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Case Series

Uncommon Pathologies of Spinal Canal – A Case Series

[1]Dr. Anees Dudekula, [2]Dr. Yashas Ullas L., [3]Dr. Sandeep Reddy Buchipudi, [4]Dr. Shaik Hasareen

[1]Assistant Professor, Department of Radiology, Sri Devaraj Urs Medical College, Tamaka, Kolar, Karnataka, India.
[2]Assistant Professor, Department of Radiology, Sri Devaraj Urs Medical College, Tamaka, Kolar, Karnataka, India.
[3]Senior Resident, Department of Radiology, Sri Devaraj Urs Medical College, Tamaka, Kolar, Karnataka, India.
[4]Junior resident, Department of Ophthalmology, Sri Devaraj Urs Medical College, Tamaka, Kolar, Karnataka, India.

Corresponding Author
Dr. Anees Dudekula, Department of Radiology, Sri Devaraj Urs Medical College, Tamaka, Kolar, Karnataka, India.

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ABSTRACT

Focal spinal cord pathology is every radiologist's nightmare. Situations such as focal pathology in the cord with no obvious extramedullary or intramedullary cause on conventional sequences are frequently encountered. At times even though some abnormality is detected on conventional sequences, it becomes difficult to characterise it. SPACE sequence in such cases is of immense value in coming to a diagnosis and brings to light the pathology which was not eminent on conventional MRI sequences. Here we illustrate a series of cases in which we encountered similar problems and how the application of SPACE sequence helped in arriving to a diagnosis.

KEYWORDS
SPACE, Arachnoid cyst, Spinal cord lesions, Dorsal web, Ventral cord herniation.

INTRODUCTION
Focal spinal cord pathology is every radiologist's nightmare. Situations such as focal pathology in the cord with no obvious extramedullary or intramedullary cause on conventional sequences are frequently encountered. At times even though some abnormality is detected on conventional sequences, it becomes difficult to characterise it. SPACE sequence in such cases is of immense value in coming to a diagnosis and brings to light the pathology which was not eminent on conventional MRI sequences.

SPACE sequence which is the abbreviated form of Sampling Perfection with Application optimized Contrast using different flip angle Evolution is a spin echo sequence. It is a type of slower version of fully refocused steady-state sequence with a shorter TR. In a SPACE sequence two runs of SSFP sequences are done. In the first run a positive and negative flip angle is used and in the second run a constant flip angle is used. These two runs show mutually shifted banding artifacts which are then combined to eliminate the artifacts and obtain

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a CISS image.[1] These features result in SPACE having many advantages over other steady state sequences. It has a shorter acquisition time owing to its short TE and TR. Tissues with long T2 relaxation like fluids will demonstrate wider ranges.[2] It has a higher signal to noise ratio and good spatial resolution. It is insensitive to susceptibility, flow or motion related artifacts.[3]

It is also a 3D sequence where it allows volumetric acquisition of the entire part with thin slices and isotropic voxels within a reasonable time period. The main advantage of this sequence is it provides very thin and high-resolution three planes or oblique reformatted slices (such as 0.7 × 0.7 × 0.7 mm) with the help of isotropic acquisition.[1] Conventional T2w and T1w sequences have thicker slice acquisitions and are not 3D sequences. Spinal cord may show focal myelopathy changes without any obvious underlying intramedullary or extramedullary etiology. Even though bigger mass lesions are easily detected on conventional sequences subtle abnormalities are easily overlooked. Moreover because of increased spatial resolution of the structures in the CSF space and thinner volumetric imaging characteristics, subtle abnormalities are highlighted.

All patients referred for MR evaluation of spine were evaluated using sagittal T2w, T1w. axial T2w, coronal STIR sequences. Prior to the scan details such as clinical history, any laboratory investigations and prior imaging studies were obtained. Following initial sequences, a radiologist evaluated the study and took a call to perform SPACE sequence. SPACE sequence was obtained in the sagittal planes and reformatted to orthogonal planes.

We present to you a series of cases where in subtle findings of diagnostic importance have not been appreciated on conventional T2w and T1w sequences but with the application of SPACE sequence one has arrived at an accurate diagnosis.

