Schmorl's nodes

Schmorl's nodes were first described by the pathologist Christian Georg Schmorl in 1927 as a herniation of the nucleus pulposus through the cartilaginous and bony endplate into the vertebral body. Although such lesions present most commonly as incidental findings in asymptomatic patients (or in patients with back or radicular pain due to other etiology), there have been several reports emphasizing the deleterious effects of the inflammatory response and endplate changes elicited by the herniation of for such reasons, Schmorl's nodes have been occasionally implicated in the etiology of chronic axial pain as well as in pathological osteoporotic fractures [1].

The protrusions may contact the marrow of the vertebra, leading to inflammation.

Among older population, many features of Schmorl's nodes parallel those of osteoporotic vertebral fracture [2]

Clinical presentation

They may or may not be symptomatic, and their etiological significance for back pain is controversial. Schmörl nodes are found in 40-75% of autopsies.

Schmörl nodes are among the diagnostic criteria of Scheuermann disease

A limbus vertebra is closely related to a Schmörl node as well.

Pathology

It is believed that Schmörl nodes develop following back trauma, although this is incompletely understood. A more recent study suggests nucleus pulposus pressure on the weakest part of the endplate or vertebral development process during early life as possible explanation 7.

Radiographic features

In the acute stage, Schmörl nodes can be difficult to diagnose or detect due to sclerosis around the margin of the herniation not having had time to develop.

Usually, they are small nodular lucent lesions involving the inferior endplate of lower thoracic and lumbar vertebral bodies. However, the involvement of both the inferior and the superior endplates is not uncommon. A sclerotic margin may be present.

CT

They are better identified on CT images, showing the same pattern observed on radiographs.

MRI

Schmörl nodes are best seen on the sagittal sequences and usually exhibit the same signal characteristics as the adjacent disc.

Unclassified

Iampreechakul P, Lertbutsayanukul P, Suanprasert N. Acute Calcific Discitis or Symptomatic Calcified Schmorl's Node of the Upper Thoracic Spine in an Adult: A Case Report and Literature Review. Asian J Neurosurg. 2019 Jul-Sep;14(3):1021-1029. doi: 10.4103/ajns.AJNS_119_19. PubMed PMID: 31497157; PubMed Central PMCID: PMC6703016.

2: Lee JH, Park S. Differentiation of Schmorl Nodes From Bone Metastases of the Spine: Use of Apparent Diffusion Coefficient Derived From DWI and Fat Fraction Derived From a Dixon Sequence. AJR Am J Roentgenol. 2019 Nov;213(5):W228-W235. doi: 10.2214/AJR.18.21003. Epub 2019 Aug 28. PubMed PMID: 31461318.

3: Yamaguchi H, Nagase H, Nishiyama M, Tokumoto S, Toyoshima D, Akasaka Y, Maruyama A, Iijima K. Fibrocartilaginous Embolism of the Spinal Cord in Children: A Case Report and Review of Literature. Pediatr Neurol. 2019 Oct;99:3-6. doi: 10.1016/j.pediatrneurol.2019.04.013. Epub 2019 Apr 26. Review. PubMed PMID: 31201068.

4: Pandita A, Madhuripan N, Hurtado RM, Dhamoon A. Back pain and oedematous Schmorl node: a diagnostic dilemma. BMJ Case Rep. 2017 May 22;2017. pii: bcr-2017-219904. doi:

10.1136/bcr-2017-219904. PubMed PMID: 28536227; PubMed Central PMCID: PMC5753748.

5: Mäkitie RE, Niinimäki T, Nieminen MT, Schalin-Jäntti C, Niinimäki J, Mäkitie O. Impaired WNT signaling and the spine-Heterozygous WNT1 mutation causes severe age-related spinal pathology. Bone. 2017 Aug;101:3-9. doi: 10.1016/j.bone.2017.04.001. Epub 2017 Apr 11. PubMed PMID: 28411110.

