Saragiotto B, Richards B, Maher CG. Primary care management of non-specific low back pain: key messages from recent clinical guidelines. *Med J Aust.* 2018;208(6):272-275.
  76. Fritz JM, Lindsay W, Matheson JW, et al. Is there a subgroup of patients with low back pain likely to benefit from mechanical traction? Results of a randomized clinical trial and subgrouping analysis. *Spine (Phila Pa 1976).* 2007;32(26):E793-800.
  77. Cai C, Pua YH, Lim KC. A clinical prediction rule for classifying patients with low back pain who demonstrate short-term improvement with mechanical lumbar traction. *Eur Spine J.* 2009;18(4):554-561. doi: 10.1007/s00586-009-0909-9.
  78. Bilgiliyoy Filiz M, Kilic Z, Uckun A, Cakir T, Koldas Dogan S, Toraman NF. Mechanical traction for lumbar radicular pain: supine or prone? a randomized controlled trial. *Am J Phys Med Rehabil.* 2018;97(6):433-439. doi: 10.1097/PHM.0000000000000892.
  79. Weatherell VF. Comparison of electromyographic activity in normal lumbar sacrospinalis musculature during static pelvic -traction in two different positions. *J Orthop Sports Phys Ther.* 1987;8(8):382-390.
  80. Baskaran M, Raman K, Ramani KK, Roy J, Vijaya L, Badrinath SS. Intraocular pressure changes and ocular biometry during Sirsasana (headstand posture) in yoga practitioners. *Ophthalmology.* 2006;113(8):1327-1332.
  81. Shah NJ, Shah UN. Central retinal vein occlusion following Sirsasana (headstand posture). *Indian J Ophthalmol.* 2009;57(1):69-70.
  82. Lerebours VC, Rohl AJ, Shaikh S. Bilateral retinal detachments associated with inversion table therapy. *Cureus.* 2017;9(3):e1098. doi: 10.7759/cureus.1098.
  83. Mitry D, Singh J, Yorston D, et al. The predisposing pathology and clinical characteristics in the Scottish retinal detachment study. *Ophthalmology.* 2011;118(7):1429-1434. doi: 10.1016/j.optha.2010.11.031.
  84. Kane MD, Karl RD, Swain JH. Effects of gravity-facilitated traction on Intervertebral dimensions of the lumbar spine. *J Orthop Sports Phys Ther.* 1985;6(5):281-288.
  85. Tekeoglu I, Adak B, Bozkurt M, Gurbuzoglu N. Distraction of lumbar vertebrae in gravitational traction. *Spine (Phila Pa 1976).* 1998;23(9):1061-1063; discussion 1064.
  86. Sheffield FJ. Adaptation of a tilt table for lumbar traction. *Arch Phys Med Rehabil.* 1964;45:469-472.
  87. Nosse LJ. Inverted spinal traction. *Arch Phys Med Rehabil.* 1978;59(8):367-370.
  88. Prasad KS, Gregson BA, Hargreaves G, Byrnes T, Winburn P, Mendelow AD. Inversion therapy in patients with pure single level lumbar discogenic disease: a pilot randomized trial. *Disabil Rehabil.* 2012;34(17):1473-1480. doi: 10.3109/09638288.2011.647231
  89. Goldman RM, Tarr RS, Pinchuk BG, Kappler RE, Slick GE, Nelson K. More on gravity inversion. *West J Med.* 1984;141(2):247.