Review Article

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Management Of Thoracolumbar Fractures In Adults: Current Algorithm

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Abstract

Thoraco-lumbar (TL) fractures are the most common sites for spinal injuries. The severity of these injuries can range from minor, un-displaced fractures amenable to conservative management to highly complex, unstable fractures requiring surgical interventions. There is still considerable ambiguity on various issues related to the management of these vertebral injuries. The current article addresses several crucial questions related to the management of TL spinal fractures.

An elaborate search was performed on standard medical search engines including pubmed, google and medline databases using keywords "adult TL fractures", adult thoracolumbar fractures", "adult thoracolumbar injuries", "adult thoracolumbar spinal injuries", "spinal injuries" and "spinal fractures". Based on this comprehensive narrative review, we have discussed the key consensus of the existing literature on various aspects of management of these fractures.

Currently the most useful system for defining TL fractures is the AO classification system. The best initial imaging modality is computerize tomography (CT) scan, with magnetic resonance imaging (MRI) being the most useful modality in AO type B2 injuries. All patients with AO types B and C injuries require surgical intervention. The current literature is shifting in favor of posterior approach, in view of less complications and morbidity associated with these surgeries. The role of decompression in enhancing neurological recovery and the need for surgical fusion in addition to instrumentation in TL fractures are still controversial. The current literature is strongly against the use of high dose steroids in acute TL fractures with SCI.

Keywords: Thoraco-lumbar fractures, AO Spine classification, Imaging modalities, Fracture fixation

Introduction:

Thoraco-lumbar (TL) region is one of the most common sites for spinal injuries, and constitute around 15-20% of traumatic spinal fractures and dislocations [1]. While majority of these fractures in younger patients occur secondary to high energy trauma, osteoporosis-related injuries constitute a significant proportion of these fractures in the elderly [2,3].

Various aspects regarding the optimal management of these TL fractures are still largely debated. The goal of treatment of these fractures in patients without neurological deficits is to achieve a well-balanced and stable spine by facilitating good fracture union, either with the help of external (bracing, immobilization etc.) or internal supports (internal stabilization) [4]. The current article discusses certain controversial and interesting issues regarding these fractures and elaborates on the pearls and pitfalls in their management.

Materials and Methods:

An elaborate search was made using keywords "adult TL fractures", "adult thoracolumbar fractures", "adult thoracolumbar injuries", "adult thoracolumbar spinal injuries", "spinal injuries" and "spinal fractures" on Pubmed, Google and Medline databases. We identified certain crucial questions concerning TL injuries and included relevant articles pertaining to those subjects. The topics for discussion in this article included:

1. Classification systems for TL fractures
2. Imaging modalities and their relevance in TL fractures
3. Operative versus non-operative treatment
4. Surgical approaches
5. Role of decompression
6. Steroids in spinal cord injury (SCI)
7. Traumatic dural injuri
8. Fusion after fixation.

We identified a total of 2961 articles, of which 379 were full texts in English language. Randomized controlled trials (RCTs) and level 1 studies were given preference. Finally, 66 articles were

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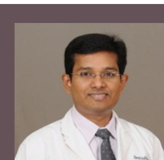

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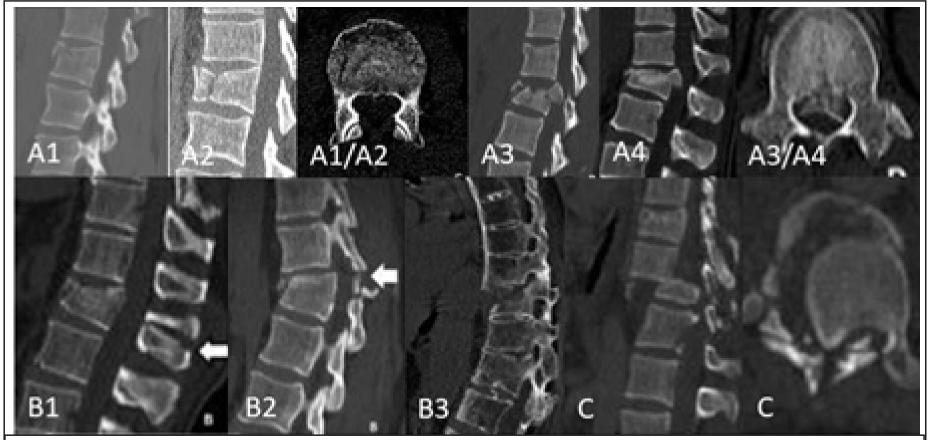

