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ORIGINAL ARTICLE

Clinical Correlation of Oblique Magnetic Resonance Imaging (MRI) for Cervical Foraminal Stenosis

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ABSTRACT

Background: Cervical foraminal stenosis frequently contributes to neck pain and radiating symptoms, which often leads to considerable discomfort and difficulty in performing daily activities. Despite routine use of MRI for diagnosis, it is unable to visualise the foraminal area clearly. Oblique MRI has been suggested as a better imaging assessment for quantifying nerve root compression, though its usefulness in practice is still being explored. The purpose of the study is to evaluate the clinical relationship of oblique magnetic resonance imaging findings with the symptoms reported in patients with cervical foraminal stenosis.

Methods: This cross-sectional study was conducted on 54 patients presenting with signs of cervical radiculopathy between January 2022 to December 2022 at the Department of Neurosurgery, Sandeman Provincial Hospital/ Bolan Medical College Quetta. Detailed clinical assessments were recorded, including pain severity (VAS), functional status (NDI), and neurological examination. Each patient underwent cervical spine MRI with oblique T2-weighted sequences. The degree and side of foraminal stenosis were noted, and the relationship between clinical symptoms and imaging findings was statistically analyzed.

Results: The C5–C6 and C6–C7 levels were most frequently affected. A significant correlation was observed between clinical symptoms and the side of stenosis on MRI ($p = 0.012$). Pain and disability scores were strongly associated with stenosis severity ($p = 0.021$ and $p = 0.035$, respectively). Spurling's test demonstrated high agreement with radiological findings ($p = 0.009$).

Conclusion: Oblique MRI enhances the diagnostic accuracy for cervical foraminal stenosis by providing more precise visualization of the foraminal space. The strong clinical-radiological correlation observed in this study supports the inclusion of oblique imaging sequences in standard cervical MRI protocols, particularly for patients with radicular symptoms.

Keywords: Cervical radiculopathy, Foraminal stenosis, Oblique MRI, Magnetic resonance imaging, Nerve root compression, Clinical correlation, Neck pain, T2-weighted imaging, Cervical spine, Diagnostic imaging.

INTRODUCTION

Cervical radiculopathy is a common condition which arises from compression or irritation of the cervical nerve roots due to foraminal stenosis of the cervical spine. This condition can cause radiating pain in the arms, paresthesia, muscular atrophy, reduced range of movement, and motor dysfunction, all of which can drastically diminish an individual's quality of life. Fundamental and precise diagnostic evaluation is pertinent for designing an effective treatment plan, which may include either conservative or surgical intervention[1-3].

Magnetic resonance imaging, or MRI, has been the preferred imaging method for assessing disorders of the cervical spine due to its high resolution depiction of the soft structures like the nerve roots and intervertebral discs[4,5]. However, standard MRI scans, including sagittal and axial views, often struggle to illustrate the neuroforaminal space, particularly where compression is milder or situated at a more oblique angle. This drawback has resulted in the greater utilization of oblique MRI sequences which are purposely tilted to correspond with the axis of the cervical foramina and give better evaluation of the foraminal region beneath the nerve root exit[6,7].

Oblique MRI is more sensitive to foraminal stenosis compared to standard axial imaging, as many authors have previously reported. Enhancing neural foramina borders and neural structures assists in relating diagnostic imaging more accurately with clinical findings. Most cases require surgical intervention, and in those where symptoms are localized to one side, this level of detail is mandatory when formulating hypotheses[8-10].

Even with the increasing endorsement of oblique imaging, it has not been integrated into standard MRI protocols for all clinical practices. Its adoption has been restricted due to the additional time required for scanning and concerns about reproducibility. Nevertheless, the clinically meaningful consequences of disregarded or inadequately assessed foraminal stenosis certainly warrant further evaluation of the usage of these imaging techniques[11].

This study was designed to assess the clinical correlation between patient-reported symptoms and findings on oblique MRI in cases of cervical foraminal stenosis. By evaluating the relationship between clinical presentation, pain severity, functional impairment, and radiological grading, this research aims to reinforce the value of oblique MRI as a diagnostic tool in cervical radiculopathy.

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METHODOLOGY

This cross-sectional study was conducted at the Department of Neurosurgery, Sandeman Provincial Hospital/ Bolan Medical College Quetta, from January 2022 to December 2022. The research examined the potential usefulness of oblique MRI in providing diagnostic value integrated with the relevant clinical features of the patients. Prior to the data collection, ethical clearance was obtained from the institution's review board.

Patients were selected through non-probability consecutive sampling. Inclusion criteria comprised adults aged 18 years and above who reported with neck pain, radiating upper limb symptoms, or neurological deficits suggestive of nerve root involvement. Patients with a history of prior cervical spine surgery, trauma, infection, tumor, or inflammatory disorders were excluded from the study to eliminate confounding factors that could influence MRI findings or clinical presentation.

