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# ROLE OF CT AND MRI IN EVALUATION AND AO SPINE CLASSIFICATION OF ACUTE SPINAL TRAUMA: A CROSS-SECTIONAL OBSERVATIONAL STUDY

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## ABSTRACT

**Background:** The proper assessment and classification of a case of spinal trauma is crucial to any treatment decision and to predicting outcome. MRI is better than computed tomography (CT) for the evaluation of soft tissue, ligamentous and neural structures, while computed tomography (CT) is better than MRI for the evaluation of fracture morphology. The purpose of this study was to assess the use of CT and MRI for the evaluation of spinal trauma and to determine the accuracy of CT and MRI in classifications of cervical spine, thoracolumbar spine and sacrococcygeal spine in spinal trauma according to the AO Spine classification system. **Materials and Methods:** The observational cross sectional study took place in Dept of Radiodiagnosis, NIMS, Jaipur between 2023-2026 with sample size of 30 patients suffering from acute spinal trauma. All patients were first evaluated by multidetector computed tomography and subsequently in most cases, by MRI, if clinically indicated. Injuries were defined using the AO Spine Classification system. Imaging data, CT/MRI agreement, neurological status and clinical parameters were analysed. **Result:** The average age of the patients was 41.03 years (15.07 years SD) and 60% were females. The most common sites of involvement were the cervical and thoracic regions (30% each). The injury distribution patterns of the CT and MRI scans were different, with MRI showing a higher number of posterior tension band and Type C injuries. Concordance was noted for 40% of CT–MRI cases and discordance was seen in 60%. There was no correlation observed between CT–based classification (p=0.567), MRI–based classification (p=0.458) or CT–MRI concordance (p=0.435) with clinical outcome. **Conclusion:** In the assessment of spinal injury, CT and MRI are complementary. Although CT still plays a fundamental role in fracture characterization, MRI can play a more important role in detecting ligamentous or neurological damages which can complement the accuracy of AO Spine classification and assist in individual treatment planning.

## INTRODUCTION

Spinal trauma is a sentinel event in health care and is a major source of morbidity and long term disability especially for the young and economically active population.[1,2] A spinal injury can be caused by trauma, and can involve a wide range of injuries that vary from slight osseous injuries to severe unstable fractures, involving the spinal cord or neurological system. Timely, accurate diagnosis of spinal injuries is essential for the development of therapy, to avoid further damage to the nervous system, and also for better treatment results.[3,4] Imaging in trauma has become an essential factor in the management and evaluation of patients with suspected spine injuries, with successive advancements in trauma care improving diagnostic capability.[5,6]

Traditional imaging methods used are conventional imaging, which has been the primary imaging modality in spine trauma but is not particularly used in high-energy trauma due to its limitations in detecting subtle fracture, complex anatomic disruption and posterior elements-related injuries.[1,7,8] However, computed tomography (CT) has become the imaging technique most commonly used to assess the spine in trauma for its great spatial definition, rapid time of acquisition and ability to clearly demonstrate bony abnormalities. CT offers a detailed visualization of fracture patterns, bending irregularities, involvement of the vertebral body, and presence of associated bony deformities, thus it is important for surgical planning and categorizing spinal fractures.[9,10]

Magnetic resonance imaging (MRI) is slower to obtain, may be limited in availability, and is used less in the initial evaluation of trauma, but is an important imaging modality in the assessment of neural and soft tissue structures.[11,12] MRI offers much better contrast resolution than CT to help assess spinal cord injury, ligamentous disruption, injuries to intervertebral discs, epidural hematoma, and other soft tissue exceptions which may not be adequately depicted on CT. Considering this, CT and MRI have complementary roles with the first supplementing to assess osseous elements, while the latter can provide all the elements necessary to evaluate spinal stability and neurological elements.[13-15]

Correct diagnosis of spinal fractures is crucial for efficient communication between clinicians, treatment planning and prognosis. Over time, different models have been created for the classification of spine trauma to a uniformly descriptive standard.[1,6] The working group for osteosynthesis questions (AO) Spine classification system is followed because it takes into account not only injury morphology but also neurological status and clinical modifiers. Recent changes, especially those in the classification of AO Spine upper cervical injuries, have made the understanding and categorization of complex cervical spine injuries more accurate, as they have taken into consideration the unique anatomical and biomechanical aspects of the upper cervical spine.[7,9]

