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Magnetic Resonance Imaging Evaluation in Cervical Radiculopathy

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ABSTRACT

This is a prospective study aimed to evaluate the causes of cervical radiculopathy and the extent of the nerve root compression with MRI on 50 patients, in the Department of Radiodiagnosis and Imaging at SreeBalaji Medical College, Chromepet, Chennai. To evaluate various causes of cervical radiculopathy. To evaluate the extent of the nerve root compression.

Keywords: Radiculopathy, osteophyte formation, pathology and radiogrpahy

1. INTRODUCTION

Cervical radiculopathy is defined as a symptom of pain or sensorimotor deficits due to compression of a cervical nerve root(s). Characteriscally there is pain in the neck and in a radicular distribution in one or both the extremities occurring in episodes lasting for a few weeks, frequently accompanied by varying degrees of sensory, motor and reflex changes.[1] Neck movement is often restricted; in most cases it may be free.In the younger population cervical radiculopathy is a result of disc herniation (occurs in 20 -25 %) or an acute injury causing foraminal impingement of an exciting nerve. In the older patient cervical radiculopathy is often a result of foraminal narrowing from osteophyte formation, decreased disc height, degenerative changes of the uncovertebral joints anteriorly and the facet joints posteriorly.[2,3]Cervical nerve root pathology may occur in many diseases. By far the most common causes of cervical radiculopathy are cervical spondylosis and intervertebraldisc prolapse resulting in nerve root impingement. Other causes include vertebral fracture/ dislocation, vertebral collapse, spondylolisthesis and trauma to the cervical roots due to avulsion or radiation injury. Infiltrative, neoplastic, infectious and metabolic conditions (l ike diabetes - which can decrease the normal blood flow to the spinal nerves) may also result in radiculopathy.[4]

Radiography of the cervical spine is usually the first diagnostic test ordered in patients who present with neck and limb symptoms. The American College of Radiology recommends plain radiographs as the most appropriate initial study in all patients with chronic neck pain. Lateral,

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anteroposterior, and oblique views should be ordered. However the clinician should be aware of the limitations of plain radiographs. Problems with both specificity and sensitivity exist. Two major drawbacks to radiography are difficulty in interpretation, limited depiction of anatomy and an unacceptably high rate of diagnostic errors as stated [5].MRI has become the method of choice for imaging the neck to detect significant soft tissue pathology, such as disc herniation. The American college of Radiology recommends the most appropriate imaging study in patients who have neurologic signs or symptoms but normal radiographs. MRI can detect ligament and disc disruption, which cannot be demonstrated by other imaging studies. The entire spinal cord, nerve root and axial skeleton can be visualized. This study is usually performed in the axial, sagittal and coronal planes. MRI has been found to be quite useful in evaluatingthe amount of CSF surrounding the cord in the evaluation of patients with cervical canal stenosis, although T2 weighted images tend to exaggerate with the degree of stenosis.[6-9]

Although MRI is considered the imaging method of choice for the evaluation of cervical radiculopathy abnormalities have been found in asymptomatic subjects. Boden SD et al (1990) observed that in 10 % of the subjects younger than 40 years were noted to have disc herniation; of subjects older than 40 years, 20 % had evidence of foraminal stenosis and 8 % had disc protrusion or herniation. Therefore as with all imaging studies the MRI findings must be in conjunction with the patient's history and physical examination findings.

2. MATERIALS AND METHODS

The data for the study intended, were collected from patients referred for MRI scan to the Department of Radiodiagnosis, SreeBalaji Medical College, Chromepet, Chennai.

METHODS OF COLLECTION OF DATA:

My intended study is a prospective study, carried out on 50 patients, for a period of 24months duration.

Case selection :

The patients who are clinically suspected, as a case of cervical radiculopathy will be investigated with Magnetic Resonance Imaging (MRI).

The study group will include a sample size of 50 patients. The data will be analyzed by a descriptive analysis.

A complete clinical history of the patient was taken with particular reference to the motor and

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sensory symptoms.

Inclusion criteria:

1.All age groups 2.Both

sexes

3.All cases of compressive myelopathy

Exclusion criteria

1. Non – cooperativepatients.
2. Patients with non – compatible MRI metallic implants.

Patient preparation:

Procedure will be explained to the patientand consent will be taken. Detail history for contraindication of MRI will be specificallytaken.

Equipment:

Hitachi APERTO 0.4 TESLA; Open permanent magnet MRI Scanner.

SEQUENCES	TR	TE	Flip Angle
Sagittal T1	400	25	90
Sagittal T2	4000	117	90
Gradient Axial	810	35	40
T1 Axial	500	25	90
STIR	2000	20	9

Gadolinium enhanced T1W spin echo sequence were used if necessary.

