Cross-sectional Study on Incidental Spinal Findings in Magnetic Resonance Imaging Lumbar Spine of Patients with Low Back Pain

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ABSTRACT

Background: Incidental finding is an observation, not related to the current medical problem. Various incidental findings can be seen in the lumbar spine (LS) magnetic resonance imaging (MRI) taken for evaluation of low back pain. **Aims:** To evaluate and analyze the spinal incidental findings in MRI LS of patients with low backache. **Settings and Design:** A retrospective, cross-sectional analytical study. **Materials and Methods:** All patients (*n* = 1269, males: 578, females: 691; mean age: 45 ± 15 years) with low backache, who underwent MRI of the LS at a tertiary care hospital in South India, during a period from January 2011 to August 2015. Two radiologists evaluated these examinations for the presence of incidental findings in consensus. We included fatty vertebral hemangioma (FVH), fatty filum terminale (FFT), extraspinal synovial cyst (SC), Tarlov cyst (TC), enostosis, and limbus vertebrae. **Statistical Analysis Used:** Calculated the prevalence of incidental findings and analyzed the relationship of these incidental findings with patient demographics. **Results:** Overall, incidental spinal findings were present in 390 patients (30.7%). FVH was the most common incidental finding (*n* = 205 patients, 16.16%), followed by extraspinal SC (*n* = 130 patients, 10.2%), and FFT (114 patients, 9%). A pattern of increasing frequency with age noted in the FVH (*P* = 0.001), TC (*P* = 0.017), and enostosis (*P* = 0.008). There was no significant sex predilection for the incidental findings. **Conclusion:** Incidental findings are common in LS MRI. Understanding on the nature and prevalence of these lesions is essential for the radiologist, for optimal reporting and for the clinician in appropriate interpretation of radiological reports.

Key words: Enostosis; extraspinal synovial cyst; fatty filum terminale; hemangioma; limbus vertebrae; Tarlov cyst

Introduction

Incidental finding in imaging is an observation that is unrelated to the patient's symptoms and found only because of imaging. During magnetic resonance imaging (MRI) of the lumbar spine (LS), various incidental findings were observed in the spinal column and extraspinal tissues. LS MRI may reveal extraspinal findings related to abdominal and pelvic organs or vasculature. However, in this article, we focused only on incidental findings in the vertebral column and spinal canal. We evaluated the findings - fatty vertebral hemangioma (FVH), fatty filum terminale (FFT), extraspinal synovial cyst (SC), Tarlov cyst (TC), enostosis, and limbus vertebrae in the study population. There were few studies on incidental findings in LS MRI, but none of them were from the Indian subcontinent. In this study, we assessed the prevalence of spinal incidental findings in a population with

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low back pain, who had undergone MRI. We also discussed the clinical importance of these findings and their imaging characteristics. Knowledge on imaging appearances and the prevalence of these incidental findings will enlighten the radiologist and clinician for optimal diagnosis.

Materials and Methods

The study was designed as a retrospective analytical study and carried out in a tertiary care setup. Approval was obtained from the Institutional Review Board. There was no requirement for informed patient consent.

Case selection

Our study population (n = 1269) comprised 578 males (45.5%) and 691 females (54.4%) with low back pain, who underwent LS MRI during the period, from January 2011 to August 2015. We searched in the picture archiving and communication system for digital archive of patients. Patients, who had a history of spinal metastasis, multiple myeloma, or acute trauma, were excluded from the study group. Magnetic resonance examinations under screening protocol and repeat examinations were also excluded from the study.

Magnetic resonance imaging technique

MRI examinations were performed on a 1.5-T scanner (GE Signa HDxt, GE Healthcare, United States) in the supine position. The routine protocol employed in the hospital was T1- and T2-weighted images in the axial and sagittal plane, and short-T1 inversion recovery (STIR) images in the sagittal or coronal plane using the same protocol for every patient without significant change in sequence parameters. Additional postcontrast T1-weighted multiplanar images were obtained depending on the discretion of the supervising radiologist. All these images were attained with a slice thickness of 4 mm and interslice gap of 0.5 mm. A field of view of 30–32 cm for sagittal images, 18 cm for axial images, and 32–34 cm for coronal images were employed. An average of 15 slices was attained in the sagittal plane, 18 in the coronal plane, and 20–24 in the axial plane. MRI parameters used were given in the [Table 1].