6: Tomasian A, Wallace AN, Jennings JW. Benign Spine Lesions: Advances in Techniques for Minimally Invasive Percutaneous Treatment. AJNR Am J Neuroradiol. 2017 May;38(5):852-861. doi: 10.3174/ajnr.A5084. Epub 2017 Feb 9. Review. PubMed PMID: 28183835.

7: Zehra U, Flower L, Robson-Brown K, Adams MA, Dolan P. Defects of the vertebral end plate: implications for disc degeneration depend on size. Spine J. 2017 May;17(5):727-737. doi: 10.1016/j.spinee.2017.01.007. Epub 2017 Jan 17. PubMed PMID: 28108405.

8: Zhang J, Zhao F, Wang FL, Yang YF, Zhang C, Cao Y, Wang YL, Shi XJ, Wan Y, Zhang M, Liu MQ, Zuo CG, Wang HQ. Identification of lumbar disc disease hallmarks: a large cross-sectional study. Springerplus. 2016 Nov 14;5(1):1973. doi: 10.1186/s40064-016-3662-7. eCollection 2016. PubMed PMID: 27917347; PubMed Central PMCID: PMC5108747.

9: Rajasekaran S, Kanna RM, Reddy RR, Natesan S, Raveendran M, Cheung KM, Chan D, Kao PY, Yee A, Shetty AP. How Reliable Are the Reported Genetic Associations in Disc Degeneration?: The Influence of Phenotypes, Age, Population Size, and Inclusion Sequence in 809 Patients. Spine (Phila Pa 1976). 2016 Nov 1;41(21):1649-1660. PubMed PMID: 27513226.

10: Wollina U, Schönlebe J, Heinig B, Nowak A, Chokoeva AA, Tchernev G. Rare association of cystic squamous cell carcinoma and small lymphocytic B cell lymphoma: successful surgical approach. Wien Med Wochenschr. 2017 Apr;167(5-6):104-109. doi: 10.1007/s10354-016-0510-x. Epub 2016 Sep 8. Erratum in: Wien Med Wochenschr. 2017 Apr;167(5-6):144. PubMed PMID: 27631871.

11: Wollina U, Langner D, Schönlebe J, Tanner C, Fuchs M, Nowak A. Sentinel lymph node biopsy in early melanoma-comparison of two techniques for sentinel removal. Wien Med Wochenschr. 2017 Apr;167(5-6):100-103. doi: 10.1007/s10354-016-0499-1. Epub 2016 Aug 30. PubMed PMID: 27577250.

12: Sandelich SM, Adirim TA. An Unusual Cause of Back Pain in a 10-Year-Old Girl. Pediatr Emerg Care. 2017 May;33(5):352-355. doi: 10.1097/PEC.0000000000000808. PubMed PMID: 27455343.

13: Diehn FE, Maus TP, Morris JM, Carr CM, Kotsenas AL, Luetmer PH, Lehman VT, Thielen KR, Nassr A, Wald JT. Uncommon Manifestations of Intervertebral Disk Pathologic Conditions. Radiographics. 2016 May-Jun;36(3):801-23. doi: 10.1148/rg.2016150223. Epub 2016 Apr 15. Review. PubMed PMID: 27082664.

14: Papadakis GZ, Millo C, Bagci U, Sadowski SM, Stratakis CA. Schmorl Nodes Can Cause Increased 68Ga DOTATATE Activity on PET/CT, Mimicking Metastasis in Patients With Neuroendocrine Malignancy. Clin Nucl Med. 2016 Mar;41(3):249-50. doi: 10.1097/RLU.0000000000001065. PubMed PMID: 26562580; PubMed Central PMCID: PMC4740202.

15: Park SJ, Kim HS, Kim HS, Kim SW. Complete Separation of the Vertebral Body Associated with a Schmorl's Node Accompanying Severe Osteoporosis. J Korean Neurosurg Soc. 2015 Aug;58(2):147-9. doi: 10.3340/jkns.2015.58.2.147. Epub 2015 Aug 28. PubMed PMID: 26361533; PubMed Central PMCID: PMC4564749.

