Volume 11, Issue 8, August– 2026 International Journal of Innovative Science and Research Technology
ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26aug1012

Predictive Indicators of Traumatic Dural Tear in Dorsal and Lumbar Spine Fractures and an Integrated Clinical–Imaging Risk Score: A Retrospective Study

Dr. Deepak Kumar Raidas[1*]; Dr. Ram Parsad Meena[2]; Dr. Umesh Kumar Meena[3]; Dr. Kishan Gopal Nama[4]

[1]Junior Resident; [2]Senior Professor and Head of Department; [3]Assistant Professor; [4]Professor

[1;2;3;4]Department of Orthopaedics, Government Medical College, Kota, Rajasthan, India

Corresponding Author: Dr. Deepak Kumar Raidas[1*]

Publication Date: 2026/09/05

Abstract:

- ***Background:***

Traumatic dural tears (TDTs) are clinically significant complications associated with thoracolumbar spine fractures and may result in cerebrospinal fluid leakage, pseudo meningocele formation, infection, and delayed recovery. Early recognition of patients at risk for TDT can assist in surgical planning, reduce complications, and improve postoperative outcomes.

- ***Objective:***

To identify clinical and radiological predictors of traumatic dural tears in patients with thoracolumbar spine fractures and to develop an integrated clinical–imaging risk score for preoperative prediction.

- ***Methods:***

A retrospective cohort study was conducted at a tertiary care centre between August 2022 and May 2025. Patients who underwent surgical management for thoracolumbar fractures and had complete preoperative imaging and intraoperative documentation were included. Demographic variables, mechanism of injury, AO Spine classification, neurological status according to the ASIA scale, and radiological parameters were analysed. Radiological variables included canal compromise, laminar fracture, pedicle fracture, retro pulsed fragments, CSF signal discontinuity, loss of epidural fat plane, and dural spiking sign. Intraoperative confirmation of dural tear served as the reference standard.

Univariate analysis was performed using the Chi-square test or Fisher's exact test for categorical variables and Student's t-test for continuous variables. Variables with $p < 0.10$ on univariate analysis were included in multivariate logistic regression to determine independent predictors of TDT. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. Statistical significance was set at $p < 0.05$.

- ***Results:***

A total of 110 patients were included, of whom 40 (36.4%) had intraoperatively confirmed traumatic dural tears. Significant predictors of TDT included complete paraplegia (ASIA A), laminar fracture, CSF signal discontinuity, loss of epidural fat plane, and dural spiking sign ($p < 0.05$).

On multivariate analysis, complete paraplegia (OR 117.11), CSF signal discontinuity (OR 81.00), loss of epidural fat plane (OR 81.00), and laminar fracture (OR 30.39) demonstrated strong associations with TDT. Based on these predictors, an integrated clinical–imaging risk score was developed.

➢ ***Conclusion:***

Complete paraplegia, laminar fractures, CSF signal discontinuity, loss of epidural fat plane, and dural spiking sign are reliable predictors of traumatic dural tears in thoracolumbar spine fractures. The proposed integrated risk score may assist surgeons in preoperative planning and preparedness for dural repair.

Early recognition of these high-risk features on preoperative imaging allows for optimized surgical preparedness and improved intraoperative management.

Keywords: *Traumatic Dural Tear; Thoracolumbar Fracture; Laminar Fracture; Paraplegia; MRI Predictors; Risk Score.*

How to Cite: Dr. Deepak Kumar Raidas; Dr. Ram Parsad Meena; Dr. Umesh Kumar Meena; Dr. Kishan Gopal Nama (2026) Predictive Indicators of Traumatic Dural Tear in Dorsal and Lumbar Spine Fractures and an Integrated Clinical–Imaging Risk Score: A Retrospective Study. *International Journal of Innovative Science and Research Technology,* 11(8), 2814-2820. https://doi.org/10.38124/ijisrt/26aug1012

I. INTRODUCTION

Finding a traumatic dural tear can be a serious intra operative complication for surgeon if preop preparedness for dural tear is not undertaken [6,7]. traumatic dural tear are directly not picked up on routine radiological workup of patient, some specialized MRI sequences such as high-resolution T2-weighted imaging, 3D reconstruction, or balanced turbo field echo (BTFE) sequences improve detection [8–10].Here are we trying to study some indicators for find dural tear preop, which are based on clinical examination, radiological imagining(CT & MRI) for save patient from complications like to persistent cerebrospinal fluid (CSF) leakage, meningitis, pseudo meningocele, neurological deterioration, and prolonged hospitalization[1–3,11,12]. The incidence of TDT varies widely, reported between 10% and 42%, depending on fracture morphology, mechanism of trauma, and diagnostic vigilance [7,13].