We included FVH, FFT, extraspinal SC, TC, enostosis, and limbus vertebrae as incidental findings. Two general radiologists with good experience in reporting musculoskeletal MRI evaluated the examinations in consensus for the presence of incidental findings. We recorded these findings and demographic data for each patient in a predesigned pro forma.

Diagnostic criteria for incidental findings

FVH appears as a rounded and well-delineated hyperintense lesion with mottled appearance, on T1- and T2-weighted images. It usually shows increased signal intensity on T2 than T1-weighted images and retains some signal on STIR images [Figures 1 and 2] due to vascular components.[1,2] FVH may also involve the entire vertebral body or extend into the posterior elements.

FFT is typically seen as a thin and linear T1- and T2-hyperintense signal, along the filum terminale, without severe thickening, or cord tethering [Figure 3].[3]

Extraspinal SCs are diagnosed when a cystic lesion is seen abutting the adjacent facet joint, outside the spinal canal.[4] Typically, these cysts appear T2-hyperintense and T1- isointense to hypointense, but the cyst signal is variable [Figure 4].

TC is defined as the cerebrospinal fluid-filled cystic dilatation of nerve root sheaths, which appears T2 hyperintense and T1 hypointense [Figure 5].[5]

Enostosis is seen as focal low signal intensity on all sequences [Figure 6].[6]

A limbus vertebrae is diagnosed, when a separate small triangular area of bone marrow signal intensity is seen

Figure 1: A 24-year-old with a fatty vertebral hemangioma of L1 vertebral body. In addition, note the Modic Type I endplate changes at L5 vertebral body. Sagittal T2 (a) and T1 (b) weighted image of the lumbar spine show a well-delineated hyperintense lesion with mottled appearance. Here, the T2 signal intensity is more than T1 signal intensity (white arrow). Axial T2 (c) and T1 (d) weighted image of the L1 vertebra also show a well-delineated hyperintense lesion with mottled appearance (white arrow), (e) coronal short-T1 inversion recovery image shows partial suppression of the L1 vertebral lesion (white arrow)

Table 1: Lumbar spine protocol and MR parameters

Sequences and imaging planes	T1-weighted FSE[1] sagittal	T2-weighted FRFSE[2] sagittal	T2-weighted FRFSE axial	T1-FSE axial	STIR[3] coronal	STIR sagittal
Matrix	512×256	512×288	352×224	352×224	320×192	320×192
TR[4] range/Effective TE[5] range (TR/TE)	520-740/14-15	3840-4920/110-120	6240-7260/110-120	600-860/10-15	2900/47	4780/42
Echo Train Length (ETL)	5	29	23	5	18	18
Time of inversion (TI)	-	-	-	-	150	150

FSE[1] – Fast Spin Echo; FRFSE[2] – Fast Recovery Fast Spin Echo; STIR[3] – Short Tau Inversion Recovery; TR[4] – Repetition Time; TE[5] – Echo time

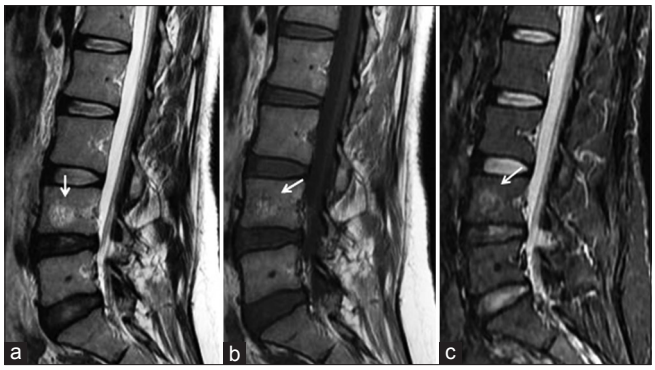

Figure 2: A 42-year-old with a fatty vertebral hemangioma of L4 vertebral body. In addition, note the enostosis at L5 vertebral body. Sagittal T2 (a) and T1 (b) weighted image of the lumbar spine show a well-defined hyperintense lesion with mottled appearance. Here, the T2 signal intensity is more than T1 signal intensity (white arrow). (c) Sagittal short-T1 inversion recovery image shows partial suppression of the L4 vertebral lesion (white arrow)

