

NOMENCLATURE AND CLASSIFICATION OF LUMBAR DISC PATHOLOGY

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During the last three years, an Ad hoc Nomenclature Committee of the American Society of Spine Radiology has focused on the lumbar intervertebral disc and has tried to devise a terminology and classification of lumbar disc pathology that would be useful for both imaging specialists and clinicians. Close collaboration was established with a group of experts in the field of neurology, neurosurgery, and orthopedic surgery, led by Dr. David Fardon, an orthopedic spine surgeon with a keen interest in the same issues.

This collaboration has resulted in the production of an extensive reference document, which has now been officially endorsed by the Executive Committee of the American Society of Spine Radiology and the Executive Committee of the American Society of Neuroradiology. It has also been officially endorsed by the Board of Directors of the North American Spine Society and the Joint Section on Disorders of the Spine and Peripheral Nerves of the American Association of Neurological Surgeons and the Congress of Neurological Surgeons. It was also recently endorsed by the Board of Directors of the American Academy of Orthopaedic Surgeons. Endorsement by other North American, European, and international societies is currently pending.

In March 2001, this work was simultaneously posted on the website of the journal *SPINE* and the linked websites of the American Society of Neuroradiology, American Society of Spine Radiology, and *American Journal of Neuroradiology (AJNR)*. It is now freely accessible on the Internet at the URL address http://www.asnr.org/spine_nomenclature.

The illustrated document includes a section devoted to coding issues in the United-States, a Glossary of relevant terms, and a Discussion of the rationale for the proposed definitions and classification, with detailed description of the different categories and sub-categories. The Recommendations of the joint task forces may be summarized as follows.

Each lumbar disc can be classified in terms of one, and occasionally more than one, of the following diagnostic categories: Normal; Congenital/Developmental Variation; Degenerative/Traumatic; Infectious/Inflammatory; Neoplastic; and/or Morphologic Variant of Uncertain Significance. Each diagnostic category can be subcategorized to various degrees of specificity according to the information available and purpose to be served. The data available for categorization may lead the reporter to characterize the interpretation as "possible," "probable," or "definite."

Normal

Normal defines young discs which are morphologically normal, without consideration of the clinical context and not inclusive of degenerative, developmental, or adaptive changes that could, in some contexts (e.g. normal aging, scoliosis, spondylolisthesis) be considered clinically normal. However, the bilocular appearance of the adult nucleus resulting from the development of a central horizontal band of fibrous tissue is considered a sign of normal maturation.

Congenital/Developmental Variation

The Congenital/Developmental Variation category includes discs that are congenitally abnormal or that have undergone changes in their morphology as an adaptation to abnormal growth of the spine such as from scoliosis or spondylolisthesis.

Degenerative/Traumatic

Degenerative and/or traumatic changes in the disc are included in a broad category that includes subcategories of: Anular Tear; Herniation; and Degeneration. Characterization of this group of discs as Degenerative/Traumatic does not imply that trauma is necessarily a factor or those degenerative changes are necessarily pathologic as opposed to the normal aging process.

Anular tears, also properly called **anular fissures**, are separations between anular fibers, avulsion of fibers from their vertebral body insertions, or breaks through fibers that extend radially, transversely, or concentrically, involving one or many layers of the anular lamellae. The terms "tear" or "fissure" describe the spectrum of such lesions and do not imply that the lesion is consequent to trauma.

Degeneration may include any or all of: real or apparent desiccation, fibrosis, narrowing of the disc space, diffuse bulging of the annulus beyond the disc space, extensive fissuring (i.e. numerous anular tears) and mucinous degeneration of the annulus, defects and sclerosis of the end-plates, and osteophytes at the vertebral apophyses. A disc demonstrating one or more of these degenerative changes can be further qualified into two sub-categories: spondylosis deformans, possibly representing changes in the disc associated with a normal aging process; or intervertebral osteochondrosis, possibly the consequences of a more clearly pathologic process.