Figure 1: Current AO classification- CT and radiographs showing type A, B and C fractures

included for this narrative review. We did not perform any screening [Preferred Reporting Items for Systematic Reviews and Meta-Analyses(PRISMA) or Methodological index for non-randomized studies (MINORS) scoring criteria for including the articles.

Discussion:

The TL junction is a transitional zone of the spinal column, distinctly positioned at the junction of rigid thoracic and flexible lumbar spines. This unique construct places these spinal segments at significantly greater biomechanical stresses; and therefore these are common zones for traumatic fractures or dislocations [5]. The fractures of thoracic and lumbar regions belong to a wide spectrum of injuries, ranging from un-displaced fractures to severely displaced injuries [6]. The management of these injuries still remains controversial. The goal of treatment of these injuries is to achieve a stable, but sufficiently mobile and pain-free spine, with maintenance of normal neurological status and adequate global balance in the coronal and sagittal planes [6]. In a majority of patients, this outcome may be achieved by conservative measures, while surgical stabilization may be warranted in more unstable fractures and situations of accompanying neurological deficits [7,8].

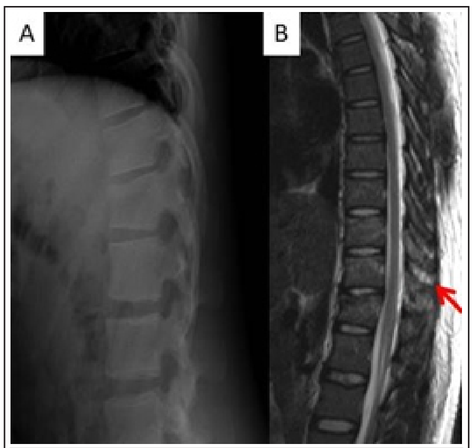

Figure 2: A – Lateral radiograph showing AO type A1 fracture; B – T2 weighted sagittal MRI showing significant hyper-intensity and injury over posterior ligamentous complex (PLC), thereby the fracture was re-classified as AO type B2

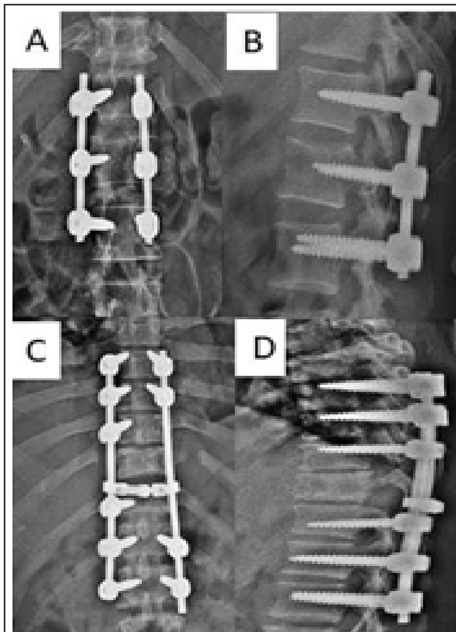

Figure 3: A, B – Antero-posterior and lateral radiographs showing short segment pedicle screw fixation; C, D - Antero-posterior and lateral radiographs showing long segment pedicle screw fixation

Classification systems of TL fractures

Classification systems aid in good communication among physicians; and an ideal classification system should be simple, easy to apply, reproducible and aid in lucidly describing the fracture pattern, focusing on characteristics most relevant to treatment planning and prognostication [9,10]. As imaging technologies have continued to evolve, the classification systems and algorithms for treatment have also persistently grown in their complexity over the years [11].

