Two-Nation Comparison of Classification and Treatment of Subaxial Cervical Spine Fractures: An Internet-Based Multicenter Study Among Spine Surgeons

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■ BACKGROUND: **To date, no evidence-based treatment algorithm is available for fractures of the subaxial spine. The aim of the present study was to assess and compare the management strategy for traumatic subaxial fractures among German and Dutch spine surgeons.**

■ METHODS: **In our web-based multicenter study, German and Dutch spine surgeons evaluated the computed tomography data of traumatic subaxial fractures (C3–C7). Supplementary case-specific information was provided. The fractures were classified using the AO spine classification. Next, 9 questions concerning the treatment algorithm were evaluated. Data were analyzed using SPSS. Statistical significance was defined as $P < 0.05$.**

■ RESULTS: **Ten surgeons (5/country) evaluated 31 cases (310 votes). The fractures were classified as AO type A in 37% (114 votes), type B in 50% (155 votes), and type C in 13% (41 votes). German spine surgeons had a lower threshold concerning the indication for surgical treatment (German, 94.2% vs. Netherlands, 58.1%; $P < 0.05$). A consensus was present for operative stabilization for type B and C injuries, but a discrepancy was found in the therapeutic algorithm for type A fractures. The most significant difference was seen in the treatment of type A2 and A3 fractures (surgery for type A2/A3 fracture: German, 92.9% vs. Netherlands, 5.3%; $P < 0.05$).**

■ CONCLUSION: **We found a consensus for the stabilization of AO type B and C fractures but country-specific differences in the treatment of type A fractures, especially for A2 and A3 fractures. Further evidence is necessary to ensure more consistent international treatment strategies.**

INTRODUCTION

The debate regarding the optimal treatment of subaxial cervical spine injuries is ongoing.[1,2] Specifically, international controversy regarding the use of surgical therapy has continued.[3] Several reasons for these conspicuous differences in spinal trauma care are possible; however, one major issue is that no consistent evidence has been reported regarding what constitutes the best treatment for these fractures. Compared with the variety of different fracture types, only a few studies with a high level of evidence have focused on the surgical treatment of traumatic subaxial spine injuries.[2,4-6] From the findings from these studies, no universally acknowledged treatment concept could be introduced.

In the case of nonoperative treatment of subaxial cervical spine fractures, external immobilizers (e.g., neck collars) have been frequently used. However, the level of evidence for this therapy has also been low.[7] Furthermore, controversy exists regarding the best surgical technique if an operation is indicated. Therefore, the optimal treatment of fractures in patients without a neurological deficit is still under debate, and the treatment choice is frequently determined by the individual experience of the surgeon in charge. In these fractures, surgical treatment not only aims to prevent neurological deficits, but also to maintain stability and cervical alignment, with preservation of mobility as much as possible. Many different radiological criteria for instability must be considered to define whether surgery is indicated

Key words
- AO spine classification
- International
- Interobserver
- Multicenter
- Spine trauma
- Subaxial cervical spine

Abbreviations and Acronyms
AO: Arbeitsgemeinschaft für Osteosynthesefragen
CT: Computed tomography
MRI: Magnetic resonance imaging

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(e.g., subluxation or fracture of a facet joint; translation in a sagittal direction [>3.5 mm]; endplate angulation [>15°]).[8]

In addition to these controversies, several studies have shown that the threshold concerning the indication for surgical treatment has country-specific differences.[3,9] Especially at border areas, differences in national treatment strategies could come into conflict. With the knowledge of this background, the aim of the present study was to assess and compare the different management strategies for subaxial cervical spine fractures in a binational setting between German and Dutch spine surgeons.

METHODS

The present Internet-based multicenter study was performed using an online survey. A consecutive case series of traumatic subaxial cervical spine fractures was presented. The radiographic data and associated case information and anonymized online questionnaires were uploaded. For sample planning, a precedent pilot study was conducted.