There are particular anatomical characteristics of the areas at the cervical spine, thoracolumbar junction and sacrococcygeal regions which have unique patterns of injury, and these areas must be tested with care.[16] The anatomy of the upper cervical region and the potential for neurologic consequences make atlas and axis fractures more difficult and often start to present neurological symptoms, as do fractures at the craniocervical junction. Likewise, the area of the spine transacted between the more rigid thoracic spine and mobile lumbar spine is a frequent region of spinal trauma, the thoracolumbar region.[5,6] Although uncommon, sacrococcygeal injuries can be associated with neurological problems, and accurate identification is required for the appropriate management and prevention of chronic pain and functional disability.[4]

Even with the development of imaging technology, the problem of proper classification of injuries to the back of the neck and trunk remains difficult, especially in multiple injuries commonly seen in trauma. This diagnostic accuracy of CT and MRI in accurately diagnosing and classifying spinal trauma based on the latest classification systems is therefore very important. These assessments may assist in determining the level of effectiveness of each modality as well as improve imaging protocols for trauma care.[3,6]

The goal of the current study is to evaluate the utility of CT and MRI in the assessment of cervical, thoracolumbar, and sacrococcygeal spinal trauma, and to determine how well they categorize the cervical spine injuries according to the recently published AO Spine upper cervical spine injury classification system. The aim of this study is to assess the role of cutting-edge imaging techniques in trauma assessment which will provide insights to enhance the diagnostic accuracy, injury characterization, and clinical decision making in patients with spinal trauma.

## MATERIALS AND METHODS

**Study Design, Setting, & Population:** The study was an observational cross-sectional study carried out in the Department of Radiodiagnosis at NIMS University, Jaipur, Rajasthan for the study period March 2023—2026. Patients who presented with acute spinal trauma because of a number of different causes, such as a road traffic accident, fall from height, assault, sporting, other traumatic events were included in the study. In the clinical or radiological evaluation of spinal trauma patients, those with clinical or radiological suspicion of spinal injury were prospectively entered into the evaluation by computed tomography (CT) and/or magnetic resonance imaging (MRI).

The study was approved by the Institutional Scientific and Ethics Committee prior to beginning. All participants or legal representatives were provided written informed consent, which explained the study goals, imaging protocol, and risks to the participant. Finally, with a convenience sampling technique, a minimum number of 30 patients were included.

**Inclusion Criteria**

Patients that met the following criteria were selected:

- The acute spinal trauma presenting cases with spinal pain.
- Patients with suspected spinal instability due to mechanical stress.
- Neurological or autonomic dysfunction that is suggestive of spinal injury.
- Suspected spinal trauma patient being referred for assessment with CT and/or MRI.

**Exclusion Criteria**

Those who had the following were excluded:

- Pregnancy
- Presence of metallic implants, or factors in contraindications for MRI.
- Normal neurologic examination, intact consciousness, no intoxication, no clinical and radiological spinal injury and normal mobility.

**Imaging protocols and Evaluation:** All patients were scanned at the trauma centre with multidetector computed tomography (MDCT) of the affected spinal part or the whole spine. When required to characterize fracture or for surgical planning, a CT thin-section (≤1.25 mm) axial scan was performed with multiplanar computed tomography sagittal, coronal reformation and three dimensional reconstruction. Evaluation of fracture morphology, vertebral body height loss, kyphotic angulation, spinal canal compromise, alignment abnormalities, and involvement of the posterior elements were computed by CT.

MRI was subsequently performed as clinically indicated with an ideal timeframe of 24–72 hours after admission, especially in a stable patient. The MRI protocol consisted of sagittal T1-weighted, sagittal T2-weighted, sagittal STIR, axial T1-weighted and T2-weighted sequences, and gradient-echo/susceptibility-weighted. Other sequences, like a diffusion tensor image or an image with a contrast agent, were acquired on a select basis. In the MRI assessment, abnormalities of the spinal cord (edema, hemorrhage, or transection), damage to the intervertebral discs, epidural hematoma and integrity of the posterior ligamentous complex (PLC) were explored.