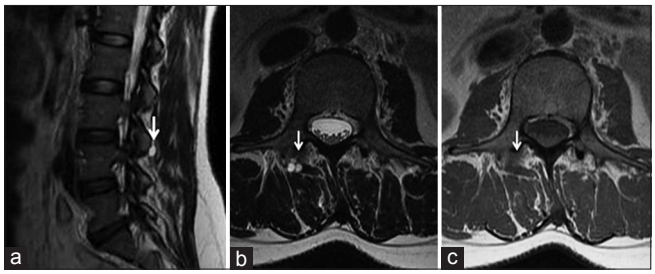

Figure 4: A 43-year-old with synovial cyst at the right L3-4 facet joint level. (a) Sagittal T2-weighted image of the lumbar spine shows a well-defined T2 hyperintense cystic lesion (white arrow) at the right L3–L4 facet joint level. Axial T2 (b) and T1 (c) weighted image of the lumbar spine at L3–L4 level show three well-defined T2 hyperintense and T1 poorly defined isointense cystic lesions (white arrow), adjacent to the right L3–L4 facet joint

subjacent to the smooth corticated margin of vertebral body, usually at the anterosuperior corner [Figure 7].[7]

Statistical analysis

The data obtained was entered in Excel spreadsheet and analyzed using SPSS 16.0 (Chicago, SPSS Inc.). The prevalence of overall incidental findings and individual findings were calculated. Patients were categorized into different age groups and prevalence calculated in each group. Relationship of each incidental finding with patient's age and sex was analyzed using the Chi-square or Fisher's exact test, depending on the expected frequencies in the cells of the contingency table. $P < 0.05$ was considered to indicate statistical significance. We also analyzed the most common site of occurrence of FVH, extraspinal SC, TC, enostosis, and limbus vertebrae.

Results

We included a total of 1269 patients in the study group, by following the inclusion and exclusion criteria. Overall, 390 patients (30.7%) had incidental findings. The most common finding was FVH seen in 205 patients (16.1%),

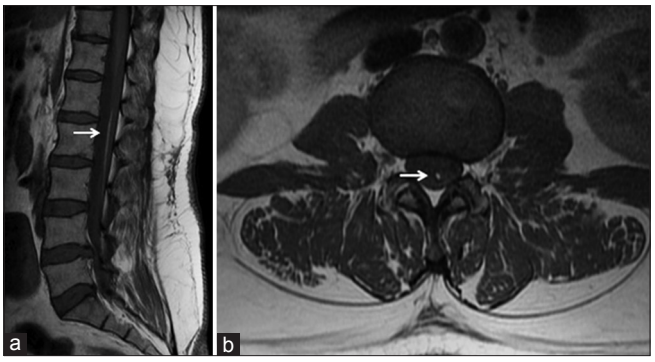

Figure 3: A 46-year-old with fatty filum terminale. Note conus medullaris is at the level of D12. (a) Sagittal T1-weighted image shows thin linear hyperintensity of fat along filum terminale, extending from lower border of L1 to upper half of L3 (white arrow). (b) Axial T1-weighted image also shows focal hyperintensity at the filum terminale (white arrow)