Participants

All participating spine surgeons were experienced surgeons from orthopedic, neurosurgical, or trauma departments. Each participant was well versed in the Arbeitsgemeinschaft für Osteosynthesefragen (AO) spine classification scheme and had received the original report on this classification system[10] 1 month before the beginning of the present study.

Development of the Website

The website (available at: www.umfrageonline.com) included computed tomography (CT) sequences of the fracture in 1-mm slices in all 3 reconstructions (axial, sagittal, and coronary). Additionally, specific case information (e.g., patient age, gender, neurological status, and injury mechanism) was provided.

Patient Inclusion Criteria

A case series of 31 consecutive patients with acute traumatic injuries of the subaxial cervical spine (C3–C7) from 2011 to 2016, evaluated at the University Hospital Aachen, was included by a committee of experts. The exclusion criteria were osteoporotic fractures, a history of malignity or infection (i.e., spondylodiscitis), and incomplete CT data sets. The treating surgeon did not participate in the present study.

Questionnaire

The first half of the survey focused on assessment of the fracture type. Using the AO spine subaxial cervical spine injury classification system, the surgeons were asked to estimate the cases regarding the greatest degree of the injury (e.g., A4, B2, C). The existence of neurological deficits and the presence of a modifier was assessed in adherence to the AO classification. Furthermore, binary collection of facet joint violations was performed. The second half of the survey consisted of 9 questions with a focus on the treatment of each case[9] (**Supplemental Table 1**).

Statistical Analysis

The anonymized data were processed using SPSS, version 21 (IBM Corp., Armonk, New York, USA). The data are presented as the mean ± standard deviation. Continuous variables were compared using the t test for normally distributed data and the Mann-Whitney U test otherwise. To determine the interobserver agreement, Cohen's κ and the percentage of agreement between the surgeons were used. In line with previous studies, the guidelines of Landis and Koch[11] were considered to categorize the κ values (0–0.2, slight reliability; 0.21–0.4, fair; 0.41–0.6, moderate; 0.61–0.8, substantial; and 0.81–1, almost perfect reliability). Interobserver agreement of the AO spine subaxial cervical spine injury classification system was calculated for the basic fracture level (A, B or C), fracture sublevels (e.g., A3), neurological status, and case-specific modifiers. Owing to the number of cases in the present study, the interobserver agreement of facet joint violations were summarized in each case to allow for a distinction between existing and nonexistent. Statistical significance was defined as $P < 0.05$.

RESULTS

Participants and Case Details

Ten board-certified spine surgeons (5 per country) from 4 trauma hospitals evaluated the data from 31 patients with fractures localized to the subaxial cervical spine. The average experience in spine surgery was 9.2 ± 3.6 years (Germany, 10.0 years; Netherlands, 8.4 years; P = NS).

The mean patient age at the injury was 53.9 ± 22.7 years. The fractures were localized in C3 in 12.9% (n = 4), C4 in 12.9% (n = 4), C5 in 16.1% (n = 5), C6 in 38.7% (n = 12), and C7 in 19.4% (n = 6).

Fracture Classification and Reliability

Regarding the fracture classification, 36.8% (114 votes) of all fractures were classified as AO type A fractures. Type B fractures were seen in 50.0% (155 votes) and type C lesions in 13.2% (41 votes; **Figure 1**). The AO subaxial cervical spine injury classification system showed the greatest agreement at the basic level (A, B, C; Germany, 75.5% [κ, 0.53]; Netherlands, 60.9% [κ, 0.36]; Germany/Netherlands, 62.5% [κ, 0.39]; **Table 1**). Considering the presence of facet joint injuries substantial agreement was found in both countries (κ value for facet joint injury: Germany, 0.78; Netherlands, 0.64; Germany/Netherlands, 0.7).

The interobserver reliability for individual neurological status and the case-specific modifiers were collected specifically according to the AO classification. The results showed moderate reliability regarding the neurological status (κ value for neurological deficit: Germany, 0.46; Netherlands, 0.44; Germany/Netherlands, 0.5). The reliability of the case-specific modifiers was identified as moderate to substantial (κ value for case-specific modifiers: Germany, 0.57; Netherlands, 0.62; Germany/Netherlands, 0.59; **Table 1**).