**Image Analysis and Injury Classification:** MRI and CT assessments were made based on a proforma (Figure 2) which takes the same approach across all studies. The AO Spine Classification system was used to classify spinal injuries and emphasis was placed on proper description of injuries in the cervical, thoracolumbar and sacrococcygeal region. The CT findings consisted of assessment of fracture morphology, with the MRI findings being assessed for further soft tissue, ligamentous, and neurological findings.

Images underwent independent evaluation by 2 well experienced musculoskeletal/spine radiologists, who had no knowledge of one another's interpretations. If there was disagreement between the observers, it was either resolved by consensus or checked by a senior radiologist. The method of interobserver agreement was used. The American Spinal Injury Association (ASIA) Impairment Scale was used to assess neurological function of patients.

**Statistical Analysis:** Clinical and imaging data were analysed using SPSS software and Microsoft Excel software, respectively. Demographic, injury pattern and imaging findings were reported using descriptive statistics. The ability of CT and MRI to categorise spinal injuries, in line with the AO Spine Classification system, was evaluated. Correlation on CT and MRI, including the recognition of the ligamentous injury, involvement of the spinal cord and other associated findings that impact on management, were assessed. The diagnostic performance and agreement between imaging modalities were statistically analysed.

## RESULTS

In total, 30 patients with acute spinal trauma were studied. Participants' mean age was 41.03 years (SD 15.07, range 18–70) and there was a female predominance (60%). Fall from a height (30%), road traffic accidents and assault (23.3%) were the most common causes of injury. Cervical and thoracic spine injuries were the most common regions (30% of all injuries each), followed by sacral (26.7%) and lumbar (13.3%) injuries [Table 1, 2 and Figure 1, 2]. The CT-based AO spine classification showed that most of the injuries were compression injuries with 20% of A2, 16.7% of A3 and 20% of type C. MRI evaluation revealed that the incidence of posterior tension band injuries, as well as the complexity of injury pattern, increased, with B2 (23.3%) and Type C injuries (26.7%) detected most frequently [Table 3; Figure 3]. However, when comparing the results of radiological classification between computed tomography (CT) and magnetic resonance imaging (MRI), there was a concordant classification result in 12 of 30 patients (40%), with a discordant result in 18 patients (60%), giving rise to added information from MRI in the classification of spinal trauma cases [Table 4]. The overall clinical performances improved in 36.7% of patients, were unchanged in 30% and worsened in 33.3% [Table 4; Figure 4]. When analyzing the data statistically, there was no significant difference between the association of the outcome with the AO classification using CT ($p=0.567$) and using MRI ($p=0.458$) and the association between the outcome and the CT–MRI concordance ($p=0.435$) [Table 5]. Despite the fact that it was not statistically significant, MRI was also used to add characterization of the ligamentous and nervous injuries, reinforcing its role as a complement to CT for a complete evaluation of spinal trauma.

**Table 1: Demographic Characteristics of Study Participants**

| Variable | Findings |
|---|---|
| Total number of patients | 30 |
| Mean age ± SD (years) | 41.03 ± 15.07 |
| Median age (years) | 40.5 |
| Age range (years) | 18–70 |
| Male | 12 (40.0%) |
| Female | 18 (60.0%) |

**Table 2: Distribution According to Mechanism and Level of Injury**

| Parameter | Frequency (n) | Percentage (%) |
|---|---|---|
| Mode of injury | | |
| Fall from height | 9 | 30.0 |
| Road traffic accident | 7 | 23.3 |


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| | | |
|---|---|---|
| Assault | 7 | 23.3 |
| Sports injury | 4 | 13.3 |
| Domestic fall | 3 | 10.0 |
| Level of spinal injury | | |
| Cervical | 9 | 30.0 |
| Thoracic | 9 | 30.0 |
| Sacral | 8 | 26.7 |
| Lumbar | 4 | 13.3 |

**Table 3: AO Spine Injury Classification on CT and MRI Evaluation**

| AO Spine Type | CT n (%) | MRI n (%) |
|---|---|---|
| A1 | 3 (10.0) | 1 (3.3) |
| A2 | 6 (20.0) | 2 (6.7) |
| A3 | 5 (16.7) | 4 (13.3) |
| A4 | 2 (6.7) | 3 (10.0) |
| B1 | 4 (13.3) | 3 (10.0) |
| B2 | 3 (10.0) | 7 (23.3) |
| B3 | 1 (3.3) | 2 (6.7) |
| C | 6 (20.0) | 8 (26.7) |