CASE PRESENTATION

Case 1

A 54-year-old male patient presented with complains of progressive weakness in bilateral lower limbs, difficulty in climbing stairs and tendency to fall since one month. No sensory symptoms. MRI examination of the dorsal spine was performed. Sagittal T2w image showed focal hyperintensity at the D7-D8 level with ventral deviation of the dorsal cord. Sagittal T1W sequence shows hypointensity with surrounding hypointensity at that corresponding level. Axial T2w images also only showed focal signal intensity changes at this level. Post contrast sequences no focal enhancing lesion in the spinal cord or posterior CSF space. On SPACE sequence increased posterior CSF space with no evidence of any mass lesion was noticed. Acute ventral angulation of the dorsal cord at the D7-D8 level with focal dilated central canal and surrounding myelomalacic changes was noted. Effacement of the CSF space was seen anteriorly between the cord and duramater. Axial reconstruction of the SPACE sequences revealed focal anterolateral herniation of the spinal cord on the left side. Any focal defect in the duramater was not seen. A diagnosis of ventral thoracic cord herniation with myelopathy was given in this case (Figure 1).

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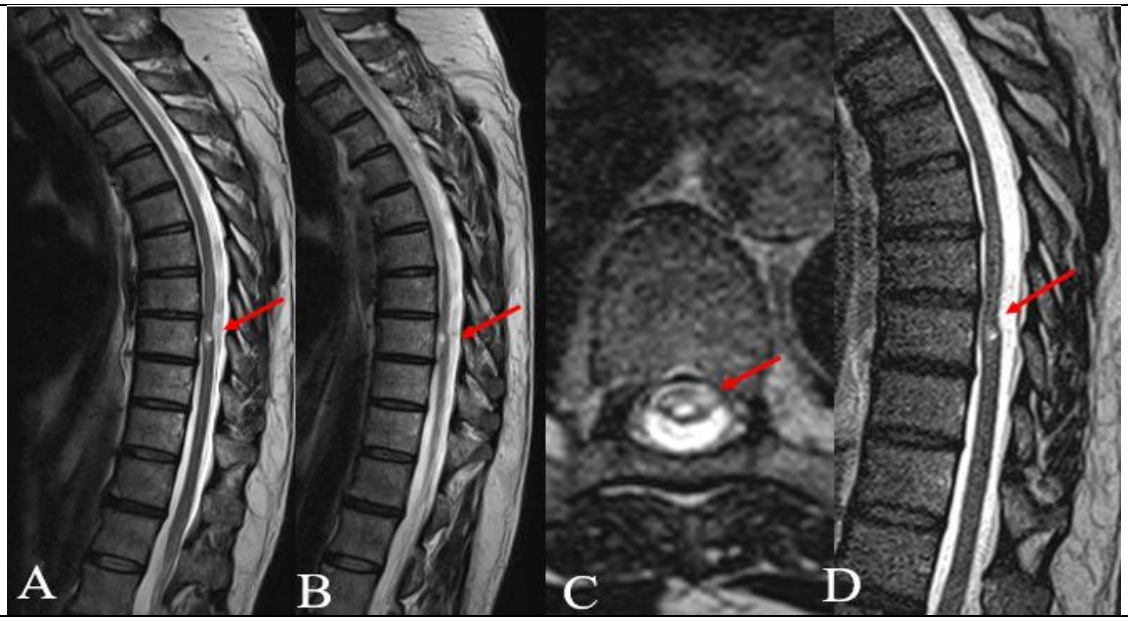

Figure 1: Sagittal T2(A, B), axial SPACE (C) and sagittal SPACE (D) sequence show focal hyperintense area in the thoracic spinal cord with focal ventral herniation of the cord better appreciated in the SPACE sequences (red arrow)

Case 2

A 56-year-old female presented with history of pain in bilateral lower limb since three months. MRI examination of the dorsal spine was performed. Sagittal T2w image showed focal hyperintensity in the dorsal spinal cord at the D1, D2 vertebral level. There was focal dorsal indention and thinning of the cord at the D2 level. Axial T2w images also only showed focal signal intensity changes at this level. SPACE sequence shows thin septae dorsally at this level. No effacement of the anterior CSF space. A diagnosis of dorsal thoracic arachnoid web with myelopathy was suggested (Figure 2).