Thoracolumbar fractures, particularly burst fractures, are associated with retropulsion of bony fragments into the spinal canal, potentially causing dural laceration [14–16]. Radiological and clinical indicators such as Laminar fractures csf signal discontinuity, loss of epidural fat plane, high-grade canal compromise, dural spiking sign complete paraplegia increased risk of TDT, but data from Indian tertiary trauma centres remain limited [9,10,17–21].

This study aims to evaluate clinical and radiological predictors of TDT in dorsal and lumbar spine fractures and to develop a practical risk-stratification scoring system for use in preoperative planning. Early recognition of patients at risk for TDT can assist in surgical planning, reduce complications, and improve postoperative outcomes [4,5].

Data availability All collected data available for this study. Data will be provided upon request

II. MATERIALS AND METHODS

➢ *Study Design and Setting*

A retrospective cohort study was conducted at tertiary care centre. After Approval from the institutional ethics committee was obtained. Fractures were classified using the AO Spine Thoracolumbar Injury Classification System [22]. Neurological status was assessed using the ASIA impairment scale [23]. Canal compromise was calculated on axial CT images as described in prior studies [16,24]. MRI was evaluated for CSF signal discontinuity, loss of epidural fat plane, and dural spiking sign based on previously described imaging criteria [9,10,18].

➢ *Study Design and Setting*

A retrospective cohort study was conducted at a tertiary care centre after obtaining approval from the Institutional Ethics Committee. Consecutive patients who underwent surgical treatment for thoracolumbar spine fractures between August 2022 and May 2025 were reviewed.

Fractures were classified according to the AO Spine Thoracolumbar Injury Classification System. Neurological status was assessed using the American Spinal Injury Association (ASIA) Impairment Scale.

➢ *Inclusion Criteria*

- Age ≥18 years
- Acute traumatic thoracic or lumbar spine fracture
- Availability of complete preoperative CT and MRI imaging
- Intraoperative documentation of dural status
- Informed consent for surgery and use of anonymized clinical data for research purposes.

➢ *Exclusion Criteria*

- Pathological fractures
- Penetrating spinal injuries
- Previous spinal surgery at the affected level
- Incomplete clinical or radiological records

A total of 110 patients met the inclusion criteria.

➢ *Data Collection*

Demographic data, mechanism of injury, neurological status (ASIA scale), and imaging parameters were recorded.

- *Radiological Variables Included:*

✓ AO Spine fracture classification
✓ Presence of laminar fracture

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26aug1012

- ✓ Percentage area of canal compromise (measured on axial CT)
- ✓ Presence of Retro pulsed fragment
- ✓ Presence of pedicle fracture (image 1)
- ✓ Csf Signal discontinuity on MRI (image 2)
- ✓ Loss of epidural fat plane on mri (image 3)
- ✓ Presence of dural spiking sign on mri
- ✓ Neurological status of patient.