**Table 4: Radiological Concordance Between CT and MRI and Clinical Outcome**

| Variable | Frequency (n) | Percentage (%) |
|---|---|---|
| CT–MRI classification agreement | | |
| Concordant findings | 12 | 40.0 |
| Discordant findings | 18 | 60.0 |
| Final clinical outcome | | |
| Improved | 11 | 36.7 |
| Static neurological status | 9 | 30.0 |
| Worsened outcome | 10 | 33.3 |

**Table 5: Association of AO Spine Classification With Clinical Outcome**

| Imaging Modality | p-value | Cramer's V | Interpretation |
|---|---|---|---|
| CT-based AO classification vs outcome | 0.567 | Not significant | No significant association |
| MRI-based AO classification vs outcome | 0.458 | Not significant | No significant association |
| CT–MRI concordance vs outcome | 0.435 | Not significant | No significant association |


**Figure 1: Distribution of Mechanism of Injury**

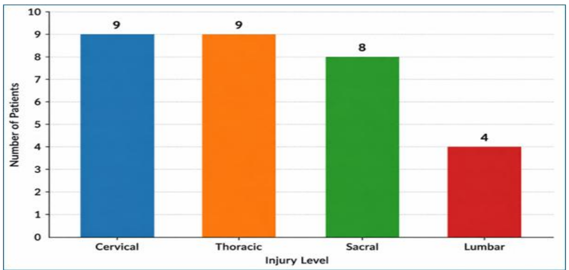


**Figure 2: Distribution of Spinal Injury Levels**

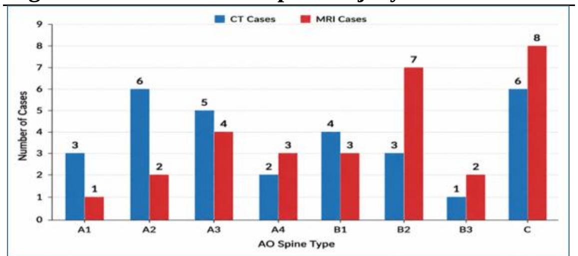


**Figure 3: Comparison of AO Spine Classification Between CT and MRI**

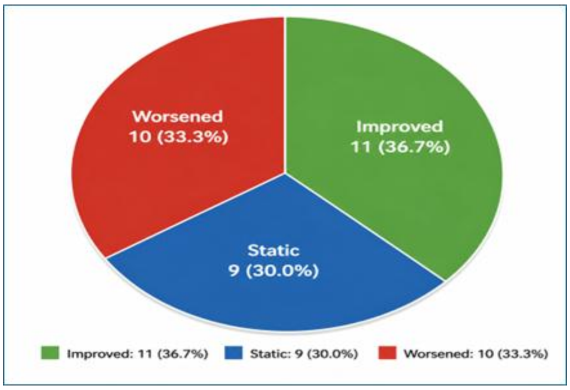


**Figure 4: Clinical Outcome Distribution**

## DISCUSSION

Evaluation and classification of spinal trauma must be accurate to assist in developing treatment strategies, to determine prognosis, and to facilitate honest communication between the radiologist and spine surgeon. CT and MRI, in the current study, were complementary in the assessment of acute spinal injury, with the imaging modality showing some contribution in assessing the fracture morphology and the MRI the contribution in spinal cord involvement, ligamentous integrity and the instability of the spine. In selected patients in whom soft tissue or neurological assessment may affect the classification of the injury or the extent of the neurological injury, it is important to note that the observed CT–MRI discordance occurred in 60% of cases.

Because of the ability to provide a consistent description of the morphology, stability and clinical importance of the spinal injury, the AO Spine Classification system is internationally accepted. Vaccaro et al. have developed the AO Spine Upper Cervical Injury Classification system and established its global validity and shown that there is high degree of reliability between the specialists of different nations in spine practice,[1] thus making the system applicable in various clinical settings. In a similar fashion, Vaccaro et al. noted that interobserver and intraobserver reliability were good for the AO Spine upper cervical injury classification system and this could be helpful in making cervical trauma evaluation more consistent.[2] In the present study, the AO Spine classification based on CT imaging identified compression injuries (type A) as common pattern, while MRI led to a greater number of B-type (posterior tension band injuries) and C-type (complex instability pattern) classifications, potentially allowing MRI to better characterize injuries which are underdiagnosed on CT imaging alone.