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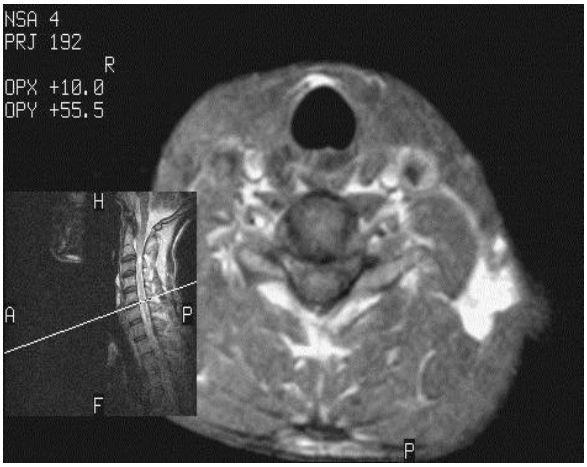
3. RESULTS AND ANALYSIS

MRI C-SPINE



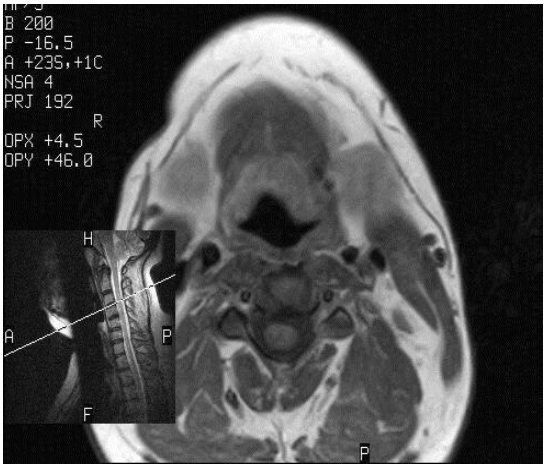


FIG 1: Posterior disc bulge with thecal sac indentation and bilateral neural foraminal stenosis with central herniation of intervertebral disc noted at C5-C6 level.

FIG 2: Posterior disc bulge with bilateral neural foraminal stenosis left more than the right noted at C4 – C5 level.

Graph 1: Age groups of the patients presenting with cervical radiculopathy.

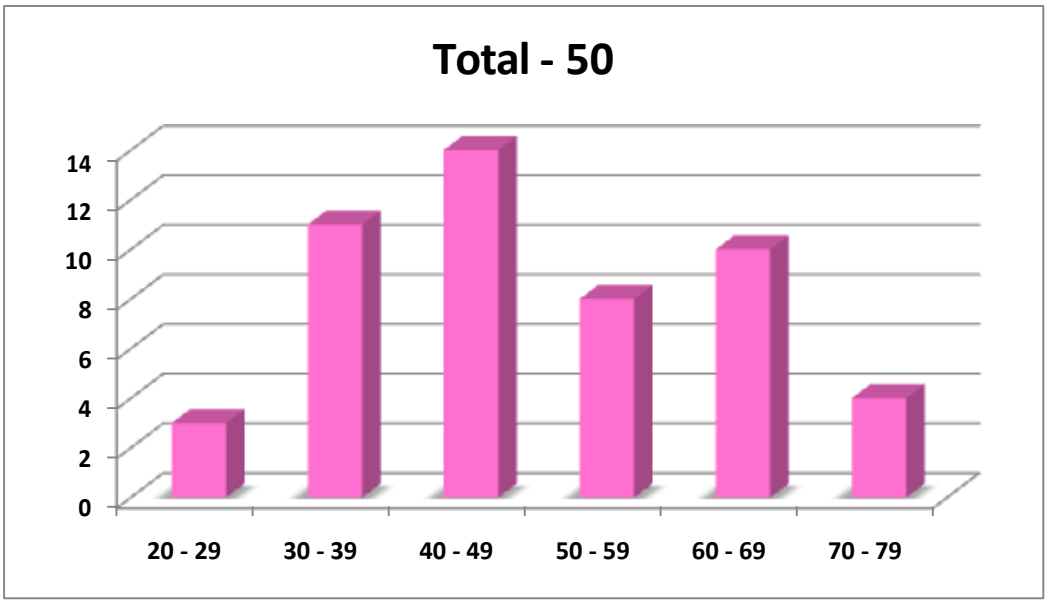


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Table 2: No of male patients with posterior disc protrusion

AGE	GRADE 0	GRADE 1	GRADE 2
20 -29	1	1	0
30 -39	0	2	0
40 -49	0	5	2
50- 59	0	3	2
60 -69	1	6	2
70 -79	0	0	1
Total	2	17	7

c

Table 3: No of female patients with posterior dis protrusion:

AGE	GRADE 0	GRADE 1	GRADE 2
20 – 29	0	1	0
30 – 39	1	8	0
40 – 49	0	6	1
50 – 59	0	1	2
60 – 69	0	0	1
70 – 79	1	1	1
Total	2	17	5

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Posterior disc protrusion grading :

Grade 0: Disc material confined within the posterior margin of the vertebralbody

Grade 1: Disc material protruding beyond the posterior margin of the vertebral body without cord compression

Grade 2: Disc material protruding beyond vertebral body with cordcompression.

