Understanding the degenerative cervical spine: implications for clinical practice and OMPT

Brian Swanson PT, DSc Rafael Ozdemirer

Cervical disc degeneration (CDD) is generally accepted to be a progressive, age-related occurrence that is frequently associated with neck pain and radiculopathy. Consistent with the majority of published clinical practice guidelines (CPG) for neck pain, the 2017 APTA Neck Pain CPG recommends cervical manipulation as an intervention to address chronic symptoms in the "Neck Pain With Mobility Deficits" category as well for individuals with "Chronic Neck Pain With Radiating Pain". While CPGs are intended to help optimize care, these guidelines generally do not recommend or discuss specific manipulation techniques, with selection left to the practitioner's discretion. From a biomechanical perspective, disc degeneration represents the loss of structural integrity/failure of the intervertebral disc. The sequelae of CDD include posterior neck pain, segmental hypermobility and/instability, radicular symptoms, myelopathic disturbance, and the potential for vascular compromise. In this session, we ask whether OMPTs are fully considering consider these mechanical, neurological, and vascular consequences of CDD? To help answer these questions, this session will review relevant information on the anatomy of the cervical disc, the mechanics of discogenic instability and changes to the intervertebral foramen, and the potential effects of spondylotic hypertrophy on the central spinal canal, spinal cord, and vertebral artery. The consequences of CDD will be discussed in the context of manual therapy, and suggestions offered for the clinician to incorporate the resulting biomechanical sequelae of CDD within the biopsychosocial model of manual therapy practice. Selected techniques will be presented and practiced in the accompanying hands-on lab session.

At the completion of this session, the participant will be able to:

1) Discuss the implications of degenerative pathology on the biomechanics of the cervical spine

2) Discuss the unique structural role of the cervical disc

3) Relate degenerative changes in the cervical spine to their associated presentations including neck pain, radiculopathy, and myelopathic symptoms

4) Apply examination techniques to identify dysfunctions resulting from cervical degenerative changes, including instability, radiculopathy, and myelopathy

5) Develop an evidence-informed treatment plan to treat impairments commonly found in individuals with degenerative cervical changes

6) Apply manual therapy techniques, including HVLA thrust, appropriate for individuals with degenerative cervical changes

Swanson BT, Creighton D. Cervical disc degeneration: important considerations for the manual therapist. Journal of Manual & Manipulative Therapy. 2021 Nov 25:1-5.

Arimi SA, Bandpei MAM, Rezasoltani A, Peolsson A, Mohammadi M. Multifidus muscle size changes at different directions of head and neck movements in females with unilateral chronic non-specific neck pain and healthy subjects using ultrasonography. Journal of bodywork and movement therapies. 2018;22(3):560-565.

Tamai K, Grisdela P, Romanu J, et al. The impact of cervical spinal muscle degeneration on cervical sagittal balance and spinal degenerative disorders. Clinical spine surgery. 2019;32(4):E206-E213.

Wang K, Wang H, Deng Z, Li Z, Zhan H, Niu W. Cervical traction therapy with and without neck support: A finite element analysis. Musculoskelet Sci Pract. Apr 2017;28:1-9.

Romeo A, Vanti C, Boldrini V, et al. Cervical Radiculopathy: Effectiveness of Adding Traction to Physical Therapy—A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Physical Therapy. 2018;98(4):231-242. doi:10.1093/physth/pzy001

Young JL, Walker D, Snyder S, Daly K. Thoracic manipulation versus mobilization in patients with mechanical neck pain: a systematic review. The Journal of manual & manipulative therapy. 2014;22(3):141-153. doi:10.1179/2042618613Y.0000000043

Young IA, Pozzi F, Dunning J, Linkonis R, Michener LA. Immediate and Short-term Effects of Thoracic Spine Manipulation in Patients With Cervical Radiculopathy: A Randomized Controlled Trial. J Orthop Sports Phys Ther. May 2019;49(5):299-309. doi:10.2519/jospt.2019.8150

Salem W, Klein P. In vivo 3D kinematics of the cervical spine segments during pre-manipulative positioning at the C4/C5 level. Manual therapy. 2013;18(4):321-326.

Wu L-P, Huang Y-Q, Zhou W-H, et al. Influence of cervical spine position, turning time, and cervical segment on cadaver intradiscal pressure during cervical spinal manipulative therapy. Journal of manipulative and physiological therapeutics. 2012;35(6):428-436.

