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Original Research Article

SCHMORL'S NODES: AN INCIDENTAL FINDING ON MRI

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ABSTRACT

Background and Purpose: A herniation of intervertebral disc nuclear material (nucleus pulposus) through vertebral end plate into the vertebral body, constitutes what is known as the schmorl's node. It is a common incidental finding in normal adult population and its presence may or may not be associated with complaints of back pain. The etiology & prevalence of these nodes is still controversial and debatable. The objective of this study was to find the prevalence of schmorl's node in an asymptomatic population.

Materials and Methods: A retrospective study was carried out in the Departments of Anatomy, Era's Lucknow Medical College & Hospital (ELMC&H) & King George's Medical University, UP, Lucknow, India in collaboration with Department of Radiology, ELMC&H, UP, India. Thoracolumbar region MRI scans of 100 patients were collected and studied for the presence of schmorl's nodes on the basis of certain predefined criteria.

Results: Schmorl's nodes were found in 18 out of 100 cases in relation to the lower thoracic and upper lumbar spine (18%). More males as compared to females displayed the presence of these nodes. No independent association of schmorl's node with back pain was identified.

Conclusion: Presence of schmorl's node may occur as an incidental finding and is not always associated with pain. Male subjects had an insignificantly higher proportion of nodes as compared to females. Prevalence of asymptomatic nodes in elderly population is nearly similar to that in young population.

KEY WORDS: Schmorl's nodes, Thoraco-lumbar spine, MRI, Back pain.

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INTRODUCTION

In 1927, pathologist Christian George Schmorl described a specific type of vertebral lesion seen primarily in the thoracolumbar spine, now known as Schmorl's nodes (SNs) [1]. It represents a herniation of intervertebral disc nuclear material (nucleus pulposus) through vertebral end plate, with displacement of this material into adjacent vertebral body [2]. Herniated tissue may form a defect in upper or lower surface of involved vertebra. SNs tend to concentrate more in thoraco-lumbar region of the spine [3]. A number of proposed theories have attempted to explain the pathogenesis of SN's; however,

no consensus currently exists. Some researchers have viewed SN's as a developmental disease whereas others consider it to be a degenerative bone disease. Some have theorized that SN's are a result of pathologies that weaken the discs and vertebral bodies; lesion tends to occur at central or posterior axis of vertebrae, near thoraco-lumbar junction. However, such weakening of end plate is not a necessary precondition for extrusion & is thought to be present as an underlying cause only in small percentage of SN cases [4, 5]. SNs are common incidental finding on plain radiographs, computed tomography, and magnetic resonance imaging. The authors considered SNs as present, when, the integrity of the vertebral body surface was disrupted, having a cup shaped depression with sclerotic margins [6].

SNs have been noted with varying prevalence in various spine studies, with a slightly higher incidence in males and with increased frequency in athletic adolescents. Some researchers proposed a positive association with increasing age, while others argued that age could not be a significant factor. Yet, a closer look at the study of Hilton et al revealed an age dependent relationship between SNs and disc degeneration in the T10-L1 region [7]. They found an incidence of 75%, with a higher frequency in the thoraco-lumbar region than in the mid and lower lumbar spines. This predisposition of certain regions of spine for development of SN, has also been noted by others. Authors have mostly restricted themselves to the study of thoracic and lumbar spine and SNs in the cervical spine have been seldom reported. In spite of this, a developmental etiology, has been the assumption of many, in conjunction with, thoraco-lumbar susceptibility to stress as an explanation. Cadaveric studies vary in their estimates and report a prevalence ranging from about 38% to as high as 79**%** [8].

Although plain radiographs can detect these lesions, they are mostly useful in the later stages of lesion when some calcification has occurred around the SN's [9]. Best imaging modality for detecting their presence is MRI. MRI is a gold standard because it can detect acute SN lesions and in addition, has the capability of distinguishing between symptomatic and asymptomatic SN's. MRI displays accentuation of concomitant edema in T2 weighted images and low signal intensity in T1 weighted images in virtually all symptomatic cases, a distinction plain radiograph cannot make [6].

