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ORIGINAL ARTICLE

Regional and experiential differences in surgeon preference for the treatment of cervical facet injuries: a case study survey with the AO Spine Cervical Classification Validation Group

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Abstract

Purpose The management of cervical facet dislocation injuries remains controversial. The main purpose of this investigation was to identify whether a surgeon's geographic location or years in practice influences their preferred management of traumatic cervical facet dislocation injuries.

Methods A survey was sent to 272 AO Spine members across all geographic regions and with a variety of practice experience. The survey included clinical case scenarios of cervical facet dislocation injuries and asked responders to select preferences among various diagnostic and management options.

Results A total of 189 complete responses were received. Over 50% of responding surgeons in each region elected to initiate management of cervical facet dislocation injuries with an MRI, with 6 case exceptions. Overall, there was considerable agreement between American and European responders regarding management of these injuries, with only 3 cases exhibiting a significant difference. Additionally, results also exhibited considerable management agreement between those with ≤ 10 and > 10 years of practice experience, with only 2 case exceptions noted.

Conclusion More than half of responders, regardless of geographical location or practice experience, identified MRI as a screening imaging modality when managing cervical facet dislocation injuries, regardless of the status of the spinal cord and prior to any additional intervention. Additionally, a majority of surgeons would elect an anterior approach for the surgical management of these injuries. The study found overall agreement in management preferences of cervical facet dislocation injuries around the globe.

Keywords Cervical spine · Trauma · Spinal injuries · Joint dislocations · Neck injuries · Spinal diseases

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Introduction

The reported incidence of cervical spine injuries after blunt trauma is approximately 3% [1–3], and the subaxial region is affected in over half of these injuries, particularly between C5 and C7 [1, 2, 4–6]. The spectrum of cervical spine facet injury ranges from unilateral facet dislocations to significantly displaced bilateral facet fracture dislocations, and the degree of neurologic injury is dependent on the amount of energy transmitted to the vertebral column during the traumatic event [4].

To date, the management of cervical facet dislocations [jumped facets(s)] and associated injuries remains controversial. There is persistent debate among surgeons regarding imaging modalities, the appropriateness of non-operative management, as well as surgical approach [4, 7–9]. The use of computed tomography (CT) as the initial imaging choice for cervical trauma evaluation is widely accepted. However, there is disagreement surrounding the utility of triage magnetic resonance imaging (MRI) for evaluating potential disc herniations and neurologic deficits [7]. Some authors suggest that incongruent findings on CT and MRI are typically unsubstantial and unlikely to change management for cervical trauma [10]. On the other hand, other experts have noted up to an 8% change in management of cervical trauma cases after MRI and espouse the adaptation of MRI as a triage tool [11]. Additionally, the decision between non-operative and surgical management is contentious, given the severe neurologic consequences associated with improper or delayed treatment [9, 12, 13]. Generally, stable and minimally displaced injuries without associated neurologic deficits are managed conservatively [4]; however, various studies have noted treatment failure to occur more commonly with non-operative management [8, 9]. Lastly, there is no consensus as to the best approach to the cervical spine for treating facet injuries. Anterior, posterior and combined approaches all carry unique advantages and disadvantages and can be particular to unique clinical scenarios [4, 13–15].

Expectedly, there exist significant differences in management preferences based on geographic location and surgical expertise. In 2008, Nassr and colleagues performed a retrospective survey study exploring preferences on surgical approach for traumatic cervical facet dislocations [7]. Their study noted low consensus in surgical approach among participants secondary to differences in training and case experience. Additionally, Grauer et al. in 2004 examined the variability in spinal trauma treatment preferences among a cohort of orthopedic and neurosurgical spine surgeons relative to geography and professional experience [16]. The authors noted that although similarities do exist, a surgeon's location and degree of experience do affect treatment preferences. The purpose of this investigation was to identify whether a surgeon's geography or years in practice influences management of traumatic unilateral or bilateral cervical facet dislocation injuries.

Methods

Data collection

A 25-question survey (Online Appendix 1) of surgeon demographics and clinical case vignettes was sent to the members of the AO Spine Cervical Classification Validation Group. The group is composed of spine surgeons located in six different geographic regions (Africa, Asia, Europe, Latin/South America, the Middle East and North America). The survey included clinical case vignettes (scenarios) of various cervical facet dislocation injuries and asked responders to select preferences among several diagnostic and management options. Only questionnaires with at least one valid answer, in addition to the demographic information, were included in the final analysis. Note years of practice experience was collected as < 5 years, 5–10 years, 11–20 years, 20+ years.