Li YK, Zhu QA, Zhong SZ. The effect of cervical traction combined with rotatory manipulation on cervical nucleus pulposus pressures. Journal of manipulative and physiological therapeutics. 1998;21(2):97-100.

Puentedura EJ, March J, Anders J, et al. Safety of cervical spine manipulation: are adverse events preventable and are manipulations being performed appropriately? A review of 134 case reports. Journal of Manual & Manipulative Therapy. 2012;20(2):66-74.

Kumaresan S, Yoganandan N, Pintar FA, Maiman DJ, Goel VK. Contribution of disc degeneration to osteophyte formation in the cervical spine: a biomechanical investigation. Journal of Orthopaedic Research. 2001;19(5):977-984

Kranenburg HA, Schmitt MA, Puentedura EJ, Luijckx GJ, Van der Schans CP. Adverse events associated with the use of cervical spine manipulation or mobilization and patient characteristics: a systematic review. Musculoskeletal science and practice. 2017;28:32-38.

Herzog W. The biomechanics of spinal manipulation. Journal of bodywork and movement therapies. 2010;14(3):280-286.

Morishita Y, Naito M, Hymanson H, Miyazaki M, Wu G, Wang JC. The relationship between the cervical spinal canal diameter and the pathological changes in the cervical spine. European Spine Journal. 2009/06/01 2009;18(6):877-883. doi:10.1007/s00586-009-0968-yAlizada M, Li RR, Hayatullah G. Cervical instability in cervical spondylosis patients. Der Orthopäde. 2018;47(12):977-985.

Kong L, Tian W, Cao P, Wang H, Zhang B, Shen Y. Predictive factors associated with neck pain in patients with cervical disc degeneration: A cross-sectional study focusing on Modic changes. Medicine. 2017;96(43)

Smith ZA, Khayatzadeh S, Bakhsheshian J, et al. Dimensions of the cervical neural foramen in conditions of spinal deformity: an ex vivo biomechanical investigation using specimen-specific CT imaging. European Spine Journal. 2016/07/01 2016;25(7):2155-2165. doi:10.1007/s00586-016-4409-4

Dugailly P-M, Beyer B, Salem W, Feipel V. Morphometric changes of the cervical intervertebral foramen: A comparative analysis of pre-manipulative positioning and physiological axial rotation. Musculoskeletal Science and Practice. 2018;34:97-102.

Harrison DE, Cailliet R, Harrison DD, Troyanovich SJ, Harrison SO. A review of biomechanics of the central nervous system—Part I: Spinal canal deformations resulting from changes in posture. Journal of manipulative and physiological therapeutics. 1999;22(4):227-234.

Harrison DE, Cailliet R, Harrison DD, Troyanovich SJ, Harrison SO. A review of biomechanics of the central nervous system—Part II: Spinal cord strains from postural loads. Journal of Manipulative and Physiological Therapeutics. 1999/06/01/ 1999;22(5):322-332. doi:https://doi.org/10.1016/S0161-4754(99)70065-5

Harrison DE, Cailliet R, Harrison DD, Troyanovich SJ, Harrison SO. A review of biomechanics of the central nervous system—Part III: spinal cord stresses from postural loads and their neurologic effects. Journal of manipulative and physiological therapeutics. 1999;22(6):399-410.

Humphreys SC, Hodges SD, Patwardhan A, Eck JC, Covington LA, Sartori M. The natural history of the cervical foramen in symptomatic and asymptomatic individuals aged 20-60 years as measured by magnetic resonance imaging: a descriptive approach. Spine. 1998;23(20):2180-2184.

Hartman J. Anatomy and clinical significance of the uncinate process and uncovertebral joint: a comprehensive review. Clinical Anatomy. 2014;27(3):431-440.

Liu B, Liu Z, VanHoof T, Kalala J, Zeng Z, Lin X. Kinematic study of the relation between the instantaneous center of rotation and degenerative changes in the cervical intervertebral disc. European Spine Journal. 2014/11/01 2014;23(11):2307-2313. doi:10.1007/s00586-014-3431-7

Morishita Y, Hymanson H, Miyazaki M, et al. Review Article: Kinematic Evaluation of the Spine: A Kinetic Magnetic Resonance Imaging Study. Journal of Orthopaedic Surgery. 2008/12/01 2008;16(3):348-350. doi:10.1177/230949900801600316

Wang B, Liu H, Wang H, Zhou D. Segmental instability in cervical spondylotic myelopathy with severe disc degeneration. Spine. 2006;31(12):1327-1331.