Previous work has highlighted the role of MRI in the imaging of cervical spine trauma as an adjunct to other imaging methods. In trauma to the cervical spine, Rutsch et al. showed that CT is the most important imaging modality, owing to its ability to reliably detect fractures, while MRI gives superior evaluation of spinal cord injury, ligamentous disruption and clinically significant soft tissue abnormalities.[4] This was also seen in our study where MRI gave further diagnostic information over and above the classification provided by CT and was more useful when considering instability and/or neurological involvement.

Thoracolumbar injury is the most common traumatic spinal injury and proper classification is essential for the proper use of conservative versus surgical treatment. Bajamal et al. emphasized the importance of classification systems, such as AO Spine and the Thoracolumbar Injury Classification System (TLICS), in accurately categorizing and planning treatment for thoracolumbar fractures (TLS).[6] Barcelos et al. also noted superiority in the utility of modern fracture morphology and stability classification systems over the previous descriptive ones.[7] In our study, CT was able to show fracture morphology and alignment abnormalities and MRI was able to show better MRI of the posterior ligamentous complex injury which is an important determinant of mechanical stability.

Past studies have also examined whether the findings on MRI alter the fracture classification and/or clinical decision making on CT. In thoracolumbar cases, MRI has been shown to yield additional information and potentially alter fracture classification or management plans over CT alone by Aly et al.[8] In another study, Aly et al. showed that MRI can markedly impact treatment decisions by recognizing unsuspected ligamentous injury or abnormalities of the nervous elements not seen on CT.[9] This was confirmed by our findings—MRI changed some patients' classifications, especially for the increased detection of B-type injuries in some patients and Type C injuries in others.

The accuracy and reliability of AO Spine classification have been internationally validated. Ono et al. evaluated the validity of an AO spine thoracolumbar classification with an application based on a standard application and found good agreement with the categorization of the fractures supporting its use in clinical practice.[10] Karamian et al. also reported successful international validation of the AO Spine subaxial cervical classification system was observed that this system was reliable among various observers and clinical settings.[5] Lambrechts et al also found that there was no significant difference in classification accuracy when hospitals were trauma centers and when they were not, supporting the idea that the AO Spine system is applicable in a wider range of clinical settings.[3] Those findings are similar to our study which showed that classification based on AO was reproducible in the setting of CT and MRI.

Classifying sacral and pelvic trauma continues to be difficult due to the complexity of the anatomic structures and the different types of injuries possible. Kweh et al. summarized the development of the AO Spine Sacral and Pelvic Classification System and highlighted the need for a structured classification system to further understanding in the management of sacral injuries.[11] Sacral injuries was not negligible with 26.7% in our study, MRI proved to be very helpful in detecting soft tissue abnormalities in association with sacral injury as well as neurological abnormalities which could have been missed using CT.

In our study, clinical outcome analysis revealed no significant difference between the clinical outcome and CT–based AO classification, MRI-based AO classification, and CT–MRI concordance, respectively. Previous validation studies have shown comparable reliability of injury classification systems for describing the injury, but correlation with functional outcomes was variable based on neurologic status, treatment approach, and/or co-injury.[1,5] Imaging classification should therefore not be used as an independent predictor of outcome, and should form part of a multidisciplinary assessment.

The overall results of this study confirmed the current available evidence that suggests CT should continue to be the preferred imaging modality for initial evaluation of spinal trauma, especially in detecting fractures and for morphological classification. But, MRI is particularly useful in complementing the information it brings regarding spinal cord injury, ligament disruption and occult instability. The benefits of integration of these images increases the accuracy of AO Spine classification and can help in the plan of individualized management.

**Limitations:** There are a number of restrictions and limitations in this study. This relatively small number of 30 patients and single center trial may mitigate the generalizability of the results. MRIs were not done on all trauma patients resulting in selection bias since the MRI was performed due to clinical indication. Long-term neurologic & functional outcomes were limited for evaluations of their effects with a short duration of follow-up. The effects of CT–MRI correlation on an increase in the accuracy of classification and clinical decisions should be further validated by larger multicenter inspection with a longer follow-up study which has a standard MRI protocol.