Treatment Strategy

Nonoperative Treatment Versus Operative Therapy. Independently of the previously used classification, operative treatment was selected significantly more often by the German spine surgeons than by the Dutch spine surgeons (surgery: Germany, 94.2%; Netherlands, 58.1%; $P < 0.05$).

Considering the results of the AO spine classification, this difference was predominantly caused by contrasting therapies for type A fractures (indication for surgery for type A fractures: Germany, 77.1%; Netherlands, 27.8%; $P < 0.05$). In contrast, fractures

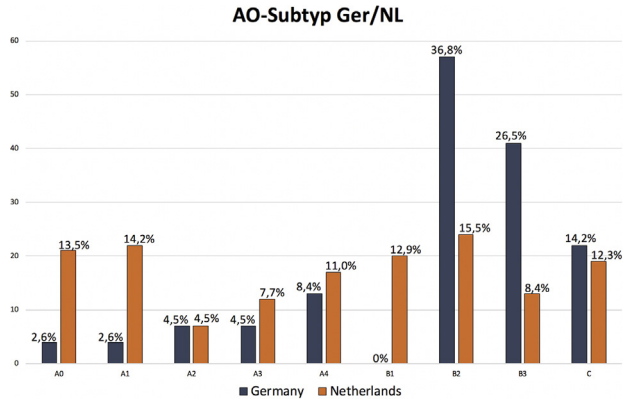

Figure 1. Graph showing fracture distribution stratified by Arbeitsgemeinschaft für Osteosynthesefragen (AO) spine subaxial cervical spine classification system. Ger, Germany; NL, Netherlands; Subtyp, subtype.

classified as type B and C were mainly treated by a surgical intervention in both countries (indication for surgery for type B fractures: Germany, 99%; Netherlands, 87.7%; $P < 0.05$; indication for surgery for type C fractures: Germany, 100%; Netherlands, 94.7%; $P = NS$; Table 2).

As expected, the results of the AO spine sublevels (i.e., A1, A2) showed that both countries predominantly selected nonoperative treatment for type A0 and A1 fractures (nonoperative for A0/A1: Germany, 87.5%; Netherlands, 76.7%; $P = NS$). For type A2 and A3 fractures, German spine surgeons had already selected operative treatment for nearly all presented cases. In contrast, surgeons from the Netherlands almost solely suggested nonoperative treatment (indication for surgery: Germany, A2/A3, 92.9%; Netherlands, A2/A3, 5.3%; $P < 0.05$). Although the operative treatment of type A4 fracture was preferred in both countries, surgery was indicated significantly more often by the German surgeons (indication for surgery: Germany A4, 100%; Netherlands A4, 64.7%; $P < 0.05$; Table 3).

Type of Nonoperative Treatment. For nonoperative treatment, the spine surgeons of both countries were in agreement regarding the application of a supportive cervical collar (nonoperative treatment using a neck collar: Germany, 100%; Netherlands, 95.4%; $P =$ NS). Furthermore, German and Dutch surgeons both preferred a hard neck collar for the initial conservative treatment (overall [Germany and Netherlands]: hard collar, 73.0%; soft collar, 9.5%; hard collar followed by soft collar, 13.5%; no external immobilization, 4.0%).

Anterior Stabilization. In surgically treated type A fractures, standalone anterior stabilization was the treatment of choice in both countries (Germany, 100%; Netherlands, 81.8%; $P < 0.05$). For type B and C fractures, anterior stabilization remained a part of the therapeutic concept; however, posterior stabilization and circumferential stabilization were also frequently suggested by both German and Dutch surgeons (Table 2).

