

The Influence of MRI Features on Surgical Decision-Making in Degenerative Cervical Myelopathy: Results From a Global Survey of AOSpine International Members

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Introduction

Degenerative Cervical Myelopathy (DCM) encompasses a spectrum of age-related pathologies of the cervical spine that result in spinal cord impairment. We conducted a survey to understand how specific pathologic features on MRI influence surgeons toward an anterior or posterior surgical approach.

Methods

A questionnaire was sent out to 6,179
AOSpine International members via email with 2 subsequent reminders. This included 18 questions on a 7-point Likert scale regarding how MRI features influence the respondent's decision to perform an anterior or posterior surgical approach. Influence was classified based on the mean and mode. Variations in responses were assessed by region and training.

Results

There were 513 respondents: 51.7% were orthopedic surgeons, 36.8% neurosurgeons and the remainder classified as fellows, residents or "other". In ascending order, multilevel bulging discs, cervical kyphosis and a high degree of anterior cord compression had a moderate to strong influence toward an anterior approach. A high degree of posterior cord compression had a strong-moderate influence, while multilevel compression, OPLL, ligamentum flavum enlargement, and congenital stenosis had a moderate influence toward a posterior approach.

Results Cont.

Differences in the degree of influence were noted between regions and training for 15 and 6 out of 18 MRI factors (p<0.05), respectively. Neurosurgeons chose anterior approaches more and posterior approaches less, in comparison to orthopedic surgeons (p<0.01). Of note, 59.8% of respondents were equally comfortable performing multilevel (=3 levels) anterior and posterior procedures, while 61.5% did not feel comfortable in determining the surgical approach based MRI alone.

| Training Level o | ponaona |
|---|--------------------------------------|
| Type of Training | Frequency (number of respondents) |
| Resident | 2.9% (n=15) |
| Fellow, Spine Surgery | 6.2% (n=32) |
| Fellow, Other discipline | 0.2% (n=1) |
| Neurosurgeon | 19.1% (n=98) |
| Neurosurgeon, fellowship trained in spine | 17.7% (n=91) |
| Orthopedic Surgeon | 10.1% (n=52) |
| Orthopedic Surgeon, fellowship trained in spine | 41.5% (n=213) |
| Other | 2.1% (n=11) |
| Total | 513 |

| Assessment of \ | /ariation by | Region an | | | | | | | |
|--|---|--|--|--|--|--|--|--|--|
| Training | | | | | | | | | |
| Please respond as to how the following factors (in isolation), as seen on MRI, influence your surgical decision toward anterior or posterior surgery? | Region | Training, Neurosurgeon (NS) vs. Orthopedic Surgeon (OS) | | | | | | | |
| High degree of anterior compression (e.g. large bulging disc). | Group - P=0.001 | P=0.076 | | | | | | | |
| | EU vs. Asia p=0.001; SA vs. Asia p=0.016 | NS - Mean Rank = 217.23 | | | | | | | |
| | Asia was less influenced toward an anterior approach. | (n=189); OS - Mean Rank = 233.99 (n=264) | | | | | | | |
| 2. High degree of posterior cord compression (e.g. ligamentum flavum inbuckling). | Group - P<0.001 | P=0.162 | | | | | | | |
| | NA vs. Asia p=0.005; SA vs. Asia p=0.021; EU vs. Asia p=0.001 | (n=187); OS - Mean Rank = | | | | | | | |
| | Asia was more strongly influenced toward a posterior approach | 232.64 (n=264) | | | | | | | |
| 3. Greater number of vertebral levels with cord compression. | Group - P<0.001 | P=0.007 | | | | | | | |
| | EU vs. SA p=0.001; EU vs. Asia p=0.001 | NS - Mean Rank = 207.45 | | | | | | | |
| | Europe was less strongly influenced toward a posterior approach | (n=188); OS - Mean Rank = 239.26 (n=263) | | | | | | | |
| 4. Greater number of bulging discs that are not causing cord compression (i.e. cord is only compressed at 1 level but discs show degeneration at other levels). | Group - P=0.008 | P=0.099 | | | | | | | |
| | SA vs. NA p=0.017; SA vs. Asia p=0.035 South America was more strongly | NS - Mean Rank = 213.93 (n=187); OS - Mean Rank = 233.73 (n=263) | | | | | | | |

NA vs. SA p=0.018; NA vs. EU p=0.01; NA NS - Mean Rank = 211.17
vs. Asia n=0.027 (n=186); OS - Mean Rank =

Results from the Likert Scale questions. Modes are bolded. Overall influence was classified based on both the mode and mean.