## CONCLUSION

Although the primary imaging method used for initial assessment of spinal trauma is CT which has the advantage of providing information on fracture morphology, involvement of the osseous components of spinal trauma is better characterized, and MRI has complementary value that provides information on involvement of the spinal cord, disruption of the posterior ligamentous complex, and occult instability. Significant discordance between CT and MRI was noted in a large percentage of the cases, which demonstrates that MRI has a potentially important role in the classification of AO Spine injuries, especially in complex injuries involving ligamentous injuries, neurological structures and/or bony elements. Imaging classification was not associated with short-term clinical outcomes, but integrating imaging evidence using both CT and MRI may be of value for diagnosis, characterization of injuries and multidisciplinary treatment planning. An integrated approach of CT and MRI in selected patients with acute traumatic spinal disorders, which aim to improve classification accuracy and clinical management, should be advised.

## REFERENCES


1. Vaccaro AR, Lambrechts MJ, Karamian BA, Canseco JA, Oner C, Benneker LM, Bransford R, Kandziora F, Shanmuganathan R, El-Sharkawi M, Kanna R, Joaquim A, Schnake K, Kepler CK, Schroeder GD; AO Spine Upper Cervical Injury Classification International Members. Global Validation of the AO Spine Upper Cervical Injury Classification. Spine (Phila Pa 1976). 2022 Nov 15;47(22):1541-1548. doi: 10.1097/BRS.0000000000004429. Epub 2022 Jul 25. PMID: 35877555; PMCID: PMC9612701.
2. Vaccaro AR, Lambrechts MJ, Karamian BA, Canseco JA, Oner C, Vialle E, Rajasekaran S, Dvorak MR, Benneker LM, Kandziora F, El-Sharkawi M, Tee JW, Bransford R, Joaquim AF, Muijs SPJ, Holas M, Takahata M, Hamouda WO, Kanna RM, Schnake K, Kepler CK, Schroeder GD. AO Spine upper cervical injury classification system: a description and reliability study. Spine J. 2022 Dec;22(12):2042-2049. doi: 10.1016/j.spinee.2022.08.005. Epub 2022 Aug 12. PMID: 35964830.
3. Lambrechts MJ, Schroeder GD, Karamian BA, Canseco JA, Bransford R, Oner C, Benneker LM, Kandziora F, Shanmuganathan R, Kanna R, Joaquim AF, Chapman JR, Vialle E, El-Sharkawi M, Dvorak M, Schnake K, Kepler CK, Vaccaro AR. The AO spine upper cervical injury classification system: Do work setting or trauma center affiliation affect classification accuracy or reliability? Injury. 2022 Oct;53(10):3248-3254. doi: 10.1016/j.injury.2022.08.030. Epub 2022 Aug 15. PMID: 36038389.
4. Rutsch N, Amrein P, Exadaktylos AK, Benneker LM, Schmaranzer F, Müller M, Albers CE, Bigdon SF. Cervical spine trauma - Evaluating the diagnostic power of CT, MRI, X-Ray and LODOX. Injury. 2023 Jul;54(7):110771. doi: 10.1016/j.injury.2023.05.003. Epub 2023 May 6. PMID: 37164902.
5. Karamian BA, Schroeder GD, Lambrechts MJ, Canseco JA, Oner C, Vialle E, Rajasekaran S, Dvorak MR, Benneker LM, Kandziora F, Schnake K, Kepler CK, Vaccaro AR; AO Spine Subaxial Classification Group Members. An international validation of the AO spine subaxial injury classification system. Eur Spine J. 2023 Jan;32(1):46-54. doi: 10.1007/s00586-022-07467-6. Epub 2022 Nov 30. PMID: 36449081.
6. Bajamal AH, Permana KR, Faris M, Zileli M, Peev NA. Classification and Radiological Diagnosis of Thoracolumbar Spine Fractures: WFNS Spine Committee Recommendations. Neurospine. 2021 Dec;18(4):656-666. doi: 10.14245/ns.2142650.325. Epub 2021 Dec 31. PMID: 35000319; PMCID: PMC8752700.