While the initial classification systems were purely morphological, the recent classification systems have tried to incorporate bony morphology, stability of both osseous and ligamentous elements; and neurological status of the patient [10,11]. Vaccaro et al. [10] introduced the TLICS (Thoracolumbar Injury Classification and Severity) system in 2007, attempting to score the severity of spinal injury based on fracture morphology, posterior ligamentous complex disruption and neurological status (shown in table 1). Studies have demonstrated good-to-excellent inter-rater reliability (among both radiologists and neurosurgical providers) for TLICS system; and reasonable to moderate validity (good negative predictive and moderate positive predictive values) for non-operative and operative cases of TL injuries [12]. Some of the criticisms against TLICS scoring system included disagreement among users on the precise definition on injury morphology and posterior ligamentous complex (PLC) injury [11,13].

In 2008, AO established Spine Classification group with the goal of revising AO-Magerl classification [14,15,16]. Further on, AO Spine Knowledge Forum Trauma, constituted by a group of International surgeons

Table 1: TLICS score: Individual Predictors

1	Morphology	-Compression	1	-Radiographs
		-Burst	2	-CT
		-Translation/ Rotation	3	
		-Distraction	4	
2	Integrity of PLC	-Intact	0	-MRI
		-Suspected	2	
		-Injured	3	
3	Neurological	-Intact	0	-Physical Examination
	Status	-Nerve root	2	
		-Complete cord	2	
		-Incomplete cord	3	
		-Cauda equina	3	
Predicts		**Need for surgery**	**0-3**	**Non-surgical**
			4	**Surgeon's preference**
			>4	**Surgical**

with special interest in trauma developed and validated classification systems for cervical sub-axial and thoraco-lumbar spine fractures. The current AO spine classification has incorporated fracture morphology, neurological status and case-specific modifiers which may potentially influence decision making and prognostication (table 2, fig. 1) [15,16].

Many studies have evaluated the inter-observor reliability of AO Spine Thoraco-lumbar Injury Classification System. In the study by Azimi et al. [16], a near-perfect reproducibility was demonstrated for the AO Spine thoraco-lumbar classification, with kappa values for intra- and inter-observer reliability approaching close to 0.83 to 0.89. In a validation study involving 100 spine surgeons world-wide, the overall reliability for all cases was moderate (kappa = 0.56), while the inter-observer reliability was 0.80, 0.68 and 0.72 (kappa values) for types A, B and C injuries, respectively [17]. In the study by Schnake et al. (2017) [18], the inter-observer reliability showed a kappa of 0.64 for all fracture types. While injury types A and C revealed kappa values of 0.72 and 0.7 respectively, the least reliability was seen in type B injuries (kappa = 0.58): especially fracture types B2 (kappa = 0.34) and B3 (kappa = 0.41). In the international validation study by Sadiqi et al. [1], there was no demonstrable association between the surgeon's level of experience and reliability of the classification system. However, another international study demonstrated only a modest reproducibility among a group of Chinese spine surgeons for AO Spine thoraco-lumbar fracture classification system [20]. A recent multi-center trial compared directly the TLICS and AO Spine TL classification systems and revealed that the latter classification showed better reliability in identifying TL fracture morphological patterns [21]. Thus, although not still a perfect solution, the AO Spine Classification is currently the most valuable and reliable tool that is available for communication, patient care and research in TL fractures.

Imaging modalities in TL fractures

Classification of TL fractures and decision making on its management relies heavily on radiological evaluation. Antero-posterior (AP) or lateral radiographs (with additional swimmer's and coned-down views for evaluation of cervico-thorasic and lumbo-sacral regions, respectively) can provide vital clues regarding the nature of injury, involvement of spinal columns and possible classification. More advanced imaging like CT and MRI provide more accurate delineation of posterior vertebral body wall fractures, spinal canal obliteration, status of spinal cord and injuries to the posterior column. The emphasis on PLC injury being considered as an independent variable in the assessment of TL fracture instability was first instituted by Vaccaro et al. and hyperintense signal changes on short tau inversion recovery (STIR) images can accurately identify this injury [22]. Although the principle of "all for all" may provide the most accurate assessment of injury, this approach tremendously enhances the costs involved and the financial strains placed on health care system [23].