Aims and objectives: Study was undertaken to investigate the prevalence of SN in thoracolumbar spine of the study population & to gain a better understanding of factors associated with SNs manifestation.

MATERIALS AND METHODS

This cross sectional, interdepartmental study was carried out in the Department of Anatomy in collaboration with Department of Radiology. Thoracolumbar region MRI scans belonging to 100 subjects, age group 20-70 years; were analyzed for the presence of SN. Cases with history of any surgery, trauma, neoplasm or cyst in the region of interest, were excluded from the study. MRI machine of 1.5 Tesla, Hitherto Japan was used, and 4mm thick T2 weighted sagittal images centered on T1 – L5 were acquired in supine position.

OBSERVATIONS AND RESULTS

Tomograms belonging to 100 asymptomatic cases, including 66 males & 34 females were studied. Analysis of scans revealed the presence of SNs in a varying proportion of male and female subjects (Fig. 1). Overall prevalence of SN was found to be 18%. SNs were found to be present in a higher proportion of males (21.3%) as compared to females (11.8%). A search was made to find any correlation between presence of nodes in relation to a specific age group or gender, but, we could not establish any significant correlation between presence of SNs in

Fig. 1: Sagittal view T2- weighted MRI scan of thoracolumbar spine showing schmorl's nodes.

relation to the gender and age of the study subjects (Table 1). Also, any significant correlation between presence of SNs and any associated degeneration of the lumbar spine could not be found.

Table 1: Prevalence of schmorl's nodes (SN's) in the study population.

Study subjects					Total	
Gender	Males (n=66)		Females (n=34)		100	
SN's	No.	% prevalence	No.	% prevalence	No.	% prevalence
Absent	52	78.7	30	88.2	82	82
SN's Present	14	21.3	4	11.8	18	18

DISCUSSION

SNs represent displacement of intervertebral disc tissue into the vertebral body. Most lesions appear as an asymptomatic incidental radiological finding on plain radiographs, computed tomography and magnetic resonance imaging (MRI). However, certain SN's can be symptomatic, causing back pain. It is important for spine surgeons to be aware of the relative prevalence of SN's. Lower back pain is one of the most frequently diagnosed conditions amongst all patients visiting the hospital, and a remarkable 85% of them are due to unexplained causes [10].

"SNs" are lytic lesions at vertebral endplates which are believed to be due to herniation of the nucleus pulposus through the cartilaginous endplate into the body of vertebral endplates. Classic description includes two basic components: (1) disruption of the cartilaginous endplate & (2) herniation of gelatinous material of nucleus pulposus into the vertebral body. Studies suggest that osteonecrosis beneath the cartilaginous endplate is the basic event following which secondary herniation of nucleus pulposus may or may not ensue. Non-acute SN are common spinal abnormalities & reported to occur in 38% to 75% of population.

Prevalence of SNs depends on several factors: method of classification of SNs (minimal size of the concavity to be considered as a node); definition of "individuals with SNs" (one or multiple cases of SNs); different methods for study of SNs [magnetic resonance imaging (MRI), computed tomography (CT) scans, roentgenograms, autopsies and skeletal material or demographics (sex ratio, ethnic origin etc.) & socioeconomic characteristics (mainly daily activities) of examined population. Most consider SN to be asymptomatic, since they are a frequent finding in persons without back pain. It is therefore not surprising that the reported prevalence of SNs in the literature varies.

SN can be demonstrated at plain radiography, computed tomography (CT), and also by bone scintigraphy, however, MRI is the modality of choice. Detection on conventional radiograph depends on the size of nodes as well as reactive processes, such as fibrosis and sclerosis in the adjacent trabecular bone. Coventry et al (1945) first reported that only 3.6% of 55 pathologically confirmed SN were visible on conventional X-ray [11]. A magnetic resonance imaging (MRI) study of 150 monozygotic and 366 dizygotic living twins found SNs in 30 % of subjects at any vertebral level, and multiple SNs in 14 % of participants [3]. Cadaveric studies have reported estimates, ranging from 38 % to as high as 79 % [12]. In the present study, 18% of study subjects revealed the presence of single as well as multiple nodes, and mostly involved the superior surface of the inferior vertebra.