Regarding the anterior surgical procedure, the surgeons of both countries favored fusion by cage accompanied by anterior plating (type of anterior stabilization: Germany, 86.6% preferred cage and plate; 12.6% preferred bone graft and plate; and 0.8% preferred solitary plating; Netherlands, 83.6% preferred cage and plate; 4.1% preferred bone graft and plate; and 12.3% preferred solitary plating).

Regarding the length of instrumentation, bisegmental anterior fusion was most frequently recommended for type A4 fractures (Germany, 13 of 13 [100%]; Netherlands, 8 of 11 [72.7%]; $P < 0.05$). Monosegmental stabilization was suggested for most of the other fracture types (anterior stabilization type [overall]: monosegmental, 138 of 192 [71.9%]; bisegmental, 47 of 192 [24.5%]; multisegmental, 7 of 192 [3.6%]).

Posterior Stabilization and Fusion. If posterior stabilization were selected, bi- or multisegmental stabilization was favored in both countries (Germany: monosegmental, 8 of 55 [14.5%]; bi- and multisegmental, 47 of 55 [85.5%]; Netherlands: monosegmental, 10 of 45 [22.2%]; bi- and multisegmental, 35 of 45 [77.8%]; $P =$ NS). In 85 of the 100 posterior stabilized cases, an additional posterior

Table 1. Interobserver Reliability of Different Portions of Arbeitsgemeinschaft für Osteosynthesefragen Subaxial Cervical Spine Injury Classification System

	Ger		NL		Ger/NL	
Variable	**%**	**κ**	**%**	**κ**	**%**	**κ**
AO fracture						
Main type	75.5	0.53	61.0	0.36	62.5	0.39
Subtype	58.4	0.46	38.4	0.31	41.7	0.33
Facet joint injury*	89.0	0.78	81.9	0.64	85.2	0.7
Neurology	89.4	0.46	81.6	0.44	86.2	0.5
Modifiers	83.2	0.57	81.9	0.62	82.3	0.59

Ger, Germany; NL, Netherlands; AO, Arbeitsgemeinschaft für Osteosynthesefragen.
*Data were analyzed regarding the observers' assessment of the presence or absence of facet joint injury, independently of the exact type (F1—F4).

Table 2. Treatment Strategy of German and Dutch Surgeons Stratified by the Arbeitsgemeinschaft für Osteosynthesefragen Spine Fracture Type

AO Type	Country (Cases)	Nonoperative Treatment	Surgical Treatment		
			Anterior	Posterior	Circumferential
A	Germany ($n = 35$)	22.9 (8)	77.1 (27)	0 (0)	0 (0)
	Netherlands ($n = 79$)	72.2 (57)	22.8 (18)	1.3 (1)	3.8 (3)
B	Germany ($n = 98$)	1.0 (1)	57.1 (56)	26.5 (26)	15.3 (15)
	Netherlands ($n = 57$)	12.3 (7)	33.3 (19)	21.1 (12)	33.3 (19)
C	Germany ($n = 22$)	0 (0)	36.4 (8)	4.5 (1)	59.1 (13)
	Netherlands ($n = 19$)	5.3 (1)	42.1 (8)	21.1 (4)	31.6 (6)

Data presented as % (*n*).
AO, Arbeitsgemeinschaft für Osteosynthesefragen.

fusion procedure was recommended (Germany, 50 of 55; Netherlands, 35 of 45; P = NS).

Spinal Decompression. For type A and B fractures, the surgeons of both countries would choose to avoid intraoperative decompression in patients without an initial neurological deficit (decompression for type A and B fractures: Germany, 28.6% yes, 48.9% no, 22.6% depending on the intraoperative findings; Netherlands, 16.9% yes and 83.1% no). In contrast, a general consensus was present regarding use of the decompression procedure for type C fractures between the German and Dutch surgeons (decompression for type C fractures: Germany, 81.8% yes, 4.5% no, 13.6% depending on the intraoperative findings; Netherlands, 78.9% yes and 21.1% no).