Miyazaki M, Hong SW, Yoon SH, et al. Kinematic analysis of the relationship between the grade of disc degeneration and motion unit of the cervical spine. Spine. 2008;33(2):187-193.

Milne N. Composite motion in cervical disc segments. Clinical Biomechanics. 1993;8(4):193-202.

Wu B, Yang L, Peng B. Ingrowth of Nociceptive Receptors into Diseased Cervical Intervertebral Disc Is Associated with Discogenic Neck Pain. Pain Medicine. 2019;20(6):1072-1077.

Peng B, Bogduk N. Cervical Discs as a Source of Neck Pain. An Analysis of the Evidence. Pain Medicine. 2019;20(3):446-455. doi:10.1093/pm/pny249

Taylor J, Twomey L, Levander B. Contrasts between cervical and lumbar motion segments. Critical Reviews™ in Physical and Rehabilitation Medicine. 2000;12(4)

Mercer S, Bogduk N. The ligaments and anulus fibrosus of human adult cervical intervertebral discs. Spine. 1999;24(7):619-626

Luxford K. 'First, do no harm': shifting the paradigm towards a culture of health. Patient Experience Journal. 2016;3(2):5-8.

Shala R, Roussel N, Lorimer Moseley G, Osinski T, Puentedura EJ. Can we just talk our patients out of pain? Should pain neuroscience education be our only tool? Journal of Manual & Manipulative Therapy. 2021/01/02 2021;29(1):1-3. doi:10.1080/10669817.2021.1873259

Louw A, Nijs J, Puentedura EJ. A clinical perspective on a pain neuroscience education approach to manual therapy. Journal of Manual & Manipulative Therapy. 2017/05/27 2017;25(3):160-168. doi:10.1080/10669817.2017.1323699

Keefe FJ, Main CJ, George SZ. Advancing Psychologically Informed Practice for Patients With Persistent Musculoskeletal Pain: Promise, Pitfalls, and Solutions. Physical Therapy. 2018;98(5):398-407. doi:10.1093/ptj/pzy024

Edwards RR, Dworkin RH, Turk DC, et al. Patient phenotyping in clinical trials of chronic pain treatments: IMMPACT recommendations. Pain. 2016;157(9):1851.

Bialosky JE, Beneciuk JM, Bishop MD, et al. Unraveling the mechanisms of manual therapy: modeling an approach. journal of orthopaedic & sports physical therapy. 2018;48(1):8-18.

Blanpied PR, Gross AR, Elliott JM, et al. Neck Pain: Revision 2017. J Orthop Sports Phys Ther. Jul 2017;47(7):A1-a83. doi:10.2519/jospt.2017.0302

Parikh P, Santaguida P, Macdermid J, Gross A, Eshtiaghi A. Comparison of CPG's for the diagnosis, prognosis and management of non-specific neck pain: a systematic review. BMC Musculoskeletal Disorders. 2019/02/14 2019;20(1):81. doi:10.1186/s12891-019-2441-3

Nakashima H, Yukawa Y, Suda K, Yamagata M, Ueta T, Kato F. Abnormal findings on magnetic resonance images of the cervical spines in 1211 asymptomatic subjects. Spine. 2015;40(6):392-398.

Peng B, DePalma MJ. Cervical disc degeneration and neck pain. J Pain Res. 2018;11:2853-2857. doi:10.2147/jpr.s180018"

Brian Swanson PT, DSc is an Associate Professor, Chair of the Department of Rehabilitation Sciences, and Director of the Physical Therapy program at the University of Hartford. Dr. Swanson also serves as Director of the Certificate in Advanced Orthopedic Physical Therapy and co-director of the HHCRN-University of Hartford Orthopedic Residency program. An experienced clinician, he is a board-certified Orthopedic Clinical Specialist and Fellow of the American Academy of Orthopedic Manual Physical Therapists. Additionally, he maintains an active research agenda, and has authored multiple peer-

reviewed manuscripts on topics including orthopedic tests/measures, clinical decision making, and manual therapy.

Rafael Ozdemirer PT, DPT is a fellowship-trained orthopedic manual therapist. He is currently practicing at Connecticut Children's Sports Physical Therapy in Farmington and is an adjunct instructor in the Physical Therapy program at the University of Hartford.