Herniation is defined as a localized displacement of disc material beyond the limits of the intervertebral disc space. The disc material may be nucleus, cartilage, fragmented apophyseal bone, anular tissue, or any combination thereof. The disc space is defined, cranial and caudal, by the vertebral body end plates and, peripherally, by the outer edges of the vertebral ring apophyses, exclusive of osteophytic formations. The term "localized" contrasts to "generalized," the latter being arbitrarily defined as greater than 50% (180 degrees) of the periphery of the disc.

Localized displacement in the axial (horizontal) plane can be "focal," signifying less than 25% of the disc circumference, or "broad-based," meaning between 25 and 50% of the

disc circumference. Presence of disc tissue "circumferentially" (50-100%) beyond the edges of the ring apophyses may be called "bulging" and is not considered a form of herniation, nor are diffuse adaptive alterations of disc contour secondary to adjacent deformity as may be present in severe scoliosis or spondylolisthesis.

Herniated discs may take the form of protrusion or extrusion, based on the shape of the displaced material. Protrusion is present, if the greatest distance, in any plane, between the edges of the disc material beyond the disc space is less than the distance between the edges of the base in the same plane. The base is defined as the cross-sectional area of disc material at the outer margin of the disc space of origin, where disc material displaced beyond the disc space is continuous with disc material within the disc space. In the cranio-caudal direction, the length of the base cannot exceed, by definition, the height of the intervertebral space. Extrusion is present when, in at least one plane, any one distance between the edges of the disc material beyond the disc space is greater than the distance between the edges of the base in the same plane, or when no continuity exists between the disc material beyond the disc space and that within the disc. Extrusion may be further specified as sequestration, if the displaced disc material has lost completely any continuity with the parent disc. The term migration may be used to signify displacement of disc material away from the site of extrusion, regardless of whether sequestered or not. Because posteriorly displaced disc material is often constrained by the posterior longitudinal ligament, images may portray a disc displacement as a protrusion on axial sections and an extrusion on sagittal sections, in which cases the displacement should be considered an extrusion. Herniated discs in the cranio-caudal (vertical) direction through a break in the vertebral body end plate are referred to as intravertebral herniations.

Disc herniations may be further specifically described as contained, if the displaced portion is covered by outer anulus, or uncontained when absent any such covering. The technical limitations of currently available non-invasive imaging modalities (CT and MR) usually preclude the distinction of a contained from an uncontained disc herniation.

This Displaced disc tissues may also be described by location, volume, and composition:

LOCATION

Anatomic "zones" and "levels" are defined using the following landmarks: medial edge of the articular facets; medial, lateral, upper, and lower borders of the pedicles; and coronal and sagittal planes at the center of the disc. On the horizontal (axial) plane, these landmarks determine the boundaries of the "central zone," the "sub-articular zone," the "foraminal zone," the "extra-foraminal zone," and the "anterior zone," respectively. On the sagittal (cranio-caudal) plane, they determine the boundaries of the "disc level," the "infra-pedicular level," the "pedicular level," and the "supra-pedicular level," respectively. Moving from central to right lateral in the axial (horizontal) plane, location may be defined as "central," "right central," "right sub-articular," "right foraminal," or "right extra-foraminal." The term "paracentral" is less precise than defining "right central" or "left central," but is useful in describing groups of discs that include both, or when speaking informally when the side is not significant. For reporting of image observations of a

specific disc, "right central" or "left central" should supersede use of the term "paracentral." The term "far lateral" is sometimes used synonymously with "extra-foraminal." In the sagittal plane, location may be defined as "discal," "infra-pedicular," "supra-pedicular," or "pedicular." In the coronal plane, "anterior," in relationship to the disc, means ventral to the mid-coronal plane of the centrum.