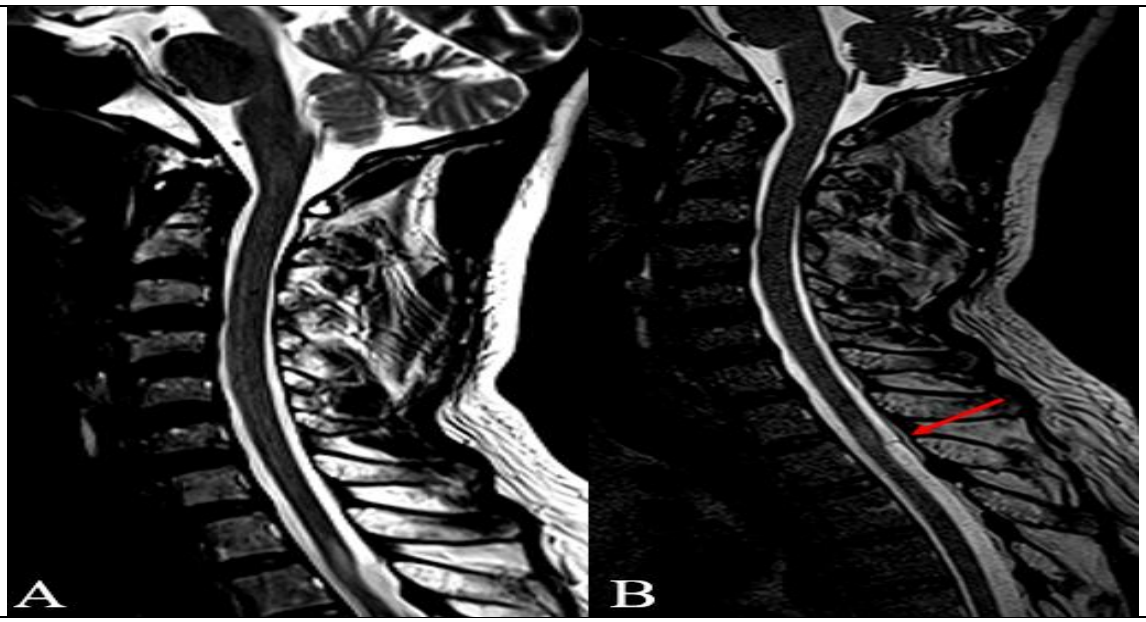

Figure 2: Sagittal T2 (A) and sagittal SPACE (B) images. anterior cord deviation and cord hyperintensity is observed in the upper thoracic cord on T2 images with no definite pathology. However, in SPACE sequence presence of a dorsal web is very well appreciated (red arrow)

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Case 3

A 41-year-old female presented with complaints of pain in bilateral lower limbs (right >left) since past 6 years which was slowly progressing. MRI examination of the dorso-lumbar spine was performed. Sagittal T2w image showed focal dorsal angulation of the thoracic cord at the D4 vertebral level. There were no signal intensity changes. SPACE sequence in addition ruled out any ventral web or arachnoid cyst. A focal T2/T1 Hyperintense lesion showing signal loss of FATSAT images was noted involving the D4 vertebral body on the posterior aspect just anterior to the cord pathology which was suggestive of a hemangioma. A diagnosis of ventral thoracic cord herniation with myelopathy was provided in this case (Figure 3).