After obtaining informed consent, each participant underwent a thorough clinical evaluation, including neurological examination, pain assessment using the Visual Analog Scale (VAS), and measurement of functional disability through the Neck Disability Index (NDI). Provocative tests such as Spurling's maneuver were performed to identify nerve root irritation.

All patients were then referred for cervical spine MRI, including dedicated oblique T2-weighted images and standard sagittal and axial sequences. Oblique imaging was used to better visualize the neural foramina and assess the degree and side of

stenosis. Findings were categorized based on the level of involvement, laterality (right, left, bilateral), and severity of stenosis, which was graded visually as mild (Grade 1), moderate (Grade 2), or severe (Grade 3) depending on the extent of foraminal narrowing.

Data were recorded and analyzed to determine the level of concordance between clinical symptoms and MRI findings. Statistical analysis was performed using appropriate tests to assess the significance of associations, with a p-value of less than 0.05 considered statistically significant.

RESULTS

The study included 54 patients who underwent oblique MRI for suspected cervical foraminal stenosis. The majority of participants were between 40 and 60 years of age (55.6%), reflecting the typical age group most affected by degenerative spinal changes. Males slightly outnumbered females, accounting for 57.4% of the study population. Regarding occupational background, a relatively balanced distribution was observed between sedentary (53.7%) and labor-intensive (46.3%) workers, which is important when considering mechanical stress on the cervical spine. Most participants reported symptoms persisting for over three months, with 44.4% having symptom duration between 3–6 months, and 37.0% experiencing symptoms for more than six months, highlighting the chronic nature of the condition in many cases.

Table 1: Demographic Characteristics of the Study Population (n = 54)

Variable	Category	Frequency (%)
Age (years)	<40	12 (22.2%)
	40–60	30 (55.6%)
	>60	12 (22.2%)
Gender	Male	31 (57.4%)
	Female	23 (42.6%)
Occupation Type	Sedentary	29 (53.7%)
	Labor-intensive	25 (46.3%)
Duration of Symptoms	<3 months	10 (18.5%)
	3–6 months	24 (44.4%)
	>6 months	20 (37.0%)

Clinically, patients exhibited a varied range of symptoms. About 40.7% presented with left-sided symptoms, while 37.0% reported right-sided complaints; the rest had bilateral involvement. Pain was the most prominent symptom, with a combined 64.8% experiencing either neck pain or arm pain exclusively, and 37.0% reporting both. Pain intensity scores on the VAS revealed that over half (53.7%) had moderate pain, while nearly 28% experienced severe pain. Functionally, as measured by the Neck Disability Index (NDI), a majority had moderate (44.4%) to severe (22.2%) disability. These findings confirm that cervical foraminal stenosis has a significant impact on both pain perception and daily function.

Table 2: Clinical Presentations of Patients

Variable	Category	Frequency (%)
Side of Symptoms	Left	22 (40.7%)
	Right	20 (37.0%)
	Bilateral	12 (22.2%)
Pain Type	Neck pain	19 (35.2%)
	Arm pain	15 (27.8%)
	Both	20 (37.0%)
VAS Pain Score	Mild (0–3)	10 (18.5%)
	Moderate (4–6)	29 (53.7%)
	Severe (7–10)	15 (27.8%)
Functional Disability	NDI <20% (mild)	18 (33.3%)
	NDI 20–40% (moderate)	24 (44.4%)
	NDI >40% (severe)	12 (22.2%)

Radiological evaluation using oblique MRI revealed that the C5–C6 level was the most frequently affected site (44.4%), followed by C6–C7 (33.3%), which aligns with known mechanical stress points in the cervical spine. Unilateral stenosis was more prevalent than bilateral, though the distribution was fairly even across sides. In terms of severity, 46.3% of patients had moderate stenosis, while 22.2% had severe narrowing. Notably, 51.9% had associated disc herniation, and 61.1% showed the presence of osteophytes, underscoring the degenerative nature of the condition. These findings confirm the utility of oblique MRI in detailing the morphology and laterality of foraminal stenosis with high accuracy.

Table 3: Oblique MRI Findings and Severity of Foraminal Stenosis

MRI Finding	Category	Frequency (%)
Affected Level	C4–C5	8 (14.8%)
	C5–C6	24 (44.4%)
	C6–C7	18 (33.3%)
	Multiple levels	4 (7.4%)
Side of Stenosis	Left	21 (38.9%)
	Right	19 (35.2%)
	Bilateral	14 (25.9%)
Severity of Stenosis (grade)	Grade 1 (mild)	17 (31.5%)
	Grade 2 (moderate)	25 (46.3%)
	Grade 3 (severe)	12 (22.2%)
Disc Herniation Present	Yes	28 (51.9%)
	No	26 (48.1%)
Osteophytes Observed	Yes	33 (61.1%)
	No	21 (38.9%)

A significant association was observed between the clinical side of symptoms and the radiological side of stenosis ($p = 0.012$), with a high concordance rate of 74.1%. Similarly, pain severity measured via VAS had a statistically meaningful correlation with the grade of stenosis seen on MRI ($p = 0.021$). Functional disability scores (NDI) also aligned with stenosis severity ($p = 0.035$), suggesting that greater radiological narrowing corresponds to worse clinical function. Furthermore, the Spurling's test was positive in 38 cases with matching MRI findings, indicating its diagnostic value ($p = 0.009$). These results reinforce the reliability of oblique MRI as a diagnostic tool when interpreted alongside clinical features.