Further Diagnostic Modalities. A preoperative magnetic resonance imaging (MRI) study was requested by most surgeons of both countries (Germany, 77.4% [120 of 155]; Netherlands, 54.2% [84 of 155]; P < 0.05). With consideration of the fracture morphology, MRI was the most frequently recommended imaging studies for type C fractures (indication for MRI: type A, 46.5% [53 of 114]; type B, 73.5% [114 of 155]; type C, 90.2% [37 of 41]).

Application of Bone Substitutes. Overall, the use of bone substitutes was recommended for 105 of 236 voted cases (44.5%) for which surgery was indicated. Thus, the use of bone substitutes was similar in both Germany and the Netherlands (bone substitutes: Germany, 70 of 146 [47.9%]; Netherlands, 35 of 90 [38.9%]; P = NS).

DISCUSSION

Owing to the lack of evidence, a debate regarding the appropriate treatment algorithm for traumatic subaxial cervical spine injuries has been ongoing.[12] Furthermore, during the past 2 decades, a sustained discussion has prevailed regarding whether anterior or posterior surgery is the optimal method to treat these fractures.[1] In this context, studies have shown that considerable regional differences exist in the management of cervical spine fractures.[3,9] Our main findings from our study were as follows:

Table 3. Treatment Strategy of German and Dutch Surgeons Stratified by Arbeitsgemeinschaft für Osteosynthesefragen Spine Subtype A

AO Type	Country (Cases)	Nonoperative Treatment	Surgical Treatment		
			Anterior	Posterior	Circumferential
A0-A1	Germany ($n = 8$)	87.5 (7)	12.5 (1)	0 (0)	0 (0)
	Netherlands ($n = 43$)	76.7 (33)	20.9 (9)	0 (0)	2.3 (1)
A2-A3	Germany ($n = 14$)	7.1 (1)	92.9 (13)	0 (0)	0 (0)
	Netherlands ($n = 19$)	94.7 (18)	0 (0)	5.3 (1)	0 (0)
A4	Germany ($n = 13$)	0 (0)	100 (13)	0 (0)	0 (0)
	Netherlands ($n = 17$)	35.3 (6)	52.9 (9)	0 (0)	11.8 (2)

Data presented as % (*n*).
AO, Arbeitsgemeinschaft für Osteosynthesefragen.

1. In the present case series, the spine surgeons from the Netherlands more often classified fractures as type A using the AO spine classification but German surgeons more frequently assumed fractures were type B fractures.
2. Surgical treatment was significantly more frequently recommended by the German spine surgeons than by the Dutch surgeons, independently of the fracture type.
3. The largest difference was observed in the analysis and treatment recommendations for type A2 and A3 fractures.
4. A general consensus was observed regarding the treatment strategy of types B and C fractures.
5. The use of MRI for decision making was recommended for most cases by the surgeons from Germany and the Netherlands.

The AO spine subaxial cervical spine injury classification system is currently the most advanced classification system for the assessment of traumatic cervical spine injuries. The morphological characteristics of the injury patterns determined from the CT scan and plain radiographic findings are the basis of this classification system.[10,13] In the present survey, we found differences in the reliability of the classification between German and Dutch surgeons. Furthermore, spine surgeons from the Netherlands assessed the injuries more often as type A fractures instead of type B fractures compared with the estimations from the German surgeons.

Various reasons could explain those differences in the interpretation of a fracture type. One possible explanation might be that the oblique indicators regarding type B injuries on the CT scans were interpreted differently by the German and Dutch surgeons. Stone et al.[14] reported that the use of MRI leads to improved identification, especially for type B fractures. Within our study, MRI scans were not provided, because the availability of MRI cannot be ensured nationwide and because the creators of the AO spine classification sought to acknowledge cases in which injury to the posterior ligamentous complex is indeterminate.[10]

Furthermore, it must be considered that the classification of the Dutch surgeons regarding the fracture type was inferior to that of the German surgeons. A few studies have shown that the agreement of independent interobserver studies was usually less than the values of the groups involved in developing a classification scheme.[15,16] This leads to the assumption that a learning curve exists in using classification systems. In the present survey, the German surgeons seemed to be more familiar with the use of the AO spine subaxial classification system owing to the previous use of the AO scheme for the thoracolumbar region. In contrast, the Dutch surgeons included in the present survey were more familiar with the Thoracolumbar Injury Classification System.