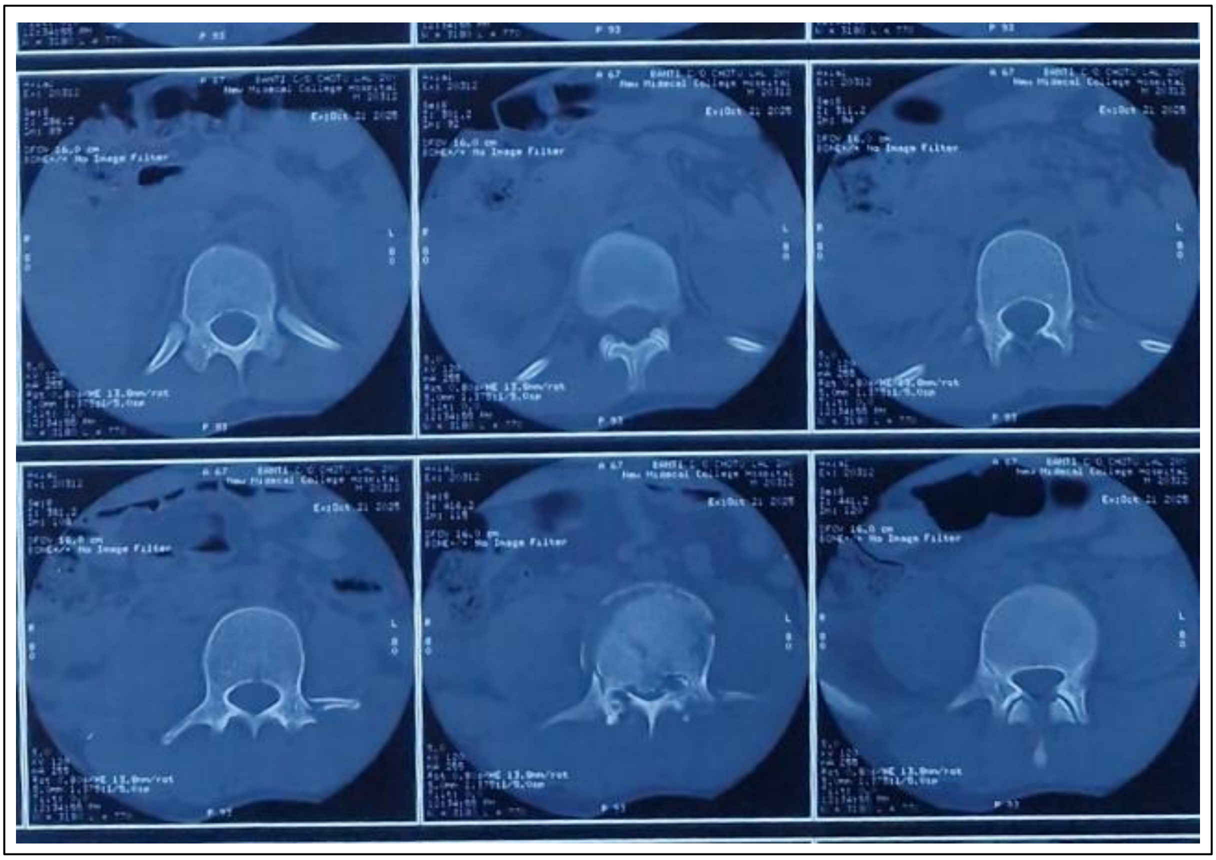

Fig 1 Showing Axial Cuts of D7 Vertebare Pedicle Fracture and Presence of Retropulsed Fragement.