| 0 11 70 1 1 | Anterior Approach | | | Posterior Approach | | | Mean | Overall | |
|--|---------------------------|------------------|-----------------|--------------------|----------------|------------------|----------------|-----------------|---------------------------------|
| Question - Please respond as to how the following factors (in isolation), as seen on MRI, influence your surgical decision toward anterior or | | | | *** | | | (m) | Influence | |
| | Strong (+3) | Moderate (+2) | Weak (+1) | Neither (0) | Weak (-1) | Moderate (-2) | Strong (-3) | | |
| posterior surgery? | Anterior approach favored | | | | | | | | |
| High degree of anterior compression (e.g. large bulging disc). | 74.1% (n=380) | 19.7% (n=101) | 3.9% (n=20) | 1.8% (n=9) | 0% (n=0) | 0.4% (n=2) | 0% (n=0) | 2.65 (n=512) | Strong Anterior |
| 9. Presence of cervical kyphosis on MRI (Interpreted as extent of kyphosis in a neutral to extended neck position) | 40.6% (n=207) | 33.7% (n=172) | 7.1% (n=36) | 5.1% (n=26) | 2.9% (n=15) | 7.5% (n=38) | 3.1% (n=16) | 1.69 (n=510) | Strong- Moderate Anterior |
| 4. Greater number of bulging discs that are not causing cord compression (i.e. cord is only compressed at 1 level but discs show degeneration at other levels). | 30.3% (n=154) | 31.6% (n=161) | 9.0% (n=46) | 17.7% (n=90) | 3.3% (n=17) | 5.9% (n=30) | 2.2% (n=11) | 1.41 (n=509) | Moderate Anterior |
| 18. Presence of Spondylolisthesis (Defined as ≥3mm displacement) | 21.6% (n=110) | 32.0% (n=163) | 11.6% (n=59) | 15.3% (n=78) | 5.1% (n=26) | 10.2% (n=52) | 4.1% (n=21) | 1.03 (n=509) | Moderate- weak Anterior |
| 5. MRI suggestive of focal ossification of the posterior longitudinal ligament (affecting one segment) | 21.9% (n=111) | 27.0% (n=137) | 7.3% (n=37) | 7.3% (n=37) | 8.3% (n=42) | 18.5% (n=94) | 9.7% (n=49) | 0.53 (n=507) | Moderate- weak Anterior |
| 8. Presence of cord compression due to retrovertrebral disease (mid- | 23.2% (n=117) | 25.8% (n=130) | 8.5% (n=43) | 11.5% (n=58) | 5.6% (n=28) | 17.5% (n=88) | 7.9% (n=40) | 0.65 (n=504) | Moderate- weak Anterior |

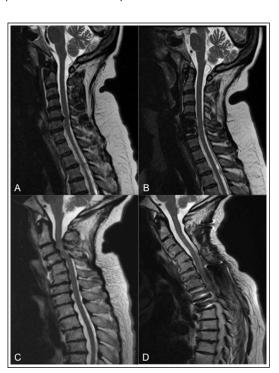
Selected additional comments by respondents in response to "Do you have any suggestions for other ways in which you use MRI to decide on anterior versus posterior surgery for Degenerative Cervical Myelopathy?".

Selected comments provided for

specific

Q - Do you have any suggestions for other ways in which you use MRI to decide on anterior versus posterior surgery for Degenerative Cervical Myelopathy? Collated from multiple Dynamic (flexion/extension) MRI should be considered in the work up of patients to assess movement dependent cord Collated from multiple Standing and/or flexion radiographs, and/or CT with or without contrast should complement MRI in decision-making Collated from multiple MRI is useful for assessing the course and location of the vertebral Collated from multiple MRI measurement of the modified K-line is useful for asse of sagittal alignmen $\label{lem:condition} Advanced \ MRI \ techniques \ (functional, \ diffusion \ tensor, perfusion)$ can be used in surgical decision-making. Collated from multiple Specific Comment Clinical risk factors for non-union such as smoking and diabetes may sway me to consider a posterior approach. Specific Comment For patients likely needing a combined approach, I favour an anterior approach initially with followed up. If there is progre or lack of improvement I then add a posterior approach Alignment assessment for MRI should be standardized as so taken with pillows, making alignment assessment difficult. Specific Commen Specific Comment Circumferential compression on MRI should be approached Measurement of disc height at the site of pathology in comparison to disc height at other sites. Level of and area of T2 signal change could be assessed. Q. High degree of anterio npression (e.g. large bulging disc) Collated from multiple If the compression is very large, a posterior approach done first and followed by an anterior approach is sometimes done. O. Greater number of vertebral levels with cord compression Collated from multiple Most respondents commented that >3 levels should be approached posteriorly Q. Greater number of bulging discs that are not causing cord compression (i.e. cord is only compressed at 1 level but discs show degeneration at other levels)

Figure 1. Two patients with preoperative and postoperative sagittal T2 weighted MRIs and clinically confirmed DCM are presented. A)
Patient 1 presents with spinal cord compression by the C5-6 disc. B) A 6-months post-operative MRI of patient 1 showing that the patient was treated with an anterior discectomy and plate at C5-6. C) Patient 2 presents with multilevel spinal cord compression with the origin of stenosis coming from both the anterior and posterior in the upper and middle cervical spine. D) A 24-months post-operative MRI of patient 2 showing that the patient was treated with multilevel posterior laminectomy and fusion from C2-T3.



Conclusions

Specific DCM pathology influences the choice for an anterior or posterior surgical approach, and these factors vary based on training and region of practice. These findings will be helpful in defining future areas of investigation in an effort to provide individualized surgical strategies and optimize patient outcomes.