Figure 5: A 42-year-old with Tarlov cyst in the sacral spinal canal at S2 level. Sagittal T2 (a) and T1 (b) weighted image of the lumbar spine show a well-defined T2 hyperintense and T1 hypointense cystic lesion (white arrow) in the sacral spinal canal. Note the minimal anterior bony scalloping. In addition, note a limbus vertebra at the anterosuperior corner of L4 vertebral body. Axial T1 (c) and T2 (d) weighted image of the sacral spine at S2 level also show well-defined T2 hyperintense and T1 hypointense cystic lesion (white arrow) in the spinal canal on the left side. In addition, note the minimal anterior bony scalloping

followed by extraspinal SC 130 patients (10.2%), and FFT 114 patients (9%) [Table 2]. The other incidental findings in the descending order of frequency were TC (50 patients, 4%), enostosis (39 patients, 3%), and limbus vertebrae (14 patients, 1.1%). A pattern of increasing frequency with increasing age was noted in the FVH ($P = 0.001$), TC ($P = 0.017$), and enostosis ($P = 0.008$).

There was no significant sex predilection for the incidental findings [Table 3].

Most common location of FVH in the LS was L1 vertebrae (53 patients), and 51 (24.8%) patients had hemangioma involving multiple vertebrae. The most common location of SC was L4/5 facet joint (52 patients, 40%) and 10 (7.6%) patients had SCs at multiple facet joint levels. Most common site of TC was S2 vertebral level (38 patients, 76%) and 8 (13.3%) patients had multiple TCs. The most common site of enostosis was L3 (12 patients, 30.7%) and that of limbus vertebrae was L4 (9 patients, 64%).

Discussion

With advancement of imaging and viewing technology, incidental findings are being increasingly reported during MRI of LS. Spinal incidental findings are usually benign lesions. However, extraspinal incidental lesions may be more significant than the suspected disease.[8] The commonly observed incidental findings in the LS MRI are FVH, extraspinal SC, FFT, TC, enostosis, and limbus vertebrae.

Fatty vertebral hemangioma

VH is considered as a benign vasoformative neoplasm of bone, comprising fatty and vascular stroma. Histopathologically, VH is composed of thin-walled blood-filled vascular channels lined by endothelium, surrounded by fat infiltrating the medullary cavity between sclerotic bony trabeculae.[9,10] Depending on the predominant tissue composition, they are categorized into fatty and vascular hemangioma. FVH is asymptomatic. It is usually focal or diffuse, confined to the vertebral body, but occasionally extends into the pedicles, lamina, and spinous processes. FVH does not expand or extend beyond the vertebral body. FVH needs differentiation from focal fatty marrow. Focal fatty marrow appears as an FVH-like rounded lesion with T1 and T2 hyperintensity, but T1 signal intensity is always more than T2 signal intensity, and there is no mottled appearance. But unlike FVH, it shows complete suppression of fat signal on STIR, and there is no postcontrast enhancement [Figure 8].

Vascular or aggressive hemangioma is composed mainly of vascular stroma with little or no adipose tissue. Aggressive hemangioma (AH) may expand the vertebrae, extend to the epidural or perivertebral space, cause vertebral compression fracture or epidural hemorrhage or compression of spinal cord or nerve roots, or a combination of these. It may cause intense pain due to myelopathy, radiculopathy, or pathological fracture.[11,12] AH appears isointense to hypointense on T1, hyperintense on T2, and STIR with avid postcontrast enhancement [Figure 9]. It constitutes <1% of total cases of VH. It can occur at any age, with peak prevalence in young

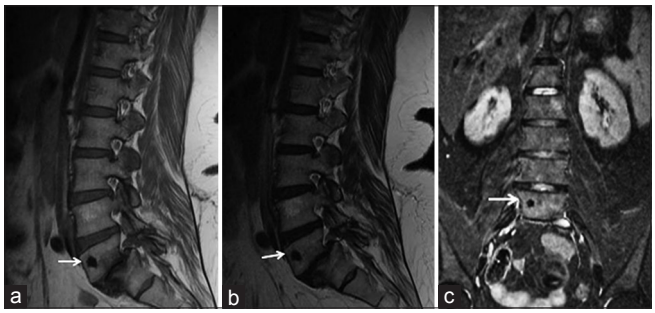

Figure 6: A 57-year-old female with enostosis of the L5 vertebral body. In addition, note the rounded focal fatty marrow in the L4 vertebral body. Sagittal T1 (a) and T2 (b) weighted image of the lumbar spine show a well-defined small hypointense area with mildly irregular margins in the L5 vertebral body (white arrow). (c) Coronal short-T1 inversion recovery image also shows a small hypointense area of similar morphology in the L5 vertebral body (white arrow)