16: Masselli G, Monti R, Guida M, Gualdi G. Giant Schmorl's Node may Cause High Uptake and Mimic a

Bone Metastasis on (18)F-Choline Positron Emission Tomography/Computed Tomography. World J Nucl Med. 2015 May-Aug;14(2):140-1. doi: 10.4103/1450-1147.154233. PubMed PMID: 26097428; PubMed Central PMCID: PMC4455173.

17: Niwa N, Nishiyama T, Ozu C, Yagi Y, Saito S. Schmorl Nodes Mimicking Osteolytic Bone Metastases. Urology. 2015 Jul;86(1):e1-2. doi: 10.1016/j.urology.2015.03.028. Epub 2015 Jun 3. PubMed PMID: 26048434.

18: Newell N, Grant CA, Izatt MT, Little JP, Pearcy MJ, Adam CJ. A semiautomatic method to identify vertebral end plate lesions (Schmorl's nodes). Spine J. 2015 Jul 1;15(7):1665-73. doi: 10.1016/j.spinee.2015.04.027. Epub 2015 Apr 23. PubMed PMID: 25912497.

19: Teraguchi M, Yoshimura N, Hashizume H, Muraki S, Yamada H, Oka H, Minamide A, Nakagawa H, Ishimoto Y, Nagata K, Kagotani R, Tanaka S, Kawaguchi H, Nakamura K, Akune T, Yoshida M. The association of combination of disc degeneration, end plate signal change, and Schmorl node with low back pain in a large population study: the Wakayama Spine Study. Spine J. 2015 Apr 1;15(4):622-8. doi: 10.1016/j.spinee.2014.11.012. Epub 2014 Nov 27. PubMed PMID: 25433277.

20: Padgett BD, Dzubak A. Unusual midsagittal defects in vertebrae from McKee Island, Alabama (1Ms32). Int J Paleopathol. 2014 Sep;6:44-52. doi: 10.1016/j.ijpp.2014.03.006. Epub 2014 May 3. PubMed PMID: 29539576.

21: Zheng S, Dong Y, Miao Y, Liu A, Zhang X, Wang B, Ge Y, Liu Y, Wang S. Differentiation of osteolytic metastases and Schmorl's nodes in cancer patients using dual-energy CT: advantage of spectral CT imaging. Eur J Radiol. 2014 Jul;83(7):1216-1221. doi: 10.1016/j.ejrad.2014.02.003. Epub 2014 Feb 14. PubMed PMID: 24820064.

22: Nagashima M, Abe H, Amaya K, Matsumoto H, Yanaihara H, Nishiwaki Y, Toyama Y, Matsumoto M. Risk factors for lumbar disc degeneration in high school American football players: a prospective 2-year follow-up study. Am J Sports Med. 2013 Sep;41(9):2059-64. doi: 10.1177/0363546513495173. Epub 2013 Jul 10. PubMed PMID: 23841993.

23: Abu-Ghanem S, Ohana N, Abu-Ghanem Y, Kittani M, Shelef I. Acute schmorl node in dorsal spine: an unusual cause of a sudden onset of severe back pain in a young female. Asian Spine J. 2013 Jun;7(2):131-5. doi: 10.4184/asj.2013.7.2.131. Epub 2013 May 22. PubMed PMID: 23741552; PubMed Central PMCID: PMC3669699.

24: Paterakis KN, Brotis AG, Dardiotis E, Hadjigeorgiou GM, Karachalios T, Fountas KN, Karantanas A. Acute Schmorl's Node during Strenuous Monofin Swimming: A Case Report and Review of the Literature. Global Spine J. 2012 Sep;2(3):159-68. doi: 10.1055/s-0032-1307262. Epub 2012 Aug 24. PubMed PMID: 24353963; PubMed Central PMCID: PMC3864465.