7. Barcelos ACES, Onishi FJ, Joaquim AF, Botelho RV. Review of best classification systems for diagnosing and treating thoracolumbar spine trauma. Surg Neurol Int. 2021 May 31;12:242. doi: 10.25259/SNI_322_2021. PMID: 34221573; PMCID: PMC8247666.
8. Aly MM, Al-Shoaibi AM, Abduraba S, Alzahrani AJ, Eldawoody H. Traumatic low lumbar fractures: How often MRI changes the fracture classification or clinical decision-making compared to CT alone? Eur Spine J. 2022 Jan;31(1):37-45. doi: 10.1007/s00586-021-06987-x. Epub 2021 Oct 8. PMID: 34625851.
9. Aly MM, Al-Shoaibi AM, Abduraba Ali S, Al Fattani A, Eldawoody H. How Often Would MRI Change the Thoracolumbar Fracture Classification or Decision-Making Compared to CT Alone? Global Spine J. 2024 Jan;14(1):11-24. doi: 10.1177/21925682221089579. Epub 2022 Apr 5. PMID: 35382642; PMCID: PMC10676184.
10. Ono AHA, Chang VYP, Rodenbeck EM, de Araujo AO, de Oliveira RG, Marcon RM, Cristante AF, Filho TEPB. Assessment of the Accuracy of the AO Spine-TL Classification for Thoracolumbar Spine Fractures Using the AO Surgery Reference Mobile App. Global Spine J. 2021 Mar;11(2):187-195. doi: 10.1177/2192568220901694. Epub 2020 Jan 29. PMID: 32875857; PMCID: PMC7882815.
11. Kweh BTS, Tee JW, Oner FC, Schnake KJ, Vialle EN, Kandziora F, Rajasekaran S, Dvorak M, Chapman JR, Benneker LM, Schroeder G, Vaccaro AR. Evolution of the AO Spine Sacral and Pelvic Classification System: a systematic review. J Neurosurg Spine. 2022 Jul 29;37(6):914-926. doi: 10.3171/2022.5.SPINE211468. PMID: 35907199.
12. Fiester P, Rao D, Soule E, Jenson M, Patel J, Supsupin E, Rahmathulla G, Tavanaiepour D. Radiologic utility of the Gehweiler and AO spine classification systems for C1 Trauma: A retrospective review from a Level I trauma center. J Craniovertebr Junction Spine. 2022 Oct-Dec;13(4):432-438. doi: 10.4103/jcvjs.jcvjs_133_22. Epub 2022 Dec 7. PMID: 36777912; PMCID: PMC9910133.
13. Cabrera JP, Yurac R, Joaquim AF, Guiroy A, Carazzo CA, Zamorano JJ, Valacco M; AO Spine Latin America Trauma Study Group. CT Scan in Subaxial Cervical Facet Injury: Is It Enough for Decision-Making? Global Spine J. 2023 Mar;13(2):344-352. doi: 10.1177/2192568221995491. Epub 2021 Mar 17. PMID: 33729870; PMCID: PMC9972275.
14. Stephenson KJ, Bullard KL, Wyrick DL, Ramakrishnaiah RH, Albert GW, Maxson RT. Can you see with CT? Is cervical spine computed tomographic imaging sufficient in pediatric trauma? Am J Surg. 2023 Jul;226(1):122-127. doi: 10.1016/j.amjsurg.2023.03.001. Epub 2023 Mar 3. PMID: 36922323.
15. Lambrechts MJ, Schroeder GD, Karamian BA, Canseco JA, Oner C, Vialle E, Rajasekaran S, Hazenbiller O, Dvorak MR, Benneker LM, Kandziora F, Schnake K, Kepler CK, Vaccaro AR; AO Spine Subaxial Classification Group Members.

Development of Online Technique for International Validation of the AO Spine Subaxial Injury Classification System. Global Spine J. 2024 Jan;14(1):177-186. doi: 10.1177/21925682221098967. Epub 2022 Apr 27. PMID: 35475400; PMCID: PMC10676157.

16. Camino-Willhuber G, Dandurand C, Scherer J, El Naga A, Joaquim AF, Chhabra HS, El-Sharkawi M, Bransford R, Schnake KJ, Schroeder GD, Fisher CG, Bigdon SF; AO Spine Knowledge Forum Trauma & Infection. AO Spine Clinical Practice Recommendations for the Management of Subaxial Spine Fractures. Global Spine J. 2026 Apr;16(3):1411-1417. doi: 10.1177/21925682261421911. Epub 2026 Jan 25. PMID: 41580985; PMCID: PMC12832217.


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