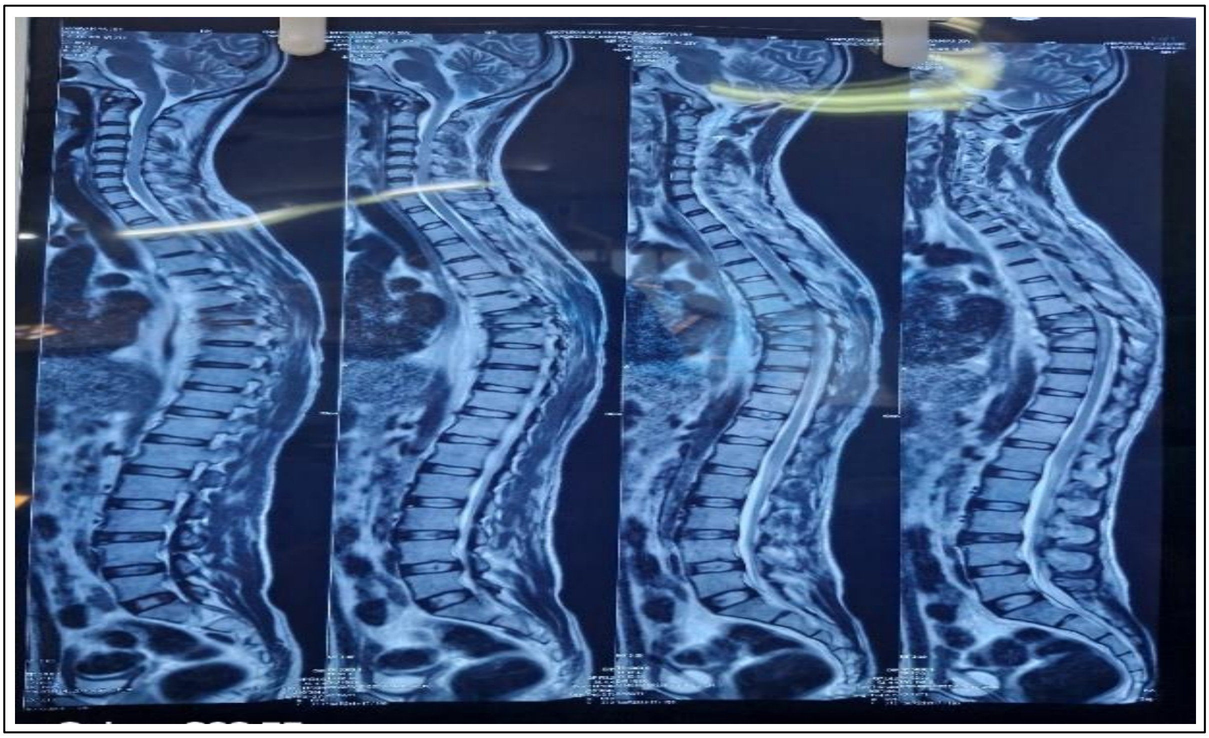

Fig 2 Showing Sagittal Cuts of Dorsolumbar Spine with CSF Signal Discontuinity

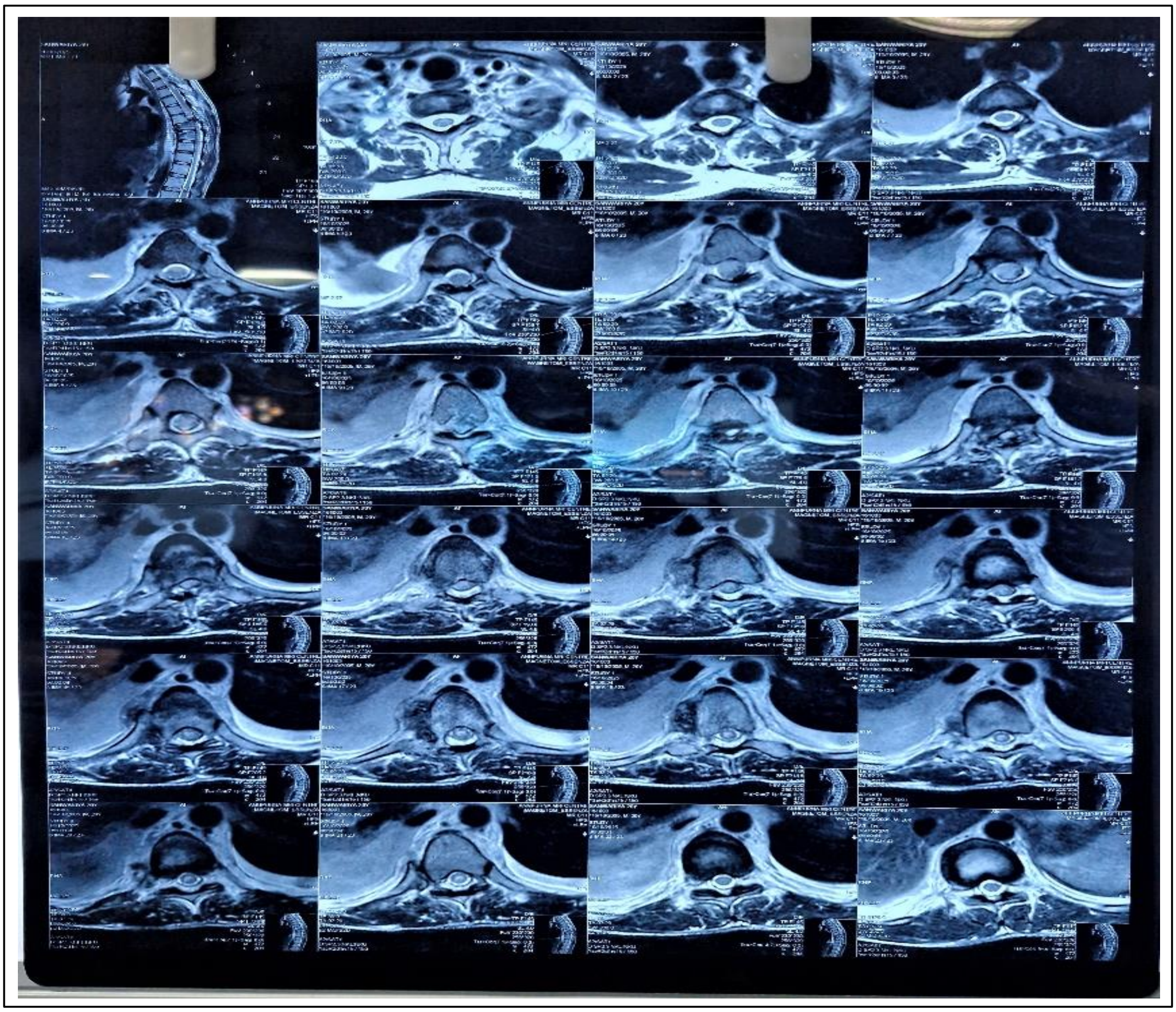

Fig 3 Showing Axial Cuts of MRI with Loss of Epidural Fat Plane

Fig 4 Intra Operative Photograph Depicting Dural Tear

Fig 5 Depicting Dural Repair Done with Prolene 6-0 RB Suture Material.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26aug1012

- *Outcome Measure:*

Intraoperative identification of dural tear (primary outcome).

➤ *Statistical Analysis*

Data analysis was performed using SPSS version 25. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages.

Comparisons between patients with and without TDT were performed using Student's t-test for continuous variables and Chi-square test or Fisher's exact test for categorical variables.

Variables with $p < 0.10$ on univariate analysis were entered into multivariate logistic regression analysis to identify independent predictors of TDT. Odds ratios with 95% confidence intervals were calculated. Statistical significance was defined as $p < 0.05$.

III. RESULTS

➤ *Demographic Characteristics*

A total of 110 patients met the inclusion criteria. The mean age was 38 years. Males accounted for the majority of patients with TDT. The most common mechanism of injury was fall from height (62%), followed by road traffic accidents (34%).

➤ *Incidence of Traumatic Dural Tear*

Traumatic dural tears were identified intraoperatively in 40 patients, corresponding to an incidence of 36.4%.

➤ *Clinical and Radiological Predictors*

Univariate analysis demonstrated significant associations between TDT and the following variables:

- Complete paraplegia (ASIA A)
- Laminar fracture
- CSF signal discontinuity
- Loss of epidural fat plane
- Dural spiking sign
- AO Spine type B or C fracture pattern

Retro pulsed fragments did not show a statistically significant association with TDT ($p = 0.1165$).

➤ *Multivariate Logistic Regression Analysis*

Multivariate analysis identified the following independent predictors of traumatic dural tear:

Table 1 Multivariate Logistic Regression Analysis

Predictor	Odds Ratio (OR)
Complete paraplegia (ASIA A)	117.11
CSF signal discontinuity	81.00
Loss of epidural fat plane	81.00
Laminar fracture	30.39
Dural spiking sign	16.00
AO Type B/C fracture	16.00
Pedicle fracture	2.25

➤ *Integrated Clinical–Imaging Risk Score for TDT*

A scoring system was developed based on independent and significant predictors. A scoring system can be constructed using the Odds Ratios (OR) as weights, as the OR quantifies the increase in the odds of the outcome occurring when a dural tear is present. The highest OR indicates the strongest predictive power.

We can categorize the strength of association into three tiers for an easy-to-use clinical prediction scale:

Table 2 Integrated Clinical–Imaging Risk Score for TDT

Score	OR Range	Strength of Association	Key Findings
3	OR>50	Extremely Strong	Signs that make a Dural Tear highly probable
2	5<OR<50	Very Strong	Findings that have a powerful and significant association
1	1<OR<5	Moderate/Weak	Findings with a significant but low-magnitude association.
0	OR<1	NO association	Findings that do not help predict a Dural Tear

By applying the scoring system to the calculated Odds.