VOLUME

A scheme to define the degree of canal compromise produced by disc displacement should be practical, objective, reasonably precise, and clinically relevant. A simple scheme that fulfills the criteria utilizes measurements taken from an axial section at the site of the most severe compromise. Canal compromise of less than one third of the canal at that section is "mild," between one and two thirds is "moderate," and over two thirds is "severe." The same grading can be applied for foraminal involvement. Such characterizations of volume describe only the cross sectional area at one section and do not account for total volume of displaced material, proximity to, compression and distortion of neural structures, or other potentially significant features, which the observer may further detail by narrative description.

COMPOSITION

Composition of the displaced material may be characterized by such terms as "nuclear," "cartilaginous," "bony," "calcified," "ossified," "collagenous," "scarred," "desiccated," "gaseous," or "liquified."

Clinical significance related to the observation of volume and composition depends upon correlation with clinical data and cannot be inferred from morphologic data alone.

INFLAMMATION/INFECTION

The category of Inflammation/Infection includes infection, infection-like inflammatory discitis, and inflammatory response to spondyloarthropathy . It also includes inflammatory spondylitis of subchondral endplate and bone marrow manifested as Modic Type 1 MRI changes and usually associated with pathologic changes in the disc. To simplify the classification scheme, the category is inclusive of disparate conditions; therefore, when data permit, the diagnosis should be subcategorized for appropriate specificity.

NEOPLASIA

Primary or metastatic morphologic changes of disc tissues caused by neoplasia are categorized as Neoplasia, with sub-categorization for appropriate specificity.

MORPHOLOGIC VARIANT OF UNKNOWN SIGNIFICANCE

Instances in which data suggest abnormal morphology of the disc but are not complete enough to warrant a diagnostic categorization can be categorized as Morphologic Variant of Unknown Significance.

CONSIDERATIONS ON RADIOLOGICAL REPORTS

Radiologists should classify each disc examined into broad diagnostic categories. Further specificity may be appropriate depending upon the data and the purpose of the examination. The ability to distinguish between various forms of herniation and between broad-based protrusion and bulging depends upon the adequacy of available imaging data and the judgment of the interpreter. Likewise, knowing whether or not there is a thin thread of continuity between displaced disc material and disc of origin, or whether there is a small lapse in the integrity of the outer fibers of anulus, may not be possible, except by surgical observation.

Interpretations are made with various degrees of confidence. Statement of the degree of confidence is an important component of communication. The reporter should characterize the interpretation as "Definite" if there is no doubt, "Probable" if there is some doubt but the likelihood is greater than 50%, and "Possible" if there is reason to consider but the likelihood is less than 50%. The source and quality of the data are important qualifiers of the degree of confidence. It may be appropriate to characterize the interpretation with one degree of confidence based upon morphologic criteria and another if clinical data are considered. If the interpreter has information enough to do so, he may further suggest that the imaging findings are, or are not, related to the patient's symptoms, but the descriptive terms and diagnostic categories proposed in this model are not meant to infer any relationship to symptoms or need for treatment. Suggestions for additional studies to improve the level of confidence are often appropriate.

REFERENCES

1. American Medical Association, Current Procedural Terminology Editorial Panel. Current Procedural Terminology 2000. Chicago: American Medical Association, 2000.
2. Bonneville JF. Plaidoyer pour une classification par l'image des hernies discales lombaires: la carte-image. *Rev Im Med* 1990; 2:557-60.
3. Bonneville JF, Diemann JL. L'imagerie dans les sciatiques; *Rev. Prat. (Paris)* 1992;42:554-66.
4. Brant-Zawadzki MN, Jensen MC. Imaging Corner: Spinal Nomenclature. Inter- and intra-observer variability in interpretation of lumbar disc abnormalities: A comparison of two nomenclatures. *Spine* 1995;20:388-90.
5. Breton G. "Is that a bulging disc, a small herniation, or a moderate protrusion?" *Can Assoc Radiol J* 1991;42:318.
6. Brock M, Patt S, Mayer HM. The form and structure of the extruded disc. *Spine* 1992;17:1457-61.
7. Coventry MB, Ghormley RK, Kernohan JW. The intervertebral disc: its microscopic anatomy and pathology. *J Bone Joint Surg* 1945;27:105-112; 233-247.
8. Czervionke LF. Lumbar intervertebral disc disease. *Neuroimaging Clin N Am* 1993;3:465-485.