Figure 7: A 48-year-old with limbus vertebra at anterosuperior corner of L3 vertebral body. Sagittal T1 (a) and T2 (b) weighted image of the lumbar spine show a separate well-defined small triangular area of bone marrow signal intensity adjacent to the smooth corticated margin of anterosuperior corner defect of the L3 vertebral body (white arrow)

Table 2: Frequency of incidental findings in different age groups

Age groups (*n*)	Fatty vertebral hemangioma *n* (%)	Filum terminale fibrolipoma *n* (%)	Synovial cyst *n* (%)	Tarlov cyst *n* (%)	Enostosis *n* (%)	Limbus vertebra *n* (%)
< 31 (236)	17 (7.2%)	22 (9%)	23 (9.7%)	3 (1.2%)	1 (0.4%)	1 (0.4%)
31-50 (564)	92 (16.3%)	54 (9.5%)	57 (10%)	24 (4.2%)	15 (2.6%)	5 (0.9%)
51-70 (408)	81 (19.8%)	29 (7.1%)	46 (11.2%)	17 (4.1%)	19 (4.6%)	6 (1.4%)
> 70 (61)	15 (24.5%)	9 (14.7%)	4 (6.5%)	6 (9.8%)	4 (6.5%)	2 (3.2%)
P value	0.00011	0.2111	0.6941	0.0172	0.0082	0.2222

[1]Chi square test; [2]Fisher exact test

Table 3: Frequency of incidental findings in gender groups

Gender groups (*n*)	Fatty vertebral hemangioma *n* (%)	Fatty filum terminale *n* (%)	Synovial cyst *n* (%)	Tarlov cyst *n* (%)	Enostosis *n* (%)	Limbus vertebra *n* (%)
Female (691)	123 (17.8%)	54 7.8%)	63 (9.1%)	32 (4.6%)	26 (3.7%)	11 (1.5%)
Male (578)	82 (14.1%)	60 (10.3%)	67 (11.5%)	18 (3.1%)	13 (2.2%)	3 (0.5%)
Total (1269)	205 (16.1%)	114 (9%)	130 (10.2%)	50 (4%)	39 (3%)	14 (1.1%)
P value	0.082[1]	0.111[1]	0.148[1]	0.167[1]	0.120[1]	0.057[2]

[1]Chi square test; [2]Fisher exact test

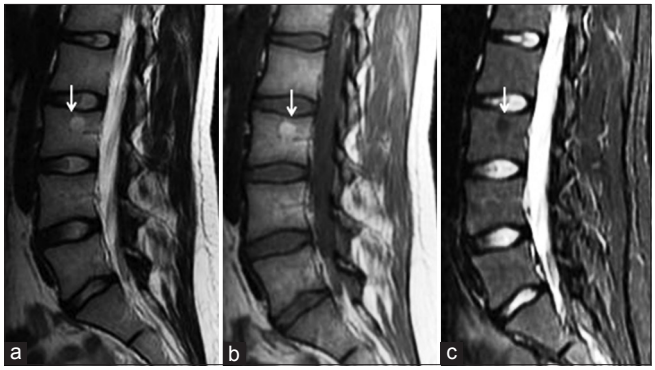

Figure 8: A 36-year-old with focal fatty marrow at L3 vertebral body. Sagittal T2 (a) and T1 (b) weighted image of the lumbar spine show a rounded lesion with T1 and T2 hyperintensity and no mottled appearance. T1 signal intensity is more than T2 signal intensity (white arrow). (c) Sagittal short-T1 inversion recovery image shows complete suppression of fat signal (white arrow)

adults. It is difficult to differentiate AH from malignant primary and metastatic neoplasm during MRI, due to morphological similarities. Computed tomography (CT) is a useful tool, if MRI features are suspicious but not diagnostic of AH.