Graph 2: Total number of patients with posterior disc protrusion:

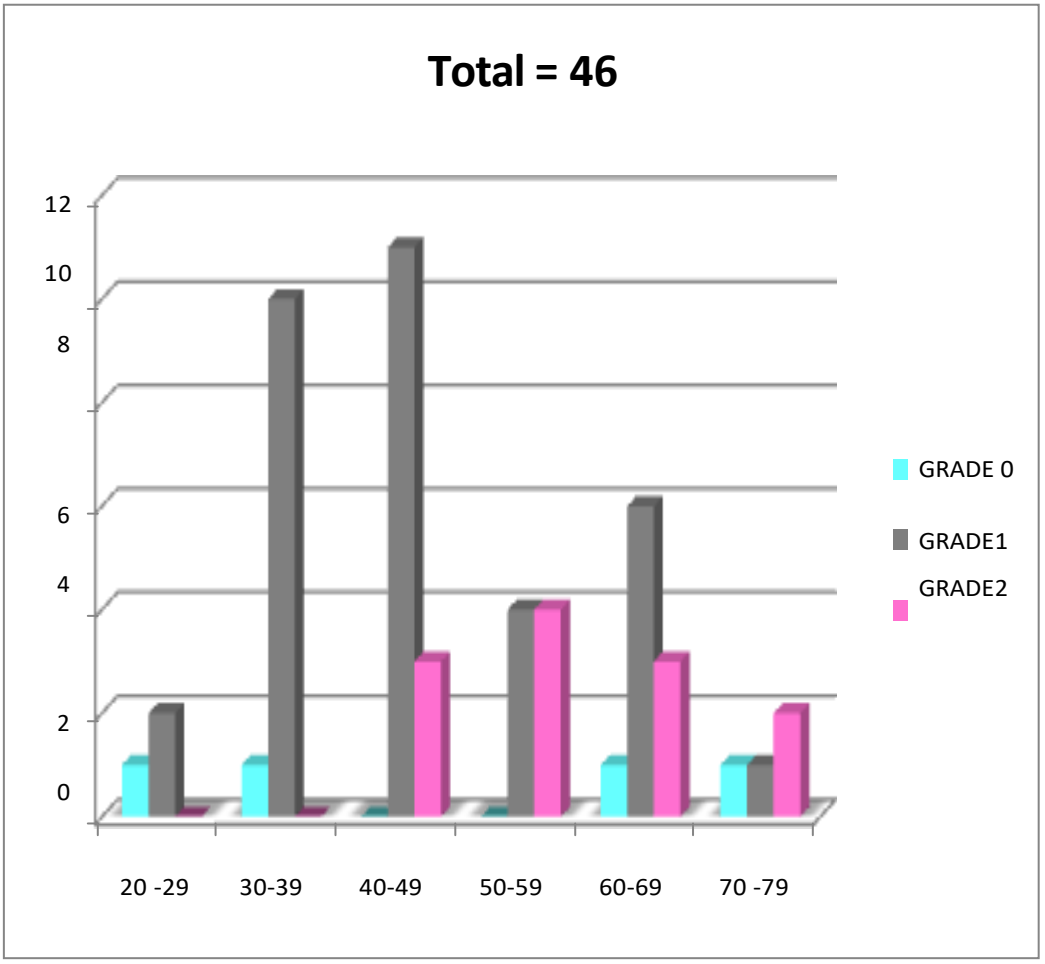

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Table 4: No of male patients with anterior disc protrusion:

AGE	GRADE 0	GRADE 1
20 - 29	2	0
30 – 39	2	0
40 – 49	7	0
50 – 59	4	1
60 – 69	8	1
70 – 79	1	0
Total	24	2

Table 5: No of female patients with anterior disc protrusion:

AGE	GRADE 0	GRADE 1
20–29	1	0
30-39	9	0
40–49	6	1
50–59	3	0
60–69	1	0
70-79	3	0
Total	23	1