Table 2: AO Classification

Fracture Morphology	Thoraco-lumbar Modifiers
Type A – Describes compression injuries to vertebral body	**M1 –** Indeterminate injury to the tension band, based on MRI or clinical examination
A0 – Mechanically insignificant fractures (spinous or transverse process fractures)	**M2** – Patient-specificcomorbidity, like
A1 – Compression or impaction fractures involving single end plate (without involvement of posterior wall of vertebral body)	ankylosing spondylitis, diffuse idiopathic skeletal hyperostosis (DISH) or burn injuries overlying the injured spine
A2 – Coronal split or pincer-type fractures, with involvement of both end plates (without involvement of posterior wall of vertebral body)	**N0** —Neurologically intact **N1** —Transient neurological deficit **N2** —Evidence of radiculopathy
A3 – Incomplete burst fractures, with involvement of a single end-plate	**N3** —Incomplete spinal cord or cauda equina injury **N4** —Complete spinal cord injury **NX** —Neurology undetermined
A4 - Complete burst fractures, with involvement of a single end-plate	
Type B – Tension Band Injury	
B1 – Monosegmental osseous failure of	
posterior tension band, extending onto vertebral body	
B2 – Disruption of posterior tension band with	
or without osseous involvement	
B3 – Anterior tension band injury with	
separation of anterior structures	
Type C – Displacement/ Translational Injury	

In a study by Rajasekaran et al. [24] involving 41 spine surgeons worldwide, 43.4% of fractures could be correctly classified according to the AO classification system on the basis of plain radiographs alone. CT and MRI further increased this percentage by 18.2% and 2.2%, respectively. AO type A fractures could be classified in 51.7% of patients, based on plain X-rays. All the three modalities had similar accuracy in diagnosing Type C fractures. MRI showed a statistically greater sensitivity in identifying type B fractures, as compared with CT imaging. Based on their observations, they concluded that although MRI conferred a modest benefit in the diagnosis of B2 fractures (fig. 2), routine need for MRI for classification, assessment of instability or need for surgery was not recommended. In another study, it was proposed that presence of kyphosis greater than 20° (sensitivity of 85% and confidence interval 64-95) on emergency room plain radiographs and inter-spinous distance widening greater than 2 mm (sensitivity of 90% and confidence interval 70-97) on emergency room plain radiographs or CT scan could potentially indicate an underlying PLC injury [25].

Sixta et al. [26] had proposed a thoracolumbar spine clearance protocol, similar to the cervical spine clearance criteria (table 3) to assess the need for an initial spine evaluation in trauma patients. In patients younger than 14 years, plain radiographs have been definitively shown to be the initial investigation of choice; nevertheless, the verdict is not very clear in older patients [27]. CT scan is currently the standard advanced imaging modality for the initial evaluation of TL fractures. Khurana B et al. [28] had recently proposed the feasibility of using a focused MRI in serious trauma situations, in order to balance the advantage of better assessment of PLC with the necessity to perform the investigation rather expeditiously. They described the "focused zone" as the region of spine extending from 3 levels proximal to 3 levels distal to the fractured vertebral segment (as identified on CT or radiograph). In their study, such a focused MRI protocol involved short tau inversion recovery (STIR), sagittal T2, sagittal T1 and axial T2 sequences of the focused zone; and could be performed in 15 minutes (as compared with the usual 45-minute study period). Although 15% of non-contiguous fractures were missed in the distant zone (beyond the focused zone) of the spinal column, none of these injuries were clinically significant injuries. Nevertheless, there are other proponents for considering whole body imaging in any patient with an identified spine fracture too, keeping in view the possibility of occurrence of non-contiguous spinal injuries [29,30].