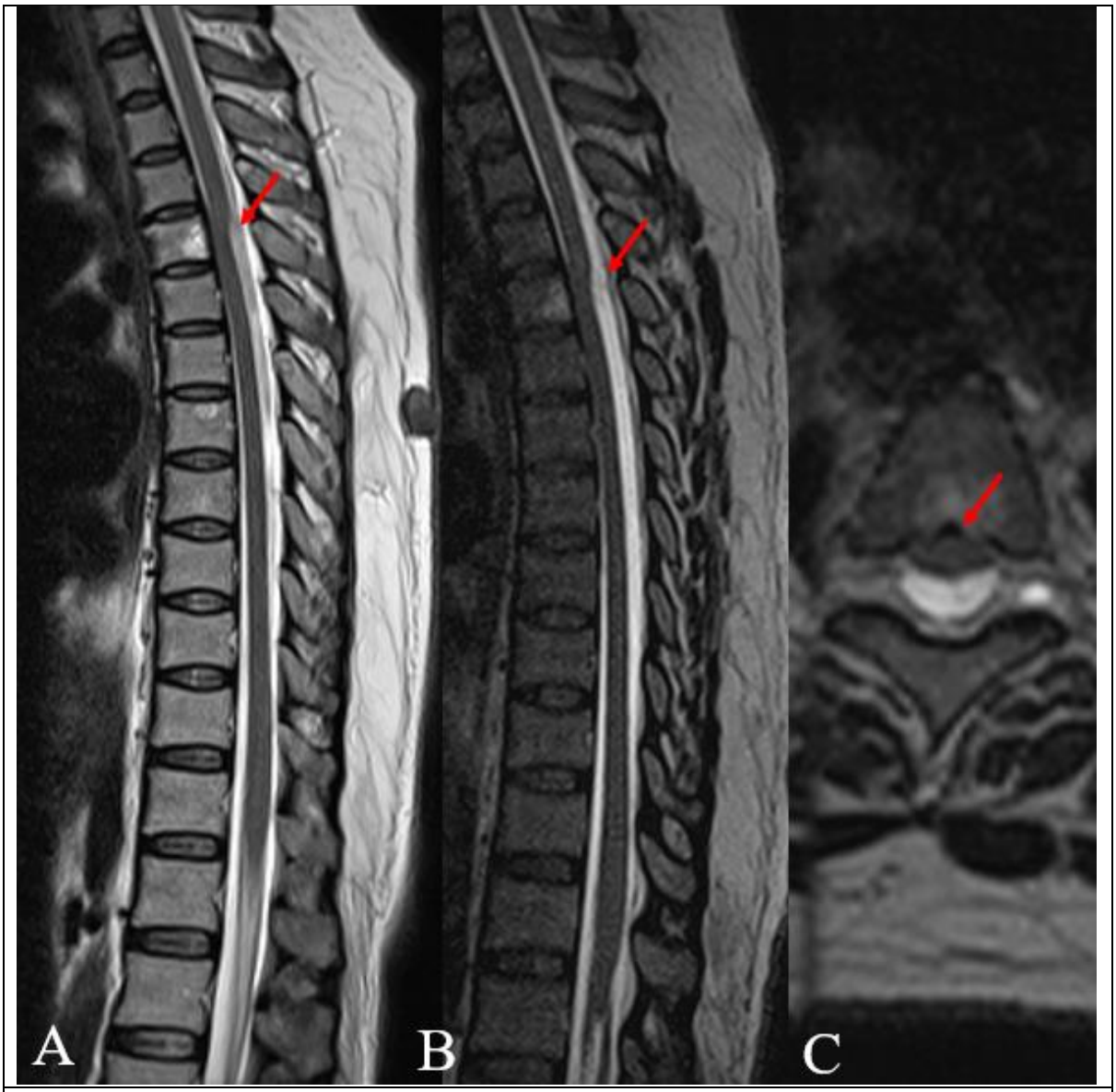

Figure 3: Sagittal T2(a), sagittal SPACE (b) and axial SPACE (c) sequence show focal anterior angulation of the thoracic spinal cord with no signal intensity changes (red arrow). SPACE sequence reveals focal ventral herniation of the cord (red arrow)

Case 4

A 35-year-old male presented with complaints of pain in bilateral lower limbs which was slowly progressing since past 1 year. MRI examination of the dorso-lumbar spine was

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performed. Sagittal T2w image showed well defined large hyperintense extraaxial cystic lesion posterior to the spinal cord from D4 to D7 vertebral level. The lesion was also well visualized on SPACE sequence. A presence of thin septation was only seen on SPACE sequence as compared to T2w sequence. Also extraspinal extension through the neural foramina is also clearly seen on SPACE sequence. A diagnosis of large spinal arachnoid cyst was suggested (Figure 4).