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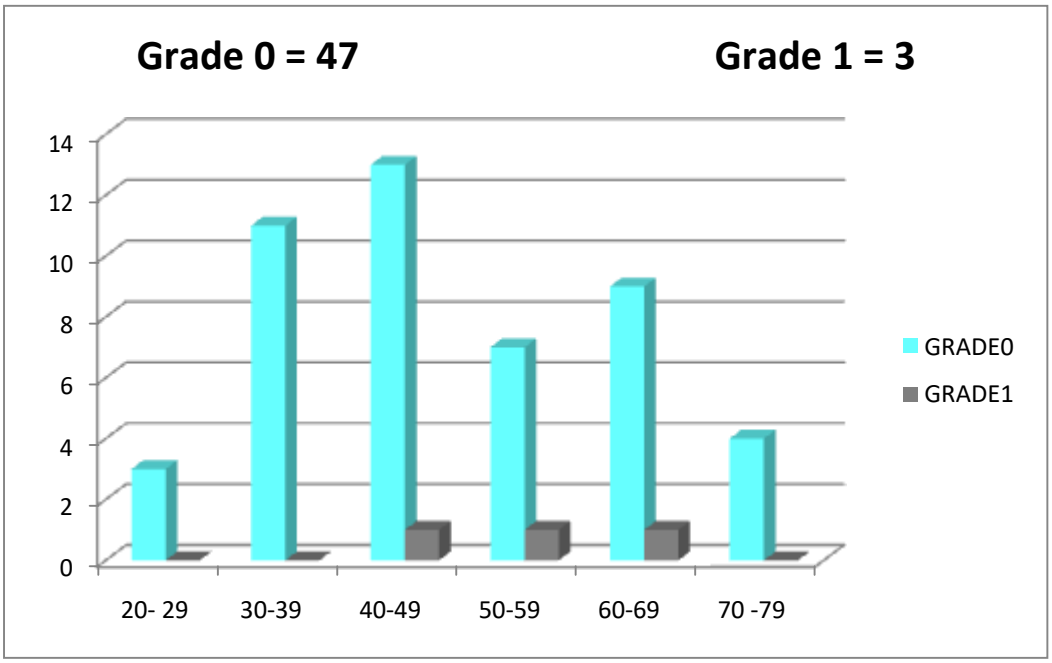
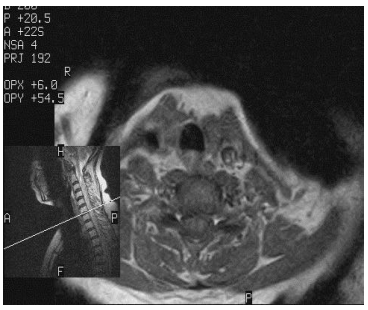
Grading of anterior disc protrusion:

Grade0: Disc material confined within the anterior margin of the vertebral body

Grade 1: Disc material protruding beyond the anterior margin of the vertebralbody

Graph 3: Total no of patients with anterior disc protrusion:





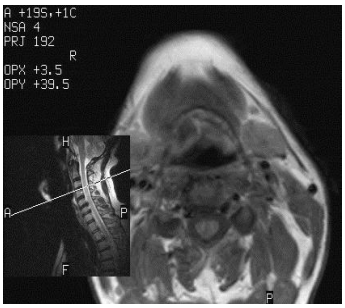


FIG 3:Diffuse disc bulge with thecal sac indentation and mild bilateral neural foraminal stenosis with central herniation of intervertebral discis noted at C6-C7 levels.

FIG 4: Posterior disc bulge with bilateral neural foraminalstenosis noted at C3 – C4 level

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Graph4: Total no of patients with narrowing of the disc space:

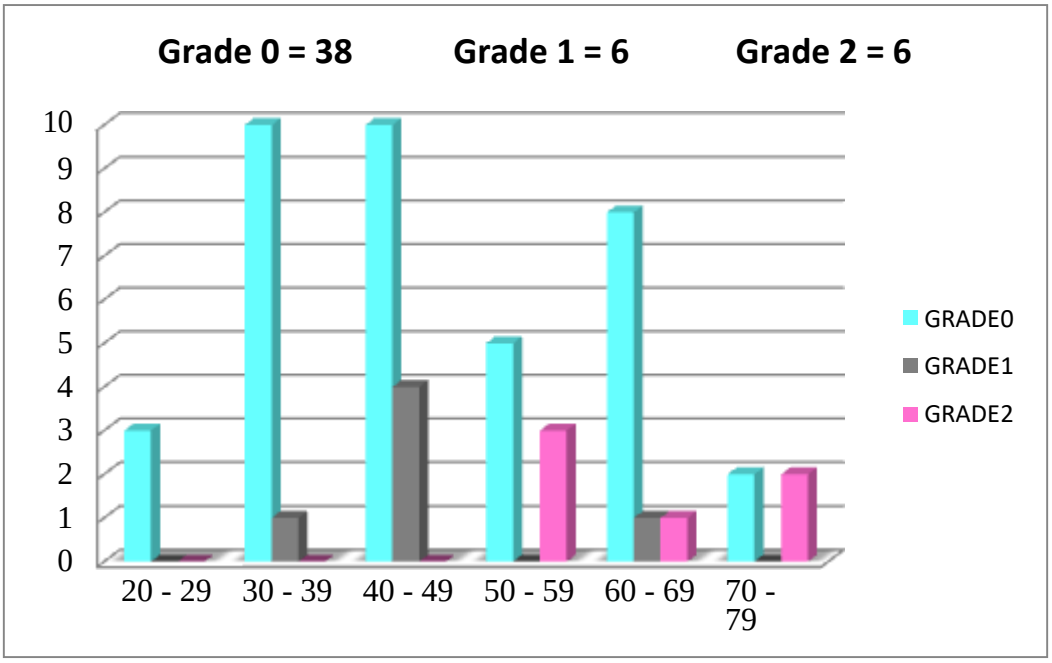

Table 7: No of male patients with foraminal stenosis:

AGE	GRADE 1	GRADE 2	GRADE 3
20 – 29	1	0	0
30 – 39	2	0	0
40 – 49	1	4	2
50 - 59	1	3	1
60 – 69	1	5	2
70 – 79	0	0	1
Total	6	12	6

Table 8: No of female patients with foraminal stenosis:

AGE	GRADE 1	GRADE 2	GRADE 3
20 - 29	1	0	0
30 – 39	5	3	0
40 – 49	1	4	2

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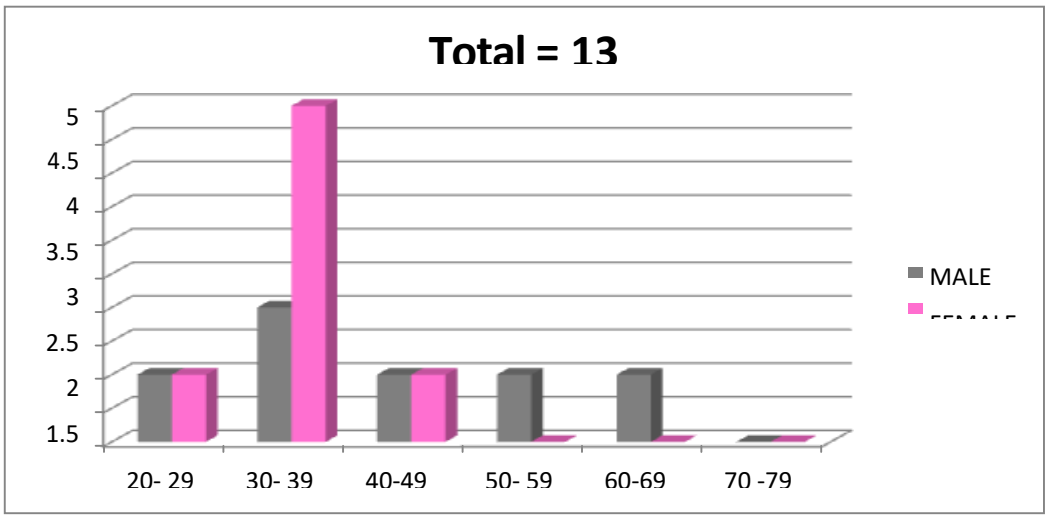
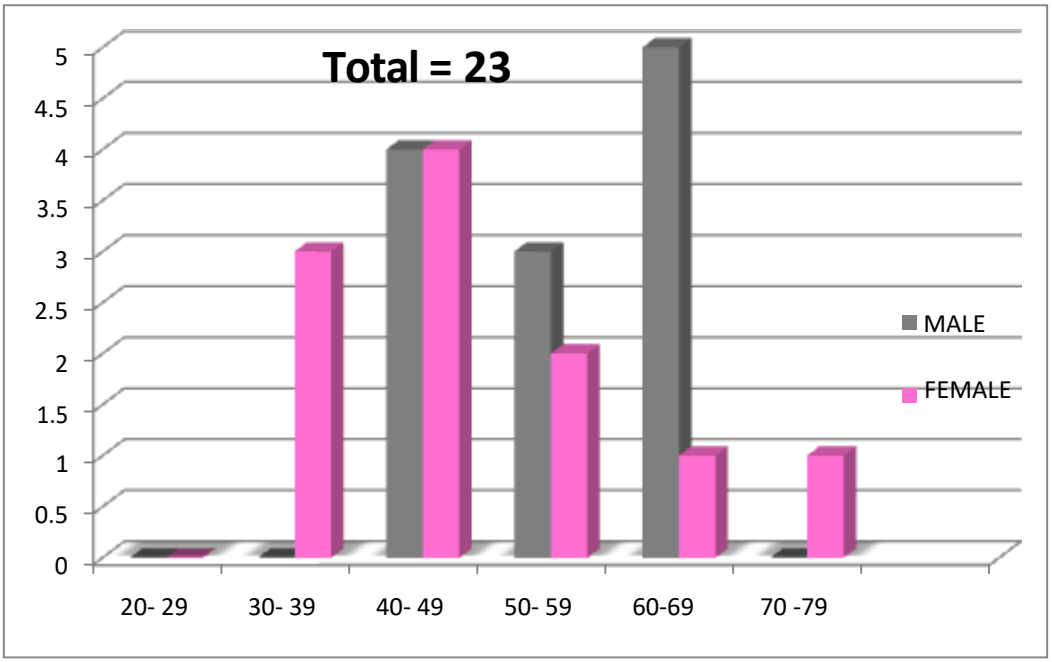
50 - 59	0	2	1
60 - 69	0	1	0
70 – 79	0	1	1
Total	7	11	4