Thus, although we do not still have the definitive answer, the best possible approach is to consider initial evaluation with plain X-rays, with a low threshold to consider more advanced imaging like CT scanin patients with a suspicion for fracture (especially in patients older than 14 years). The need for MRI scan, as an additional mode of imaging, may be considered on a case-to-case basis.

Operative versus non-operative treatment; and the role of bracing

As previously mentioned, there are still no clear guidelines on TL fracture management. The decision to consider conservative versus surgical management of these fractures is predominantly based on neurological status and spinal column stability. In general, based on the AO classification, surgical intervention is generally considered for types A fractures, when the compression is more than 50%, involvement of 3 or more contiguous levels and PLC injury is suspected (more than 30° kyphosis) or present; and all type B and C fractures [31] (fig. 3).

AO type A0 fractures typically do not require any intervention. AO types A1 and A2 fractures are conservatively managed with bracing extending over 2 or 3 months. The main purpose of brace is to restrict spinal flexion, thereby enabling transfer of minimal loads across the anterior column. It is also recommended that standing AP and lateral X-rays need to be obtained before committing the patient to non-operative management with bracing. Similarly, AO types A3 and A4 fractures (<30° kyphosis, <50% collapse and <50% spinal canal compromise) are also amenable to conservative treatment with bracing. A thoraco-lumbo-sacral brace (TLSO), which enables immobilization of spine in relative extension (3-point compression principle) can stabilize spine and prevent any development of kyphotic collapse. The duration of bracing extends over 8 to 12 weeks, with regular standing radiographs obtained every 4 to 6 weeks. Progressive deformity, persistent back pain and any neurological symptoms may indicate failure of non-operative treatment [32, 33,34,35].

Surgical approaches

In the surgical group, the approaches that may be broadly considered include anterior, lateral, posterior or a combination of anterior and posterior techniques. Although there is extensive literature on the different surgical techniques for fracture reduction and stabilization, there is still no consensus on the ideal treatment. The expertise and preference of the treating surgeon play a major role in the decision making regarding the surgical approach [36].

Posterior spinal instrumentation is the most frequent fixation in TL fractures, owing to the low incidence of morbidity and mortality [37]. Certain studies have revealed some loss of correction over time with posterior spinal fixation. Without an additional reinforcement of the anterior support, the vertebral body and the intervertebral (IV) discs can undergo progressive collapse by around 7 to 9°38. Curfs et al. [39] revealed that type A3 and T12-L1 level fractures carry a high risk for developing progressive kyphosis. In posterior-only fixation, it has been demonstrated that 1/1 (one level proximal and distal) constructs did not maintain correction adequately. Based on the existing literature, 2/2 posterior-only constructs have been recommended as adequate fixation in TL fracture scenarios, with the addition of another proximal and distal level of fixation to the 2/2 constructs not contributing any further to the strength and stability [31,40]. The loss of correction in posterior-only fixation has however not been associated with poorer clinical outcome in certain previous studies [41]. On the contrary, Seo et al. [42] did observe a significant relationship between residual post-operative thoracolumbar kyphosis (>10°) and poorer radiological and clinical outcome. Kanezaki et al. [43] also emphasized on the importance of severity of intervertebral disc injury (IDI) in TL fractures; and concluded that the long-term prognosis for kyphosis progression following implant removal is primarily dependent on the damage imparted to the discal element at the time of injury (rather than the bony morphology).