Statistical analysis

A descriptive statistical analysis was performed for categorical and continuous data. For categorical data, frequencies were calculated based on the number of non-missing replies. Continuous data were analyzed using the following descriptive statistics: median and interquartile range (IQR). Regional variations were compared between surgeons from Europe and the Americas (combined responses between North and Latin/South America) and variations in experience by regrouped years of surgeon experience (≤ 10 years, > 10 years). Differences in the treatment algorithm were analyzed by Chi-square test or Fisher's exact test. Differences for the variable reduction threshold weight within groups were tested with a Student's t test. The significance level was defined at $\alpha = 0.05$. All analysis was performed using the statistical software SAS version 9.4 (SAS Institute Inc., Cary, NC, USA).

Results

A total of 189 out of 272 members responded with complete clinical vignette surveys. Demographic characteristics of responders are summarized in Table 1.

Table 1 Demographic information of participating surgeons

Demographic	*N* (%); median (IQR)
Subspecialty	
Orthopedic surgery	131 (69.3)
Neurosurgery	58 (30.7)
World region	
Africa	12 (6.3)
Asia	34 (18.0)
Europe	70 (37.0)
Latin/South America	40 (21.2)
Middle east	15 (7.9)
North America	18 (9.5)
Years in practice	
< 5	50 (26.5)
5–10	61 (32.3)
11–20	50 (26.5)
> 20	28 (14.8)
Work setting	
Academic	78 (41.3)
Hospital	88 (46.6)
Private practice	23 (12.2)
Number of spine trauma patients treated per year	50.0 [20.0, 100.0]
Time to obtain an MRI at home institution	
< 2 h	52 (27.5)
2–12 h	62 (32.8)
12–24 h	28 (14.8)
> 24 h	42 (22.2)
Cannot obtain	5 (2.6)

Regional variations

Remarkably, 50% or more of surgeons in each region would initiate management of cervical facet dislocation injuries with a cervical spine MRI. Only the African survey responders noted other management options as relevant choices in 5 out of 6 exception cases, making initial MRI screening a sub-50% response. In the remaining exception, Middle Eastern responders split their top management option between MRI and closed reduction in an awake/alert patient (both 35.7%) when there was a unilateral jumped facet complicated by a complete spinal cord injury. For initial management clinical cases, a comparison between European and American (combined North and Latin/South America) responders only showed a statistically significant difference in three scenarios (Table 2). In the case of a patient with imaging evidence of a unilateral jumped facet with 25% translation of C5 on C6 without associated symptoms, 74.1% of American surgeons would initiate management with a cervical spine MRI prior to intervention, whereas only 57.1% of European surgeons would do so ($p < 0.04$). In addition, for a case of a unilateral jumped facet with incomplete spinal cord injury, with imaging demonstrating 25% translation of C5 on C6, 72.9% of European surgeons would initiate management with an MRI, compared to 55.2% of American surgeons ($p < 0.01$). Finally, for a case of a unilateral jumped facet with a complete spinal cord injury, 71.4% of European responders would initiate with an MRI, whereas only 60.3% of American surgeons would pursue imaging first ($p < 0.04$). A summary of overall and regional variations in initial management by surgeon preferences across geographic regions is provided in Supplementary Table 1.

Overall, surgeons that chose operative management were more likely to intervene with an anterior cervical discectomy and fusion (ACDF) for either bilateral (43.3%) or unilateral (46.0%) jumped facets status post-reduction. There was some variation, however, when deciding between non-operative versus operative management. While nearly all the North American surgeons chose operative management for unilateral injuries, all other regions had a relatively greater proportion of responders electing non-operative management. In fact, 58.3% of African responders identified a hard cervical collar as the preferred treatment modality for unilateral cases. There was far greater agreement for bilateral jumped facets as over 80% opted for surgical intervention. Of note, in all regions except Africa, neuromonitoring changes and significant patient discomfort were the most common reasons to abort a closed reduction of a C5/6 bilateral jumped facet without any changes in physical examination. African surgeons noticeably considered a reduction weight threshold as a reason to abort the procedure. The median weight threshold for aborting a closed reduction in this instance was 16 [10.0;24.5] kg overall, with a regional variation from 14 kg (Asia) to 28.5 kg (North America). No statistically significant difference in surgical management preferences by region and threshold weight for aborting a closed reduction was noted between surgeons in Europe and the Americas. A summary of surgical management preferences by region is provided in Supplementary Table 2.