Graph5: No of patients with Grade 1 foraminal stenosis:



Graph 6: No of patients with Grade 2 foraminal stenosis:



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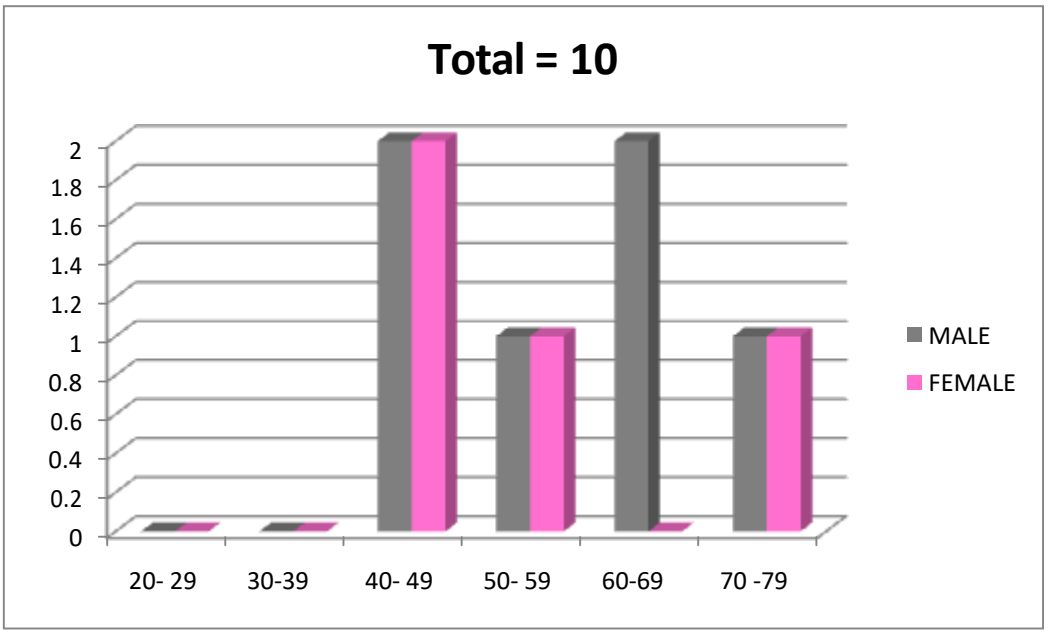
Graph 7: No of patients with Grade 3 foraminal stenosis:



Grading of foraminal stenosis:

Grade 1: Foraminal stenosis [mild (below 50% ofnerve root circumference) perineuralfat obliteration. No morphological change of the nerve root isseen.

Grade 2: Foraminal stenosis [moderate (above 50% of nerve root circumference) perineuralfat obliteration. No morphological change of the nerve root isseen.

Grade 3: Foraminal stenosis, collapsed nerve root with morphological change of the nerve root. Severe perineuralfatobliteration is alsocombined.