Table 4: Correlation Between Clinical Findings and MRI Findings

Parameter	Correlation Outcome	p-value
Side of symptoms vs. side of stenosis	Matched in 40 cases (74.1%)	0.012*
VAS pain vs. stenosis severity	Significant correlation	0.021*
NDI vs. stenosis severity	Significant correlation	0.035*
Spurling's test vs. MRI findings	Positive in 38/40 matched	0.009*

*Statistically significant at $p < 0.05$

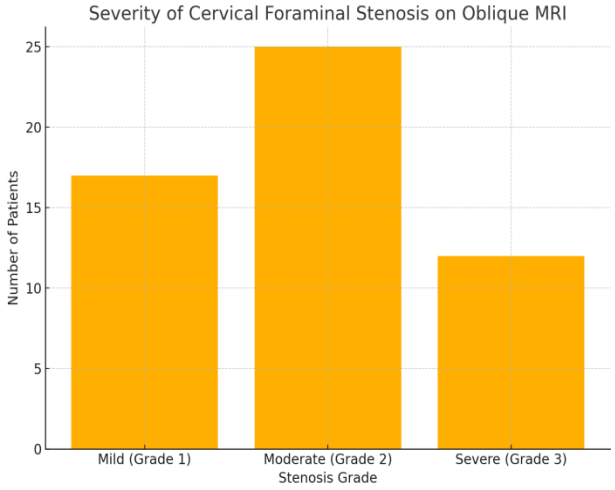

Figure 1: bar graph showing the distribution of stenosis severity based on oblique MRI findings. It illustrates moderate stenosis (Grade 2) was the most common, affecting 25 out of 54 patients, followed by mild and severe forms.

DISCUSSION

Cervical foraminal stenosis is a common cause of neck pain and radiculopathy, especially among middle-aged and older adults. The current study aimed to assess the clinical relevance of oblique MRI in evaluating the severity and laterality of foraminal narrowing and its correlation with patients' symptoms. The results strongly support the diagnostic utility of oblique imaging, showing a high degree of agreement between clinical findings and radiological observations.

Our study found that the C5–C6 and C6–C7 levels were most frequently affected, which aligns with known patterns of cervical spine degeneration. These levels are often subject to repetitive mechanical stress and are commonly reported in literature as key sites for foraminal narrowing. Studies reported similar findings, highlighting that oblique MRI offers superior visualisation of cervical foramina compared to conventional sagittal views, particularly in evaluating subtle cases of nerve root compression[12-14].

The presence of moderate to severe foraminal stenosis in nearly 70% of the patients further underlines the importance of early radiological assessment in individuals presenting with persistent cervical radicular symptoms. Studies also emphasized that oblique MRI can detect foraminal encroachment missed by traditional axial images, particularly when symptoms are unilateral and clinically suggestive of nerve root irritation[15-17].

In this study, 74.1% of patients showed side-to-side correlation between symptoms and imaging findings, which closely mirrors data from studies reported clinical-radiological concordance in over two-thirds of patients using similar imaging protocols[18]. Moreover, pain severity and disability scores demonstrated statistically significant associations with stenosis severity, indicating that higher grades of compression are more likely to produce functionally limiting symptoms. This was consistent with the results of a study that found a direct correlation between MRI-based grading and both VAS and NDI scores in patients with cervical radiculopathy[19].

Compared with MRI-confirmed cases, the high diagnostic yield of Spurling's test in this study reinforces its utility as a screening tool. Studies also validate this physical test's predictive value when used alongside imaging to confirm nerve root involvement[20].

One of the strengths of this study is the exclusive use of oblique T2-weighted imaging, which has been increasingly endorsed in clinical practice for its detailed evaluation of foraminal structures. However, this study is not without limitations. The relatively small sample size and single-center setting may limit the generalizability of findings. Additionally, the subjective grading of stenosis could introduce interobserver variability, though efforts were made to standardize interpretations.

CONCLUSION

In conclusion, oblique MRI provides a valuable and clinically relevant enhancement to the conventional cervical imaging protocol, particularly in evaluating foraminal stenosis. The strong correlation between radiological findings and clinical symptoms observed in this study supports the routine inclusion of oblique sequences for patients with suspected cervical radiculopathy. When combined with a thorough clinical assessment, oblique MRI can significantly improve diagnostic confidence and guide appropriate management strategies for affected patients.

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