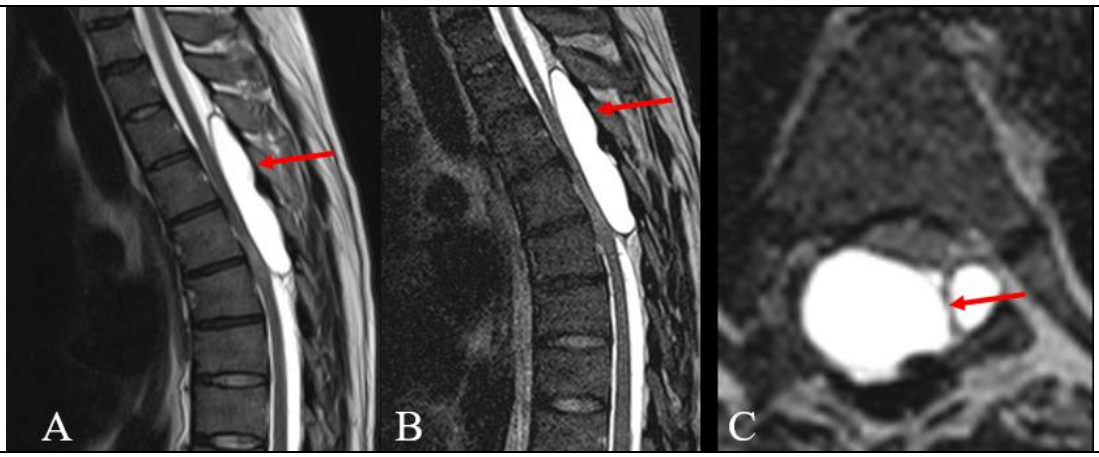

Figure 4: Sagittal T2 (A), sagittal SPACE (B) and axial SPACE (C) images. Large cystic lesion in the region within the spinal cord (red arrow). However, in SPACE sequence on axial section (C) septation within is clearly visualized (red arrow)

Case 5

A 25-year-old male patient with history of tingling sensation in his left leg from the past 5 months. Sagittal T2w sequence was initially appearing normal, however on careful examination there wall a well-defined hyperintense lesion in the region of left D12 neural foramina. On SPACE sequence showed a well-defined cystic lesion was visualized in this region. We can also see that the lesion is displacing the exiting spinal nerve roots posteriorly and compressing them which is the cause for his chronic leg pain. The nerve roots were not visualized on T2w sequence. A large meningocele in the location of left neural foramina was made (Figure 5).

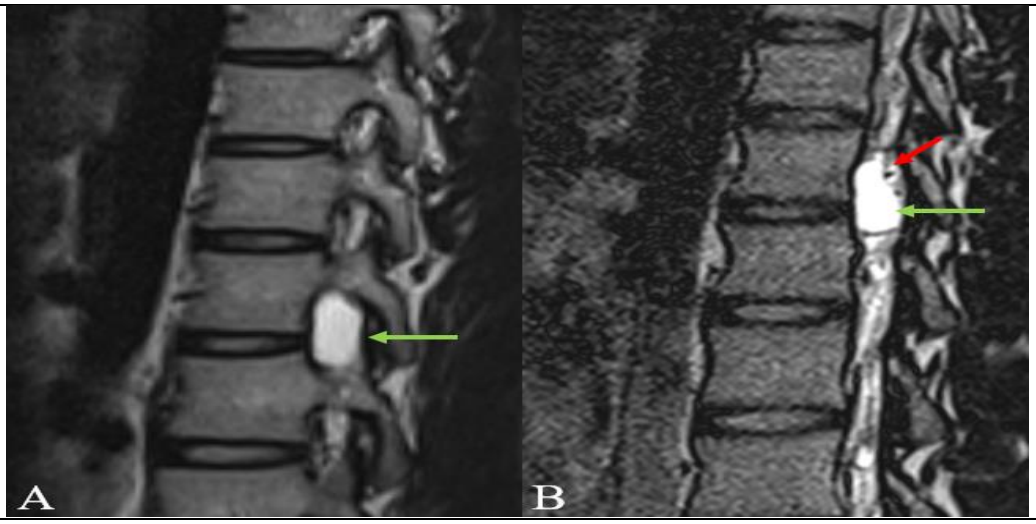

Figure 5: Sagittal T2 (A) and sagittal SPACE (B) images. Large cystic lesion in the region of left D12 neural foramina (green arrow). However, in SPACE sequence (B) compressed nerve roots are very well appreciated (red arrow)