9. Eckert C, Decker A. Pathological studies of the intervertebral discs. *J Bone Joint Surg* 1947;29:447-454.
10. Faciszewski T, Broste SK, Fardon D. Quality of data regarding diagnoses of spinal disorders in administrative databases. *J Bone Joint Surg (Am)* 1997;79A:1481-8.
11. Faciszewski T, Johnson L, Noreen C, Smith ED. Administrative databases' complication coding in anterior spinal fusion procedures. What does it mean? *Spine* 1995;20:1783-8.
12. Fardon DF. Disc nomenclature - current journal practices. Poster presentation, American Orthopaedic Association 110th Annual Meeting, Boca Raton, FL, June 11, 1997.
13. Fardon DF, Balderston RA, Garfin SR, Nasca RJ, Pinkerton S, Salib RM. Disorders of the Spine, A Coding System for Diagnoses. Philadelphia: Hanley and Belfus, 1991:20-2.
14. Fardon DF, Balderston RA, Garfin SR, Nasca RJ, Pinkerton S, Salib RM. Terms used for diagnosis by English-speaking spine surgeons. *Spine* 1993;18:1-4.
15. Fardon DF, Herzog RJ, Mink JH, Simmons JD, Kahanovitz N, Haldeman S. Nomenclature of Lumbar Disc Disorders, In: Garfin SR, Vaccaro AR, eds. *Orthopaedic Knowledge Update - Spine*, Rosemont IL: American Academy of Orthopaedic Surgeons, 1997, A3-A14.
16. Fardon DF, White AH, Wiesel S. Diagnostic terms and conservative treatments favored for lumbar disorders by spine surgeons in North America. Presented at the First Annual Meeting, North American Spine Society, Lake George, New York, 1986.
17. Farfan HF, Huberdeau RM, Dubow HI. Lumbar intervertebral disc degeneration: the influence of geometrical features on the pattern of disc degeneration - a post-mortem study. *J Bone Joint Surg [Am]* 1972;54:492-510.
18. Federative Committee on Anatomic Terminology. *Terminologia Anatomica*, New York and Stuttgart, George Thieme Verlag, 1998: 27
19. Herzog RJ. The radiological assessment for a lumbar disc herniation. *Spine* 1996;21:19S-38S.
20. Hirsch C, Schajowicz F. Studies in structural changes in the lumbar annulus fibrosus. *Acta Orthop Scand* 1952;22:184-231.
21. International Anatomical Nomenclature Committee approved by Eleventh International Congress of Anatomists. *Nomina Anatomica*, Fifth Edition, Baltimore MD, Waverly Press, 1983, A23.
22. Jarvik JG, Haynor DR, Koepsell TD, Bronstein A, Ashley D, Deyo RA. Interreader reliability for a new classification of lumbar disc abnormalities. *Acad Radiol* 1996;3:537-44.
23. Kieffer SA, Stadlan EM, Mohandas A, et al. Discographic-anatomical correlation of developmental changes with age in the intervertebral disc. *Acta Radiol [Diagn]* (Stockholm) 1969;9:733-39.
24. Masaryck TJ, Ross JS, Modic MT, Boumphrey F, Bohlman H, Wilbur G. High resolution MR imaging of sequestered lumbar intervertebral discs. *AJNR Am J Neuroradiol* 1988;9:351-8.