25: Arana E, Kovacs FM, Royuela A, Estremera A, Sarasíbar H, Amengual G, Galarraga I, Martínez C, Muriel A, Abraira V, Zamora J, Campillo C. Influence of nomenclature in the interpretation of lumbar disk contour on MR imaging: a comparison of the agreement using the combined task force and the nordic nomenclatures. AJNR Am J Neuroradiol. 2011 Jun-Jul;32(6):1143-8. doi: 10.3174/ajnr.A2448. Epub 2011 Apr 14. PubMed PMID: 21493764.

26: Jang JS, Kwon HK, Lee JJ, Hwang SM, Lim SY. Rami Communicans Nerve Block for the Treatment of Symptomatic Schmorl's Nodes -A Case Report-. Korean J Pain. 2010 Dec;23(4):262-5. doi: 10.3344/kjp.2010.23.4.262. Epub 2010 Dec 1. PubMed PMID: 21217891; PubMed Central PMCID: PMC3000624.

27: Wenger M, Markwalder TM. Fluoronavigation-assisted, lumbar vertebroplasty for a painful Schmorl node. J Clin Neurosci. 2009 Sep;16(9):1250-1. doi: 10.1016/j.jocn.2008.11.016. Epub 2009 Jun 17. PubMed PMID: 19539476.

28: Fukuta S, Miyamoto K, Iwata A, Hosoe H, Iwata H, Shirahashi K, Shimizu K. Unusual back pain caused by intervertebral disc degeneration associated with schmorl node at Th11/12 in a young athlete, successfully treated by anterior interbody fusion: a case report. Spine (Phila Pa 1976). 2009 Mar 1;34(5):E195-8. doi: 10.1097/BRS.0b013e318198c60cXXX. PubMed PMID: 19247160.

29: Masala S, Pipitone V, Tomassini M, Massari F, Romagnoli A, Simonetti G. Percutaneous vertebroplasty in painful schmorl nodes. Cardiovasc Intervent Radiol. 2006 Jan-Feb;29(1):97-101. PubMed PMID: 16328689.

30: Fukunaga M, Sone T, Ohtsuka N, Nagai K. [Diagnostic imaging of osteoporosis: special reference to diagnosis by radiography and DXA]. Clin Calcium. 2001 Jan;11(1):36-41. Japanese. PubMed PMID: 15775488.

31: Chan KK, Sartoris DJ, Haghighi P, Sledge P, Barrett-Connor E, Trudell DT, Resnick D. Cupid's bow contour of the vertebral body: evaluation of pathogenesis with bone densitometry and imaging-histopathologic correlation. Radiology. 1997 Jan;202(1):253-6. PubMed PMID: 8988219.

32: Walters G, Coumas JM, Akins CM, Ragland RL. Magnetic resonance imaging of acute symptomatic Schmorl's node formation. Pediatr Emerg Care. 1991 Oct;7(5):294-6. PubMed PMID: 1754491.

33: Hansson TH, Keller TS, Spengler DM. Mechanical behavior of the human lumbar spine. II. Fatigue strength during dynamic compressive loading. J Orthop Res. 1987;5(4):479-87. Erratum in: J Orthop Res 1988;6(3):465. PubMed PMID: 3681522.

34: Resnick D, Niwayama G, Guerra J Jr, Vint V, Usselman J. Spinal vacuum phenomena: anatomical study and review. Radiology. 1981 May;139(2):341-8. PubMed PMID: 7220878.

1)
Mattei TA, Rehman AA. Schmorl's nodes: current pathophysiological, diagnostic, and therapeutic paradigms. Neurosurg Rev. 2014 Jan;37(1):39-46. doi: 10.1007/s10143-013-0488-4. Epub 2013 Aug 18. PubMed PMID: 23955279.

2)
Wáng YXJ, Wang XR, Leung JCS, Yu BWM, Griffith JF, Kwok TCY. Schmorl's nodes are associated with prevalent osteoporotic vertebral fracture and low bone mineral density: a population-based thoracic spine MRI study in older men and women. Quant Imaging Med Surg. 2023 Mar 1;13(3):1914-1926. doi: 10.21037/qims-22-1410. Epub 2023 Jan 13. PMID: 36915321; PMCID: PMC10006149.