Within the present study, the surgeons from Germany and the Netherlands predominantly suggested nonoperative therapy for AO type A0 and A1 fractures. This is in line with the treatment recommendations from the working group "lower cervical spine" of the German Orthopedic and Trauma Society for subaxial cervical spine injuries and indicates a consensus has been reached for nonoperative treatment of those injuries.[8]

Conspicuous in the present survey, however, was that the largest discrepancy between German and Dutch surgeons was found in the treatment of type A2 and A3 fractures. Although the German surgeons saw the need for anterior stabilization for most of those injuries (92.9%), Dutch surgeons almost entirely recommended nonoperative treatment (94.7%). A2 fractures have been defined as coronary split or pincer fractures that involve both adjacent endplates but do not affect the posterior wall of the vertebral body.[10,13] Those fractures will generally be assessed as stable injuries for which the indication for surgery usually results from the degree of the segmental kyphotic deformity. Surgical therapy should be recommended for a kyphotic deformation of the fractured vertebra of ~15°.[8] These values were determined from biomechanical studies from the early 1980s.[17,18] Thus, it is unclear whether, with modern external cervical immobilization methods (e.g., cervical collars or halo fixators), such fractures could be treated adequately. Furthermore, Sadiqi et al.[19] identified worldwide variation in the assessment of fracture kyphosis and vertebral body height loss, and Bono et al.[20] described the partially poor reliability of those radiographic measurements for the subaxial cervical spine. Considering those difficulties, the validity of these radiological instability criteria must be considered and might explain the differences in the treatment choices of German and Dutch surgeons.

In contrast to type A2 fractures, type A3 fractures are defined as fractures with additional posterior vertebral wall involvement, resulting in impairment of the spinal canal. Dvorak et al.[2] emphasized that sole anterior stabilization of burst fractures is adequate and that additional posterior stabilization will only be necessary in rare cases. However, other studies have advised nonoperative therapy for injuries with a low grade of deformity.[8] Prerequisite for such cases, however, is the radiologically based exclusion of the development of secondary segmental kyphosis during the follow-up period. The existing controversy regarding the correct treatment choice was confirmed in our binational analysis because the German surgeons tended to opt for surgery for type A3 fractures, but the Dutch surgeons chose to treat those fractures conservatively. This is in line with the results of a previously reported study that found opposing therapy choices between German and Dutch surgeons in the treatment of burst fractures in the thoracolumbar region.[9]

Studies have inferred that the risk of secondary kyphosis with A4 fractures will be significantly increased compared with A3 injuries owing to the higher grade of segmental instability.[8] This finding was confirmed by the results from the present study, which showed that surgical stabilization was consistently recommended for A4 fractures by the German surgeons and predominantly recommended by the Dutch surgeons.

Another important aspect regarding medical treatment is the difference in the healthcare system between the 2 countries. In Germany, the proceeds are determined using a diagnosis-related group-based payment system. As a result, the performance of surgery would seem to be economically advantageous compared with conservative treatment. In the Netherlands, the bargaining position of health insurers toward hospitals remains relatively weak, although a major healthcare reform was introduced in 2006.[21,22] Consequently, different economic conflicts of interest between countries are clearly recognizable. All participants in the present study, however, asserted that their individual treatment recommendations were based solely on the medical criteria and that economic interests had no effect on their decision.