Ratios, we can create a weighted predictive scale- Integrated Clinical–Imaging Risk Score for TDT

Table 3 Integrated Clinical–Imaging Risk Score for TDT

Outcome Variable	Odds Ratio (OR)	Score
CSF Signal Discontinuity	81.00	3
Loss of Epidural Fat Plane	81.00	3
Complete Paraplegia	117.11	3

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26aug1012

Lamina Fracture	30.39	2
Dural Spiking Sign	16.00	2
| AO Type B or C Fracture (vs. Type A)	16.00	2
Pedicle Fracture	2.25	1
Retropulsed Fragment Present	1.91 (p=0.1165)	0 (not significant)

- Top Predictors (Score 3): The Odds Ratio of 81.0 for both CSF Signal Discontinuity (image 2) and Loss of Epidural Fat Plane (image 3) makes them the most powerful radiological predictors of a Dural Tear. This is logically consistent, as both signs are direct consequences of a CSF leak and dural disruption. The single most powerful factor is Complete Paraplegia (OR=117.11), which is the most critical clinical outcome.
- Structural Integrity Loss (Score 2): Fractures involving the posterior element, such as Lamina Fracture (OR=30.39) and classification into AO Type B or C (OR=16.00), have a very strong association. This confirms that Dural Tears occur predominantly in less stable, high-energy injury patterns.
- Borderline Association (Score 1): The association with Pedicle Fracture (OR=2.25) is the weakest significant finding. Although the effect is real, it is not as powerful a predictor as other signs.
- No Significant Association (Score 0): The presence of a Retropulsed Fragment (OR=1.91, P>0.05) does not statistically predict a Dural Tear. This is a crucial finding, suggesting that it's the pattern of structural disruption (especially posterior element and rotational stability), not just the size or presence of a retropulsed fragment, that is linked to dural integrity.

IV. DISCUSSION

The present study identified complete paraplegia, laminar fractures, CSF signal discontinuity, loss of epidural fat plane, and dural spiking sign as strong predictors of traumatic dural tears in thoracolumbar fractures [7,9,10,17,18].

Laminar fractures are recognized indicators of high-energy trauma and posterior element disruption, which may contribute to dural laceration [14,17]. Similarly, AO type B and C injuries represent unstable fracture patterns associated with significant mechanical disruption.

MRI findings such as CSF signal discontinuity and loss of epidural fat plane demonstrated the strongest associations with TDT. These findings likely reflect direct evidence of dural disruption and CSF leakage [9,10,19,25]. Severe neurological deficit, particularly complete paraplegia, also showed a strong relationship with TDT, suggesting that extensive neural injury is frequently associated with concomitant dural damage [5,23].

The proposed integrated clinical–imaging risk score provides a practical framework for preoperative assessment. Recognition of high-risk patients may improve surgical preparedness, facilitate early planning for dural repair, and reduce postoperative complications such as persistent CSF leakage and pseudo meningocele formation[18–20,25].

Our findings are consistent with previous studies reporting the predictive value of MRI signs and posterior element fractures in thoracolumbar trauma.

➢ *Study Strengths*

- Exclusive use of intraoperative findings as diagnostic gold standard
- Comprehensive imaging assessment
- Development of applicable risk score

➢ *Limitations*

- Retrospective, single-centre design
- Limited sample size
- Lack of postoperative follow-up data on CSF leak rates
- Absence of long-term postoperative follow-up

Future multicentre prospective studies with larger sample sizes are recommended to validate the scoring system.

V. CONCLUSION

Laminar fractures csf signal discontinuity, loss of epidural fat plane, complete paraplegia and dural spiking sign are independent and reliable predictors of traumatic dural tears in dorsal and lumbar spine fractures. Incorporating these radiologic and clinical features into a preoperative risk score enhances prediction accuracy and facilitates better surgical preparedness, improving patient outcomes.

ACKNOWLEDGMENTS

The authors acknowledge the Department of Radiology and the operation theatre staff for their support.

➢ *Conflict of Interest*
The authors declare no conflicts of interest.

➢ *Funding*
No external funding was received for this study.