The prevalence of FVH in our study group was 16.1%, and there was no gender predilection. A trend of increasing frequency with age was noted, and 24.8% of patients had hemangioma involving multiple vertebral bodies. Barzin and Maleki[13] had reported a prevalence of 26.9% for VH and increased frequency in older age group, in MRI study on 782 patients, in Northern Iran. They had also reported that VH was more common in females (30%) than males (23%) and 33% of cases had multiple VH. Park *et al*. reported a prevalence of 1.5%, and no differences in prevalence between the sexes and age groups in MRI study on incidental findings in the LS, in 1268 patients in South Korea.[14] These differences suggest the influence of the race on the prevalence of VH.

Fatty filum terminale

FFT is defined as the presence of fat within the filum terminale not associated with cord tethering or neurological dysfunction. FFT is typically seen as thin and linear T1 hyperintense signal, extending over few vertebral segments.[15] All patients showed a normal conus position, above L2 vertebral level. FFT is more conspicuous on the axial images than on the sagittal images. When the fatty filum is thicker than 2 mm, it is considered

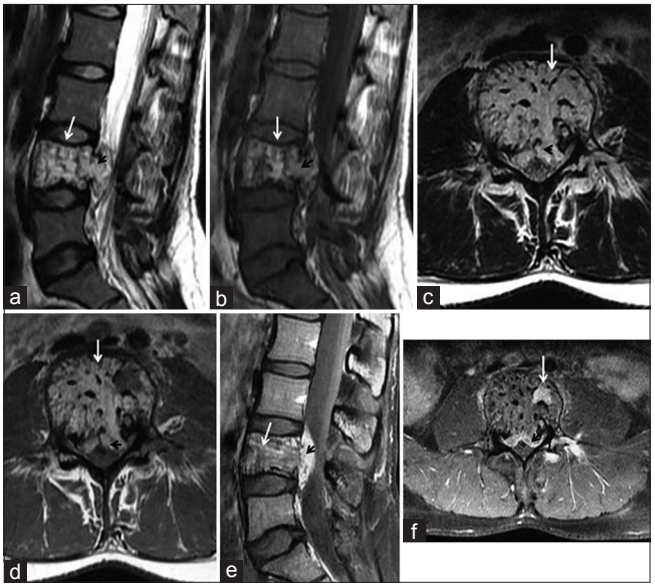

Figure 9: A 24-year-old female with aggressive hemangioma L4 vertebral body. Sagittal T2 (a) and T1 (b) weighted image of the lumbar spine show a diffuse hyperintensity with mottled appearance of the L4 vertebral body (white arrow) and epidural soft tissue causing cauda equina compression (black arrow). In addition, note compression fracture with mild height reduction of L4 vertebral body. Axial T1 (c) and T2 (d) weighted image of the lumbar spine also show a diffuse hyperintensity with mottled appearance of the L4 vertebral body (white arrow) and epidural soft tissue causing cauda equina compression (black arrow). Postcontrast fat saturated sagittal (e) and axial T1 (f) weighted image of the lumbar spine show heterogeneous enhancement with mottled appearance of L4 vertebral body (white arrow) and intense enhancement of epidural soft tissue (black arrow)

as filar lipoma and commonly associated with tight filum terminale syndrome. The prevalence of FFT in our study group was 9% with no significant gender predilection. Park *et al*. reported a prevalence of 3.2%, with a male and younger age group predilection, in South Korean population.[14]