Experiential variations

As expected, a majority (50% or more) of surgeons regardless of practice experience would initiate management of cervical facet dislocation injuries with a cervical spine MRI. The two exceptions were in the cases of bilateral jumped facets with 50% translation of C5 on C6 with incomplete and complete spinal cord injury, where only 47.5% (incomplete) and 49.2% (complete) of responders in the 5–10-year experience range would initiate with an MRI. For initial management clinical cases, a comparison between surgeons with ≤ 10 years of experience and those with > 10 years of experience only showed a statistically significant difference in one scenario (Table 2). In the case of an obtunded

Table 2 Significantly different scenarios in management by region and experience

	America (58)	Europe (70)	America versus Europe *p* value
CT of the cervical spine demonstrates a unilateral jumped facet with 25% translation of C5 on C6, *n* (%)			
Obtain a cervical spine MRI prior to any intervention	43 (74.1)	40 (57.1)	0.04
Perform a closed reduction outside of the operating room in the awake alert patient	10 (17.2)	13 (18.6)	
Perform an open posterior reduction and fusion without monitoring	0 (0.0)	6 (8.6)	
Perform an open anterior reduction and fusion without monitoring	4 (6.9)	8 (11.4)	
Perform an open posterior reduction and fusion with monitoring	0 (0.0)	3 (4.3)	
Perform an open anterior reduction and fusion with monitoring	1 (1.7)	0 (0.0)	
Unilateral jumped facet with incomplete spinal cord injury. Plain films and CT of the cervical spine demonstrate a unilateral jumped facet with 25% translation of C5 on C6, *n* (%)			
Obtain a cervical spine MRI prior to any intervention	32 (55.2)	51 (72.9)	0.01
Perform a closed reduction outside of the operating room in the awake alert patient	16 (27.6)	5 (7.1)	
Perform an open posterior reduction and fusion without monitoring	2 (3.4)	3 (4.3)	
Perform an open anterior reduction and fusion without monitoring	5 (8.6)	6 (8.6)	
Perform an open posterior reduction and fusion with monitoring	0 (0.0)	4 (5.7)	
Perform an open anterior reduction and fusion with monitoring	3 (5.2)	1 (1.4)	
Unilateral jumped facet with complete spinal cord injury, *n* (%)			
Obtain a cervical spine MRI prior to any intervention	35 (60.3)	50 (71.4)	0.04
Perform a closed reduction outside of the operating room in the awake alert patient	11 (19.0)	6 (8.6)	
Perform an open posterior reduction and fusion without monitoring	1 (1.7)	4 (5.7)	
Perform an open anterior reduction and fusion without monitoring	9 (15.5)	6 (8.6)	
Perform an open posterior reduction and fusion with monitoring	0 (0.0)	4 (5.7)	
Perform an open anterior reduction and fusion with monitoring	2 (3.4)	0 (0.0)	
	≤ 10 years (111)	> 10 years (78)	≤ 10 versus > 10 years *p* value
Plain films and CT of the cervical spine demonstrate bilateral jumped facets with 50% translation of C5 on C6 in an obtunded patient without possible examination, n (%)			
Obtain a cervical spine MRI prior to any intervention	79 (71.2)	63 (80.8)	0.05
Perform a closed reduction outside of the operating room in the awake alert patient	10 (9.0)	3 (3.8)	
Perform an open posterior reduction and fusion without monitoring	9 (8.1)	1 (1.3)	
Perform an open anterior reduction and fusion without monitoring	6 (5.4)	2 (2.6)	
Perform an open posterior reduction and fusion with monitoring	3 (2.7)	1 (1.3)	
Perform an open anterior reduction and fusion with monitoring	4 (3.6)	8 (10.3)	

patient with imaging evidence of a bilateral jumped facet injury with 50% translation of C5 on C6, 80.8% of surgeons with > 10 years of experience would initiate with an MRI prior to any intervention, compared to 71.2% of surgeons with ≤ 10 years of experience (*p*: 0.05). A summary of variations in initial management by surgeon preferences across practice experience is provided in Supplementary Table 3.

When deciding to abort a closed reduction of jumped facets, nearly all age brackets indicated that neuromonitoring changes and significant patient discomfort would alter management. Older surgeons (> 20 years of practice experience), however, identified a reduction weight threshold and patient discomfort as reasons to abort, in lieu of neuromonitoring changes. Finally, there was a statistically significant difference ($p < 0.01$) noted in the weight threshold for aborting a closed reduction by surgeon years of experience, with younger surgeons reaching weights of 19 [11.3;28.5] kg (< 5 years) and 20 [10.0;30.0] kg (5–10 years) compared to surgeons with > 10 years of experience, who did not reach a weight greater than 16.5 [10.0;20.0] kg. No statistically significant differences in surgical management preferences were noted between those with more or less than 10 years of practice experience; a summary is provided in Supplementary Table 4.

Discussion

Globally, there are significant differences in preferences for managing traumatic spine injuries among surgeons [17, 18]. Because of the gravity and negative functional consequences of these injuries, there is a strong interest in developing universal management guidelines [12]. The current study provides an updated view of preferred cervical facet dislocation injury management practices around the world focusing on surgeon location and practice experience.