The Spine Study Group of German Association of Trauma Surgery demonstrated through a prospective multicenter study involving 448 patients

Table 3:Thoracolumbar Spine Clearance

Thoracolumbar spine imaging - Indicated in patients who meet any of the following criteria:
High mechanism of injury
—Fall > 10 feet
—Ejection from motor vehicle
—Motorcycle crashes
—High velocity MVA
—Pedestrian struck by motor vehicle
Abnormal clinical presentation
—Back pain
—Point tenderness
—Neurologic deficit
—Altered mental status (GCS <15)
Other abnormal findings
—Multiple/ distracting injuries
—Cervical spine injury
—Head injury

treated with posterior-only approach, as against 197 patients treated with a combined approach [44-46]. There was a significantly better correction of a post-traumatic kyphotic deformity in patients treated with combined approach, as compared with posterior-only approach. However, posterior-only approach is associated with significantly shorter duration and less blood loss, both of which may be advantageous in polytrauma or high risk scenarios.

While posterior approaches can achieve indirect decompression with ligamentotaxis and realignment of spinal segments, approaching the fractured vertebra anteriorly can enable direct access to the ventrally impinging bone fragments and provide direct decompression of the neural elements [47]. However, in burst fractures not associated without neurological deficits, it has been shown that the retropulsed fragments and the spinal canal do undergo significant remodeling over time, raising a question on whether clearing those fragments is of any benefit at all. In addition to posterior spinal fixation, addition of vertebroplasty or balloon kyphoplasty to regain vertebral body height has been gaining popularity recently [48-51].

Minimally invasive approaches have been reported to help in achieving fixation in TL fractures, with much less morbidity. In a systematic review by Phan et al. [52] there was a statistically significant reduction in the length of stay in MIS approaches, as compared with open surgeries. In a randomized controlled study (RCT) by Chang et al. [52], comparison was made between thoracolumbar fractures treated with open reduction and internal fixation via posterior paraspinal muscle approach (PPMA) and those treated with the traditional posterior midline approach (PA). The PPMA approach involved blunt dissection through the interval between multifidus and longissimus. The PPMA approach required longer surgical time and radiation exposure time than PA approach. Nevertheless, PPMA provided several advantages including small volume of blood loss, lower post-operative drain output, better post-operative pain relief and better functional outcome as compared to PA approach.

Dhall et al. [54] described an algorithm, based on the TLICS score for assisting the surgeon in formulating treatment plan for minimally invasive (MI) surgical option in TL fractures. Based on their approach, patients with TLICS <4 are candidates for external bracing, TLICS = 4 are candidates for external bracing, open surgery or MI surgery [anterior or lateral approach – for fusion; versus posterior approach – including percutaneous fixation (DISH, AS), MI decompression and MI corpectomy]; and patients with TLICS >4 are candidates for open posterior surgery; or anterior/lateral MI approach for corpectomy along with open/percutaneous posterior instrumentation. They cautioned against universal application of percutaneous implants in the form of "internal brace" and delayed implant removal, as there is still unclear evidence on the long-term efficacy of such an approach and the screw-bone interface may gradually loosen in the long run.

Another important factor to be considered in spinal fixation is the length of instrumentation. While type A fractures do well with short segment instrumentation, type B and type C fractures need longer segment fixation. Based on the report by Kanna et al. [55], the middle pedicle screw typically acts as the forward driving point, forming a string force for reduction and kyphosis correction. It has also been suggested that single axis screws aid better in reduction, as co pared to polyaxial screws [56].

Thus, literature is still largely inconclusive on the ideal approach for the management of TL fractures. In a recent meta-analysis published by Tan et al. [57] comparing anterior versus posterior approaches for TL fractures, no differences were observed between the two approaches with regard to the length and cost of hospital stay, late kyphotic angle, construct failure or instrument revision rates and return to work. The authors concluded that given the similarities in neurological, radiological and functional outcomes between the two approaches, the significantly longer duration of surgery, as well as estimated blood loss need to considered as important factors by the surgeon, prior to deciding upon the approach. They recommended the need for high quality research on this subject to understand this issue better. The philosophy in our hospital regarding the surgical approach is also quite similar. Over the past years, we have drifted towards all-posterior approach for most of the TL injuries in view of the aforementioned factors.