Vertebral development is initiated by the notochord with a sonic hedgehog (Shh) mediated induction on the early somite to form the sclerotome. The ventromedial portion of the somite ultimately forms the centrum (body) of the vertebra while the notochord disappears from the bodies of the vertebrae and persists as the nucleus pulposus [13]. Any disruption in the developmental process can lead to malformation of the vertebrae, intervertebral discs and associated structures. It has been postulated that SNs form due to a developmental insult leading to an indentation in the developing vertebrae into which disc material can herniate [14]. Mok et al (2010) carried out a cross sectional population based MRI study of 2,449 individual's and reported SN in upper lumbar levels with highest prevalence in L2-L3 [1]. In a skeletal study conducted by Dar et al, SN appeared more frequently in T7- L1 region [15]. Their finding was consistent with that reported by Pfirrman & Resnick [12]. We found SNs more frequently in the T7–L1 region than in the higher thoracic vertebrae (T4–T6) or the lower lumbar vertebrae (L2–L5), a frequency distribution agreeing with that of Dar et al & Pfirrmann and Resnick's. Study subjects revealed the presence of either single or

multiple nodes and almost 2/3rd SNs were located on the superior surface of vertebral end plates. Statistical tests were performed to find their association in relation to the gender & age of the subject. We could not establish any significant correlation between presence of SNs in relation with gender and age.

To explain the unequal distribution of SNs in the spine, Hilton and colleagues proposed a strictly developmental pathogenesis for SNs in their study of postmortem thoracolumbar spines. They reported that thoracolumbar spine is under greater stress as compared to other regions of vertebral column, and, therefore, is predisposed to SN formation due to these developmental insults. They, therefore, rejected a degenerative disease model and proposed a developmental/embryogenic model, arguing that SNs are already present during skeletal maturation; hence, the lack of a difference between specimens from their subject pool over and under the age of 50 years [14].

Present study is in agreement with the abovementioned theory & that of Dar et al who proposed an axial load model in which they argued that because of erect posture and bipedal locomotion, humans must accommodate increased axial forces in addition to balancing the need for spinal mobility and stability. The thoracolumbar spine bears great axial stress and is relatively mobile, it may accumulate microtraumas that can lead to the formation of SNs in the general population [15]. They concluded that the combination of increased range of rotational movement, anteriorly located instantaneous axis of rotation, and low-disc thickness relative to vertebral body height in the thoracic spine makes this region more vulnerable to develop SNs & this predominance of SNs in the lower thoracic region has also been verified by other studies [3]. They found no relationship between age and SNs. Relationship between presence of SN and pain in the back is not yet clear. Takahashi et al analyzed MRI findings in patients with symptomatic and asymptomatic SNs [6]. In symptomatic patients, the vertebral body marrow surrounding the SN gave a low signal intensity on T1-weighted and a high signal intensity on T2-weighted images. This indicated the presence of inflammation and edema in the vertebral bone marrow. These MRI findings were not present in asymptomatic individuals suggesting that nodes became asymptomatic when inflammation subsides.

CONCLUSION

In summary, SNs are common lesions, seen primarily in the thoracolumbar spine, often asymptomatic, but in certain cases can be a source of back pain. MRI is the best modality to diagnose the presence of SN. The prevalence of SNs in the present study was 18%, and they were localized mainly in relation to the superior surface of lower thoracic and upper lumbar vertebrae. The distribution and location of SNs along the thoraco-lumbar spine probably supports the vertebral development process during early life than a traumatic or pathologic explanation of the phenomenon.

Conflicts of Interests: None

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