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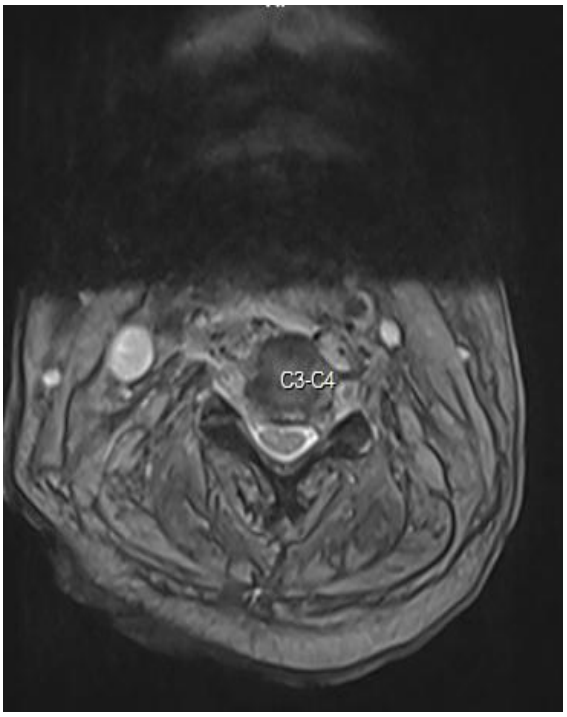

FIG:5 **FIG:6**

FIG 5 &6: Marrow replacement involving entire C4 vertebral body secondary to malignancy with soft tissue in the right C3-C4 neural foramina compressing the right C4 nerveroot.

Graph9: Level of the disc causing compression of the nerve root

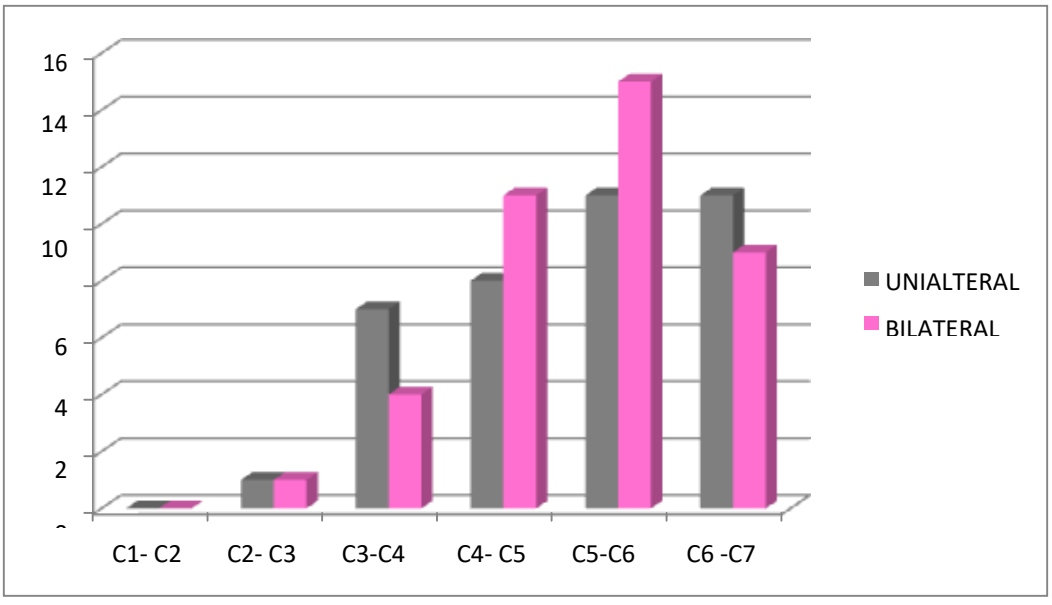

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FIG7

FIG 8

FIG 7 &8: Bilateral inter-facetaljoint dislocation and disruption of the intervertebral disc at C5 – C6 level with prevertebralsoft tissueswelling.

Table 12: No of patients with prevertebraland paravertebral soft tissueabnormality:

	Age	Total
Pre vertebral and paravertebral soft tissue abnormality	20 – 29	1
	30 – 39	1
	40 – 49	0
	50 – 59	2
	60 – 69	1
	70 – 79	1

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4. DISCUSSION

The ability of MRI in evaluating the cause and extent of cervical radiculopathy is well established. The American college of Radiology recommends MRI as the most appropriate imaging modality in patients with chronic neck pain who have neurologic signs and symptoms, but normal radiographs.[10]MRI can detect ligament and disc disruption, which cannot be detected in other studies. MRI is currently the only modality, which can demonstrate the entire spinal cord, nerve roots and axial skeleton, which can be completely visualized in the sagittal, coronal and axial planes[11].In our study of 50 patients presenting with symptoms of cervical radiculopathy, we found various causes for the nerve root compression like one patient with infective tuberculousspondylosis, one patient with secondary malignant lesion in the vertebral body causing neural foramen compression. Five patients with history of trauma with fracture of the vertebral body/posterior elements, causing nerve root compression.[12]