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DISCUSSION

Extramedullary intradural lesions which are predominantly cystic or of very thin calibre are extremely difficult to identify on conventional sequences due to the high signal intensity on T2w images and thin imperceptible walls. Many extramedullary lesions present with just subtle displacement of cord.[4] These lesions are poorly visualized of T2w sequences. In dorsal thoracic arachnoid web, there is sudden anterior displacement of spinal cord with a focal indentation by the web producing the "Scalpel sign".[5,6]

SPACE sequence is extremely helpful as it is a 3D isotropic volume acquired sequence with thin slices of up to 0.7mm.[1] An arachnoid cyst is a benign cavity that contains cerebrospinal fluid. It is surrounded by an arachnoid membrane. This membrane is very thin and imperceptible to regular thick section MRI sequences.[7] Structures such as arachnoid cyst have high signal intensity on T2w sequence. Arachnoid cysts are usually intracranial, however a few of them tend to occur in the intraspinal location. Most the cysts tend to be asymptomatic until they become enlarged in size and start causing mas effect on adjacent structures. They also tend to displace the nerves and vessels in their vicinity. They cause smooth indentation of the spinal cord. They may be located dorsal of ventral to the spinal cord. Using thin imaging slices and sequences with high better spatial resolution such structures are easily visible. Also, any thin septae cannot be visualized if the axial section is not acquired at this level.[8] Even if acquired at this level it may not be detected. Since 3D reconstruction is possible with SPACE sequence and due to isometric sampling and thin slice acquisition, septae and other such small structures are easily demonstrated. Myelographic studies are finally needed for the confirmation and demonstration of such abnormalities. It is an invasive procedure and is accompanied by its own set of complications. SPACE sequence by demonstrating these small abnormalities ablates the need for performing myelographic studies. Following the development of medical imaging there has been increase in the incidence of arachnoid cysts. This is because these indolent lesions tend to get recognised when the patient gets investigated for some other pathology and these lesions are picked up.

Anterior thoracic spinal cord herniation is a rare condition, characterized by prolapse of cord through a defect in the anterior or antero-lateral duramater. Though the exact origin of defect is unknown, the most likely causes are trauma, pressure erosion on duramater and congenital defects.[9] These patients usually present with paraparesis and bowel dysfunction.[10] It is usually more common in older and middle-aged patients. In case of a small defect in the duramater, it may not be visualized on regular MR sequences. With the application of SPACE sequence these defects and herniated spinal cord can be better visualized.[11] These patients usually tend to get misdiagnosed as a lumbar spinal disorder or disc disease and keep getting treatment for the same.

Spinal nerve roots are clearly demonstrated of SPACE sequence. Higher spatial resolution results in better visualization of the dorsal and ventral nerve roots. Brachial plexus injury are the most common type of avulsion injury to occur following trauma. Standard and CT myelographic studies are required to demonstrate the avulsion injuries.[12,13] These nerve roots are sometimes difficult to evaluate with CT myelography owing to artifacts from the shoulders. This problem is significant in burly young males, who represent the majority of BPI patients. However, standard myelography is disadvantageous in that ventral and dorsal nerve roots cannot be evaluated separately.[14] The diagnostic accuracy of radiological findings was more compared with clinical findings.[15]

CONCLUSION

Extramedullary intradural lesions which present with subtle findings are difficult to diagnose on conventional MR sequences. SPACE is very useful as a problem-solving sequence when encountering such focal spinal cord pathologies. Its efficacy is well established in conditions

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such as spinal arachnoid cysts and nerve root avulsions. With reference to the above cases, we would conclude that SPACE is truly the sequence to be performed when faced with focal spinal cord pathologies with no obvious pathology in conventional sequences. In such events SPACE will be of great use and aid us in coming to a correct diagnosis. Therefore, SPACE sequence should be incorporated in all the protocols for spine imaging.

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