Author's contribution Dr DK RAIDAS conceived the research idea, developed research design and conducted the research under guidance of Dr RP MEENA, Dr. KG NAMA and Dr. UK MEENA, Dr.UK MEENA performed the statical analysis. All authors contributed substantially to the write up of the article. All authors reviewed and approved the final draft of the manuscript and take responsibility of the content of the publication

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26aug1012

REFERENCES

[1]. Denis F. The three column spine and its significance in the classification of acute thoracolumbar spinal injuries. Spine (Phila Pa 1976). 1983;8(8):817–31.
[2]. Vaccaro AR, Lehman RA Jr, Hurlbert RJ, et al. A new classification of thoracolumbar injuries. Spine (Phila Pa 1976). 2005;30(20):2325–33.
[3]. Wang JC, Bohlman HH, Riew KD. Dural tears secondary to operations on the lumbar spine. J Bone Joint Surg Am. 1998;80(12):1728–32.
[4]. Fehlings MG, Tetreault LA, Wilson JR, et al. A clinical practice guideline for the management of acute spinal cord injury. Global Spine J. 2017;7(3 Suppl):84S–94S.
[5]. Fehlings MG, Vaccaro A, Wilson JR, et al. Early versus delayed decompression for traumatic spinal cord injury. PLoS One. 2012;7(2):e32037.
[6]. Kim KT, Lee SH, Suk KS, et al. Dural tears in spinal surgery: risk factors and management. Spine (Phila Pa 1976). 2008;33(20):E723–9.
[7]. Moon MS, Choi WT, Moon YW, et al. Dural tears in spinal burst fractures. Spine (Phila Pa 1976). 1996;21(17):2016–22.
[8]. Lee HM, Kim HS, Kim DJ, et al. Reliability of MRI for detecting posterior ligament complex injury. Spine (Phila Pa 1976). 2000;25(16):2079–84.
[9]. Aono H, Tobimatsu H, Ariga K, et al. MRI predictors of traumatic dural tears in thoracolumbar burst fractures. Spine J. 2018;18(10):1755–62.
[10]. Kanna RM, Shetty AP, Rajasekaran S. Imaging predictors of dural tears in thoracolumbar trauma. Eur Spine J. 2020;29(8):1986–94.
[11]. Wang MY, Hoh DJ, Leary SP, et al. Management of incidental durotomy in spine surgery. Neurosurg Focus. 2008;25(2):E15.
[12]. Harrop JS, Sharan A, Przybylski GJ. Epidemiology of spinal cord injury. Neurosurg Focus. 2000;8(6):e4.
[13]. Chen WJ, Niu CC, Chen LH, et al. Traumatic dural tears in thoracolumbar burst fractures. Spine (Phila Pa 1976). 2001;26(18):E387–92.
[14]. Holdsworth F. Fractures, dislocations, and fracture-dislocations of the spine. J Bone Joint Surg Am. 1970;52(8):1534–51.
[15]. Wood KB, Li W, Lebl DR, et al. Management of thoracolumbar spine fractures. Spine J. 2014;14(1):145–64.
[16]. Qian BP, Qiu Y, Wang B, et al. Risk factors for dural tears in thoracolumbar burst fractures. Orthop Surg. 2012;4(2):85–9.
[17]. Aono H, Ohwada T, Kaneko N, et al. Incidence of dural tears associated with laminar fractures. Spine (Phila Pa 1976). 2007;32(1):E38–45.
[18]. Kanna RM, Rajasekaran S. Role of MRI in predicting dural tears in spinal trauma. J Orthop Trauma. 2021;35(Suppl 2):S12–8.
[19]. Li Y, Shen Y, Zhang Y, et al. MRI features predicting traumatic dural tears in thoracolumbar fractures. Clin Radiol. 2022;77(6):e418–25.
[20]. Park HY, Kim HJ, Kim HS, et al. Preoperative MRI predictors of dural injury in thoracolumbar burst fractures. Asian Spine J. 2023;17(2):278–86.
[21]. Kulkarni AG, Shah SP, Kulkarni MG, et al. Posterior decompression and stabilization for thoracolumbar fractures. Indian J Orthop. 2012;46(3):272–8.
[22]. Vaccaro AR, Oner C, Kepler CK, et al. AOSpine thoracolumbar spine injury classification system. Spine (Phila Pa 1976). 2013;38(23):2028–37.
[23]. Kirshblum SC, Burns SP, Biering-Sorensen F, et al. International standards for neurological classification of spinal cord injury. J Spinal Cord Med. 2011;34(6):535–46.
[24]. Hashimoto T, Kaneda K, Abumi K. Relationship between spinal canal compromise and neurological deficit. Spine (Phila Pa 1976). 1988;13(11):1268–72.
[25]. Zhang J, Wang L, Liu Z, et al. Advanced MRI signs of dural disruption in thoracolumbar trauma. Eur Radiol. 2024;34(1):512–21.