The main observation noted in the descriptive study of the 50 patients with cervical radiculopathy was that all the patients had one or more degenerative disc causing neural foramen compression unilaterally or bilaterally at one or multiple levels.[13,14] The patients who had metastasis and infection and trauma to the cervical spine had accompanying degenerative changes in the disc causing neural foramen compression.Kelsy et al (1978) 12 concluded that cervical nerve root pathology may occur in many diseases. By far the most common causes of cervical radiculopathy are cervical spondylosis and intervertebral disc prolapse resulting in nerve root impingement. Other causes include vertebral fracture/dislocation, vertebral collapse, spondylolisthesis and trauma to the cervical roots with avulsion or radiation injury. Infiltrative, neoplastic, infectious, para-infectious and metabolic conditions may also result in cervical radiculopathy.[16-19]Since disc degeneration was the predominant finding in all the patients who presented with cervical radiculopathy, a grading system used in the article forcervical disc degeneration was used [20]

Posterior disc protrusion on T1 W images were diagnosed when non osseous material with an intermediate signal level protruded into the spinal canal or the neural foramen causing the compression of the nerve root. The protrusions were classified as median, paramedian or lateral according to their apex on axial images in relation to the spinal cord. Median protrusion opposite the middle third of the cord. Para-median opposite the lateral third and lateral protrusions were lateral to the cord.[21]Posterior disc protrusion is clinically important since it may cause radiculopathy and myelopathy.[22]noted that posterior disc protrusion causing cervical radiculopathy and even compression of the spinal cord were not rare even in asymptomatic patients above 40 years of age.

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(1) Posterior discprotrusion:

In all the 50 patients evaluated for cervical radiculopathy 46 patients had posterior disc bulge, out ofwhich the predominant age group of 50 – 59 had Grade 2 posterior disc bulge i.e.. (disc bulge beyond the vertebral body with cord compression) and age group of 40 – 49 had Grade 1 posterior disc bulge.

(2) Anterior discprotrusion:

Anterior disc protrusion was observed in a total of 3patients, out of which one belong to the age group of 40 – 49, one in 50 -59 and another 60 - 69. Isolated cases of anterior disc protrusion causing cervical radiculopathy are not reported till date, they are mostly accompanied by posterior disc bulge in patients with cervical radiculopathy.[23] Of the 50 patients evaluated for cervical radiculopathy, 6 patients had Grade 2 disc space narrowing in age group of 50 – 79 and 6 patients had Grade 1 disc space narrowing in the age group of 40 – 69.Marrow replacement was noted in one patient involving entire C4 vertebral body, both pedicles and part of lamina with anterior epidural soft tissue componentindenting the cord with a soft tissue in the right C4 -C5 neural foramina compressing the right C4 nerve root.One patient presented with end plate irregularity with mild increase in signal intensity, with features suggestive of early discitis, with posterior disc bulge causing neural foramen compression at C6 – C7 level.[24,25]

A total of 5 patients with history of trauma had prevertebral and paravertebral soft tissue swelling. One patient with infective spondylosis also had soft tissue abnormality.[26] Evaluation of foraminal stenosis causing nerve root compression and grading was done according to the severity of nerve root compression.

- C5 – C6 was the most common level of nerve root compression with 30% (15 patients) having unilateral and 22% (11 patients) having bilateral compression of the nerveroots.
- C6 – C7 was next followed by with 22% (11 patients) having unilateral nerveroot compression and 18% (9 patients) having bilateral nerve rootcompression.
- C4 – C5 had 16% (8 patients) with unilateral and 22% (11

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patients)with bilateral nerve root compression.

- C2 – C3 was the least with 2% (1patient) having unilateral nerve root compression and 2% (1patient) with bilateral nerve rotcompression.

Foraminal stenosis objectively as being above or below 50% is based on the degree of fat obliteration. It as found that the incidence of Grade 3 stenosis was higher at the C5–C6 level than at other cervical levels are attributed to the results of the fact that the C5 –C6 level showed the largest range of movement, and, therefore, the most severe deformity of the neural foramen can be seen at this level.

CONCLUSION

MRI is the definitive modality in assessing soft tissues of the spine and spinal cord abnormalities. It is the best modality to evaluate the nerve roots and integrity of the intervertebral discs and ligaments. The new grading system of cervical foraminal stenosis based on oblique sagittal MRI provides reliable assessment of cervical foraminal stenosis and good reproducibility. This new grading system is a useful and easy method for the objective evaluation of cervical neural foraminal stenosis.In my study with the help of MRI I could successfully evaluate the cervical spine and intervertebral discs and evaluate the cause and the extent of the nerve root compression. It can be concluded that MRI is very definitive, sensitive, accurate, though costly but very specific, non-invasive, radiation free modality for evaluation of Cervical radiculopathy.

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Ethical approval: The study was approved by theInstitutional Ethics Committee

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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