25. Milette PC. The proper terminology for reporting lumbar intervertebral disk disorders. *AJNR Am J Neuroradiol* 1997;18:1859-66.
26. Milette PC, Fontaine S, Lepanto L, Cardinal E, Breton G. Differentiating lumbar disc protrusions, disc bulges, and discs with normal contour but abnormal signal intensity. *Spine* 1999;24:44-53.
27. Milette PC, Melançon D, Dupuis PR, Vadeboncoeur R, Bertrand G, Pelletier JP, Raynauld JP. A simplified terminology for abnormalities of the lumbar disc. *Can Assoc Radiol J* 1991;42:319-25.
28. Mink JH. Terminology of lumbar spine disorders, The problem... and a solution. Burlingame, CA: California Managed Imaging Medical Group Publication, 1993.
29. Modic MT. Degenerative Disorders of the Spine; in *Magnetic Resonance Imaging of the Spine*. New York: Yearbook Medical, 1989;83-95.
30. Modic MT, Herfkens RJ. Intervertebral disk: normal age-related changes in MR signal intensity. *Radiology* 1990;177:332-4.
31. Modic MT, Masaryk TJ, Ross JS, Carter JR. Imaging of degenerative disk disease. *Radiology* 1988;168:177-186.
32. Nathan H. Osteophytes of the vertebral column. An anatomical study of their development according to age, race, and sex, with consideration as to their etiology and significance. *J Bone Joint Surg* 1962;44:243-68.
33. Nordby EJ, Brown MD, Dawson ED, et al, eds. *A Glossary on Spinal Terminology*. Chicago: American Academy of Orthopaedic Surgeons, 1985;31-2.
34. Pritzker KPH. Aging and degeneration of the lumbar intervertebral disk. *Orthop Clin North Am* 1977;8:65-77.
35. Resnick D, Niwayama G. Degenerative disease of the spine. In: Resnick D (ed): *Diagnosis of Bone and Joint Disorders*, ed 3. Philadelphia: WB Saunders, 1995:1372-1462.
36. Sauser DD, Goldman AB, Kaye JJ. Discogenic vertebral sclerosis. *J Can Assoc Radiol J* 1978;29:44-50.
37. Schmorl G, Junghanns H. *The Human Spine in Health and Disease*, Second American Edition. Translated by EF Besemann. New York: Grune and Stratton, 1971:141-148, 186-198.
38. Sether LA, Yu S, Houghton VM, et al. Intervertebral disk: normal age-related changes in MR signal intensity. *Radiology* 1990;177:385-388.
39. Taveras JM. Herniated intervertebral disk: a plea for a more uniform terminology. *AJNR Am J Neuroradiol* 1989;10:1283-4.
40. Twomey LT, Taylor JR. Age changes in lumbar intervertebral discs. *Acta Orthop Scand* 1985;56:496-9.
41. Twomey LT, Taylor JR. Age changes in lumbar vertebrae and intervertebral discs. *Clin Orthop* 1987;224:97-104.
42. United States Department of Health and Human Services. Publication No. (PHS)91-1260, *International Classification of Diseases Ninth Revision, Clinical Modification Fifth Edition*, Washington, DC, 1998; adapted and published by Practice Management Information Corporation, Los Angeles, and by St. Anthony's Publishing Company, Alexandria, Virginia, 1999.

43. Williams AL. CT diagnosis of degenerative disc disease, the bulging annulus. *Radiol Clin North Am* 1983;21:289-300.
44. Williams AL, Haughton VM, Daniels DL, Grogan JP. Differential CT diagnosis of extruded nucleus pulposus. *Radiology* 1983;148:141-8.
45. Wiltse LL, Berger PE, McCulloch JA. A system for reporting the size and location of lesions of the spine. *Spine* 1997;22:1534-37.
46. World Health Organization. *Manual of the International Classification of Diseases, Injuries, and Causes of Death*. Geneva, Switzerland: World Health Organization, 1977.
47. Yasuma T, Koh S, Okamura T, Yamjauchi Y. Histological changes in aging lumbar intervertebral discs. *J Bone Joint Surg* 1990;72A:220-9.
48. Yasuma T, Makino E, Saito S, Inui M. Histological development of intervertebral disc herniation. *J Bone Joint Surg* 1986;68A:1066-73.
49. Yu S, Haughton VM, Sether LA, Wagner MI. Annulus fibrosus in bulging intervertebral disks. *Radiology* 1988;169:761-763.