The reported research has shown that a general consensus has been reached regarding the surgical treatment of type B and C fractures.[1,2,8,23] Only for type B1 fractures could nonoperative treatment be indicated for select cases.[8] Our study has confirmed these results and shown that nonoperative treatment of type B and C fractures was the exception in both countries. Considering the choice of the surgical approach, our study showed that the indication for posterior and circumferential treatment was more frequent for fractures with a high grade of instability (type B and C). For these cases, posterior spondylodesis was recommended for 85% in our survey. Dvorak et al.[2] proposed an algorithm based on the Subaxial Cervical Spine Injury Classification, which has confirmed these findings and shown that the choice of the respective surgical approach and the indication for spondylodesis must be considered and should depend on the fracture morphology.

Within our study, the indication for intraoperative decompression of the spinal canal for type A and B fractures was relatively low. This can be explained by the low number of neurological deficits within our case series.

Concerning the need for advanced medical imaging, the surgeons participating in our survey were asked whether they required an additional MRI study to receive more information of the fracture type for their decision making. The need for MRI was proportional to the injury severity. Although the development of modifiers improves the indirect identification of a posterior ligamentous complex injury,[10] MRI can provide further information for surgical planning,[24,25] not only in the case of neurological deficits, but also to rule out epidural hematoma or herniation of vertebral discs in the case of facet joint dislocations.

Within the present study, bone substitutes were consistently used by both German (47.9%) and Dutch (38.9%) surgeons. Furthermore, our study showed that the use of autologous iliac bone grafts is no longer the treatment of choice. This is in line with the findings from Kadam et al.,[26] who reported that modern bone substitutes show good bone healing results.

The present study had some limitations. One major limitation of our study was the sample size of only 31 cases, which could not reflect all possible scenarios in cervical spine trauma. However, an excessive increase in case numbers could have been associated with an increasing probability of failure during the observation process owing to the observers losing concentration.

Differences in the treatment strategy could also have been influenced by the medical background and subspecialty training of the participating surgeons. This could have reduced the pure country-specific comparability. However, it is also necessary to reflect the opinions of spine surgeons from different departments to consider interdisciplinary differences. Furthermore, although border area studies offer the possibility of demonstrating commonalities and differences in local regions, they cannot necessarily represent the opinion of all spine surgeons from the participating countries. National surveys by the respective spine societies might provide more generalizable results.

CONCLUSION

A general agreement exists between German and Dutch spine surgeons that AO type B and C fractures of the subaxial cervical spine should be treated surgically. However, we found country-specific differences in the treatment of AO type A fractures, especially in the case of pincer (A2) and incomplete burst (A3) fractures. In the Netherlands, the surgeons will usually recommend nonoperative treatment of AO spine type A0, A1, A2, and A3 fractures. However, German surgeons have a lower threshold concerning use of the anterior fusion procedure for type A2 and, in particular, type A3 fractures.

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Supplemental Table 1. Second Part of the Questionnaire: Treatment Strategy

1	Which therapy would you recommend?
A	Nonoperative
B	Anterior stabilization
C	Posterior stabilization
D	Anteroposterior stabilization
2	If nonoperative, which type of external immobilization would you recommend?
A	I would not treat nonoperatively
B	No external immobilization
C	Soft neck collar
D	Hard neck collar
E	First hard neck collar, followed by soft neck collar
3	If you would recommend anterior stabilization, how would you perform it?
A	I would not perform anterior stabilization
B	Tricortical iliac bone grafts
C	Tricortical iliac bone grafts and plate
D	Cage
E	Cage and plate
F	Plate
4	How would you perform anterior stabilization?
A	I would not perform anterior stabilization
B	Monosegmentally
C	Bisegmentally
D	More than 2 segments
5	How would you perform posterior stabilization?
A	I would not perform posterior stabilization
B	Monosegmentally
C	Bisegmentally
D	More than 2 segments
6	Would you perform posterior spondylodesis?
A	Yes
B	No
7	Would you routinely perform spinal decompression for the case (posterior or anterior)?
A	Yes
B	No
C	Depending on operative findings
8	Would you require an MRI preoperatively?
A	Yes
B	No
9	Would you use a bone substitute?
A	Yes
B	No

MRI, magnetic resonance imaging.