Extraspinal synovial cyst

SCs are well-circumscribed smooth cysts seen in relation with the facet joints. They are seen in the spinal canal and extraspinally. Usually, the spinal canal SC is symptomatic due to neural compression, and extraspinal SC is asymptomatic. In the study, we included only the asymptomatic SC-outside the spinal canal. SC is associated with degenerative disease of the spine.[14] SC shows variable signal intensity, depending on the

protein content, previous hemorrhage, vacuum phenomenon, or calcification, but typically they are T2 hyperintense and T1 hypointense.[16,17] Calcified cysts show low signal intensity wall, and hemorrhagic cysts display increased signal intensity compared to CSF, on both T1- and T2-weighted images. Cysts with proteinaceous fluid may show T1 isointensity. The relationship of SC with facet joint is best displayed on transverse than sagittal images. Neural-based cysts are differentiated from SC by their intimate relation with the adjacent nerve, rather than with the adjacent facet joint. Contrast administration may be needed in some intraspinal cysts due to their atypical signal intensities. They may display thin peripheral enhancement.

The prevalence of extraspinal SC in our study group was 10.2% and showed no significant gender predilection or association with age. Park *et al*. had reported a prevalence of 0.8%, with a younger age group (<50 years) predilection, in South Korean symptomatic population.[14] The reasons for difference may be due to racial differences, technical parameters of acquisition of MRI, and viewing techniques. These asymptomatic tiny lesions rarely find a place in routine busy radiological reporting, unless they are specifically looked for. Most common location of SC in our study group was L4/5 facet joint level (40%), in accordance with the previous studies.

Tarlov cyst

TCs are CSF-filled dilatation of nerve root sheaths, at the dorsal root ganglion and are directly connected to the subarachnoid space of the spinal column. TC is also known as perineural cyst and can be distinguished from other meningeal cysts by nerve fiber-filled wall. They are most frequently located in the spinal canal from S1 to S4 region. They may cause scalloping of adjacent bony walls due to long-standing pressure effect and pulsations. These cysts are usually asymptomatic. However, when they expand in size, they compress adjacent nerve fibers, resulting in pain, weakness, and abnormal sensation.[18]

The prevalence of the TC in our study was 4% and showed increasing prevalence with age and no sex predilection. Park *et al*. reported a prevalence of 2.1%, with younger age group preponderance and no gender predilection.[14] Other previous reported studies were dealing with the symptomatic TCs. The most common location of TC in our study was S2 vertebral level (76%).

Enostosis

Enostosis is a small focus of compact bone within cancellous bone.[19] They are benign asymptomatic lesions seen in radiographs, CT, and MRI. Enostosis appears as a low signal intensity focus on all MRI sequences. The prevalence of the enostosis in our study was 3% and showed increasing prevalence with age and no sex preponderance. The most common site of enostosis in our study was L3 vertebrae (30.7%), followed by L2 (20%).

Limbus vertebrae

A limbus vertebra appears as a bone defect at the corner of a vertebral body in the radiograph, similar to a fracture. The anterior-superior corner of the vertebra is the most common site; however, it can also be seen at the inferior corner and posterior margin less frequently. Limbus vertebra occurs as a consequence of a remote injury in an immature skeleton. It occurs due to herniation of the nucleus pulposus through the ring apophysis before fusion and separates a small segment from the vertebral rim. Anterior limbus vertebra is usually asymptomatic, but posterior limbus vertebra may cause nerve compression.[20] Limbus vertebra may cause confusion with fracture or Schmorl's node.

The prevalence of the limbus vertebrae in our study was 1.1% and showed no association with age or sex. The most common site of limbus vertebrae in our study was L4 (64%), followed by equal frequency of L3 and L5.

Our study is the first, to provide prevalence of spinal incidental findings in Indian population. Knowledge about prevalence in the symptomatic population of the geographical region is essential for radiologist in optimal reporting and for clinician in best understanding of the radiological report. The limitation of our study is that it was not based on any gold standard methods for the confirmation of diagnosis. The diagnosis was solely based on MRI, in the majority of cases, but in very few cases, we got correlation from archives of other imaging modalities. All these incidental findings were of benign nature and might not warrant any regular follow-up.

Conclusion

Incidental findings are common in the symptomatic population, and few were associated with age. Awareness on the prevalence and imaging features of these benign lesions will enlighten the radiologist in differentiating these lesions from other similar pathological conditions.

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Conflicts of interest

There are no conflicts of interest.

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