Regional variations

CT with coronal and sagittal reconstructions is widely accepted as the initial imaging modality for the evaluation of cervical spine trauma, given its widespread availability, and excellent sensitivity (99%) and specificity (100%) [18]. However, the addition of MRI as a triage study is still debated [4, 18]. Our study suggests that the use of a screening MRI has also been adopted by most practicing spine surgeons around the world for cervical facet dislocations. This finding is noteworthy, as historically the decision to obtain an MRI for cases of cervical spine trauma has been controversial [4, 7, 19–21]. A recent study by Malhotra et al. noted that given a negative CT study after cervical spine trauma, the addition of a triage MRI detected only 11 out of 712 patients with a missed unstable injury, leading to only 3 changes in management [22]. In our study, a notable exception to this trend was seen among surgeons practicing in the African region, where they were more likely to opt for definitive management over an MRI. This observation may be secondary to limited access to MRI equipment, as a recent survey by Karekezi and colleagues of 21 Sub-Saharan African neurosurgeons found 86% of respondents noted CT scanner accessibility, whereas only 38% noted having an MRI scanner available [23].

While there was appreciable agreement on the use of triage MRI, there were some variations regarding surgical approach, as expected. Previously, Nassr and colleagues reported little to no consensus among Spine Trauma Study Group members regarding the best treatment option for cervical facet dislocations as preferences varied according to the presence of disc herniation, neurologic status and laterality [7]. Interestingly, a recent study by Finger et al. found that preoperative MRI in addition to routine CT for cervical facet dislocations improved the consensus on the choice of surgical approach [20]. The authors observed that the combination of the two imaging modalities changed management in almost 60% of cases. Overall, our study did not find any statistically significant difference between European and American surgeons regarding definitive surgical management. The observation that most respondents selected ACDF when pursuing operative management of a cervical facet dislocation injury was expected, given recent and well-documented reports noting the viability of anterior-only approaches [4, 13, 24].

Experiential variations

Practice experience also showed variability in terms of preferred management options, albeit without any statistical significance. Our study suggests that, regardless of practice experience, obtaining a triage MRI is the choice in over 50% of providers treating cervical facet dislocation injuries. However, when spinal cord injuries were involved, this percentage dropped to under 50% in surgeons with 5–10 years of experience, signaling a persistent debate on the usefulness of an MRI prior to intervention in these scenarios. And though older providers were more inclined to obtain a triage MRI in bilateral jump facet cases compared to younger surgeons, this was an exception. Surgically, there was no difference noted in preferred treatment options, with most opting for an ACDF. Interestingly, a higher proportion of younger surgeons elected for more non-operative management options than older surgeons, albeit insignificantly.

These finding should be considered in light of a previous study by Grauer and colleagues comparing preferences for managing spinal trauma [16]. While the authors found no differences attributed to practice experience, they noted that neurosurgeons were more likely to obtain triage MRI compared to spine orthopedic surgeons, and those outside the USA were more likely to approach the cervical spine anteriorly [16]. Arnold et al. also observed that neurosurgeons were more likely than their orthopedic counterparts to obtain an MRI prior to intervention, regardless of the status of the cord [19]. However, these aforementioned findings may be outdated, as our study suggests a majority of spine surgeons throughout the world now opt for an anterior approach for cervical facet dislocation injury despite geographical location or subspecialty background.

Our study is not without limitations. First, the study design provides a small sample of surgeons with uneven numbers across geographical regions. Moreover, the regional variability in available equipment and resources may confound management preferences. Additionally, the report may be limited by the breadth of presented cases, as given the scope of the survey, more comprehensive questions were not possible. For example, the time elapsed from injury to treatment is not accounted for in these scenarios, which could affect the decision-making process. Finally, respondents were limited to those with academic affiliations; thus, these results may not be as generalizable in regions where community hospitals with fewer resources are more common.

Overall, the present study did find significant agreement when managing cervical facet dislocation injuries among spine surgeons around the globe. Most notably, more than half of responding spine surgeons would obtain a triage MRI in cases of cervical facet dislocation injuries prior to more invasive interventions, even in the setting of spinal cord injury. This finding was true across geographical regions (with few case exceptions), and across the breadth of practice experience. This is a remarkable observation, as historically, the use of triage MRI was contentious. Additionally, a majority of responders chose to approach these injuries anteriorly, regardless of geography or practice experience. Although this survey study was not designed to coalesce treatment recommendations, the findings do highlight practice trends among spine surgeons. The individual preferences reported here can help set the stage for future higher-level investigations for establishing guidelines for spine surgeons globally.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This clinician survey study was exempt from Institutional Review Board review.

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