Role of decompression and steroids in neurological recovery in SCI

Various studies have recommended surgical intervention in TL fractures (types A3 and A4) in order to decompress the spinal canal and clear the retropulsed bony fragments. Surgical decompression of the spinal cord, either directly by manually removing the fragments or corpectomy, or indirectly through ligamentotaxis, is traditionally the accepted line of management for TL burst fractures. Nevertheless, the critical degree of canal compromise and the need for such a canal decompression universally in all patients with TL fractures is still largely ambiguous [58].

Meves et al. [59] demonstrated a significant positive correlation between the degree of canal compromise and severity of incomplete neurological deficit (Frankel types B, C and D). Hashimoto et al. [60] also observed an association between neurodeficit and spinal canal compromise. Fontine et al. [61] concluded that although a significant correlation between the occurrence of neurological deficit and canal compromise existed, there was no further correlation between the degree of compromise and the severity of neurodeficit (based on Frankel grades). However, certain other studies have demonstrated no significant association between the degree of canal compromise and neurological status. Such observations have been explained by the hypothesis that neurological deficit occurs at the time of injury, when anatomy of the vertebra is maximally distorted, and imaging (CT or MRI) hours after the injury does not accurately reflect the actual displacement at the moment of violation of neural elements [58,62].

It has also been shown that the retropulsed fragments gradually clear from the spinal canal with time. Kinoshita et al. [63] reported that bony fragments gradually reduced to 50% of the initial size within one year post-injury and then get completely resorbed within 5 years. Other studies have also observed that spinal canal remodeling usually starts within 2-3 weeks post-injury, and therefore a significant amount of canal clearance happens within the first 3-4 weeks. Miyashitaet al. [58] reported that based on these observations, bony fragments visible in the spinal canal might not truly represent an ongoing compression and therefore, clearance of these fragments might not be truly required in most instances.

The literature is still unclear on whether decompression enhances the neurological recovery in patients following TL injuries. Some studies have recommended anterior decompression and stabilization in AO types A3 and A4 fractures, and observed that the degree of neurological improvement varied between 1.7 and 1.9 Frankel grades post-operatively [64,65]. Nevertheless, other studies have not demonstrated any significant neurological improvement in patients who underwent spinal canal decompression, as compared to those who did not [58]. In a comparative study between patients who underwent anterior decompression and fusion and posterior non-decompression surgeries, Dall et al. [66] concluded that the initial fracture pattern (including kyphotic collapse) was the only factor which correlated with neurological recovery. Recent studies have described the roles of minimally invasive procedures, in the form of percutaneous pedicle screw fixation and ligamentoxis (indirect decompression) and mini-open lateral approaches for corpectomy and anterior column support for TL SCI patients [67]. At our institution, we do not perform decompression in AO types A3 and A4 fractures without any neurodeficit. However, in patients with neurological deficits, we do perform appropriate decompression, so as to allow maximal chances of recovery. There is also sufficient evidence to suggest that early decompression within 24 hours after SCI is safe and can be potentially associated with better neurological outcome [67]. The general recommendation is that surgery should be performed as soon as the patient is medically stable.

In the second National Acute Spinal Cord Injury Study (NASCIS-2), Bracken et al. [68] had shown a small benefit of high-dose methyl prednisolone (MP) for neurological recovery in patients with post-traumatic SCI. They had recommended that the drug should be administered within the initial 8 hours. The rationale underlying the purported utility of MPs was based on its ability to inhibit inflammatory reactions, lipid peroxidation and secondary cascade of SCI [68]. However, several other studies over the past years, have demonstrated the inefficiency and significant, potential complications associated with MP administration in SCI patients [69]. Most of the up-to-date pharmacological guidelines and recent meta-analyses have also recommended against the role of high dose MPs in meliorating neurological recovery in SCIs [69,70]. Thus, the current literature is strongly against the use of MPs in SCI patients.

Dural repair of traumatic dural injuries

The incidence of traumatic dural lacerations ranges between 18 and 36% [71]. The classic fracture patterns associated with cerebrospinal fluid (CSF) leaks include vertical laminar fractures [71]. Patients with traumatic dural tears have a very high likelihood of associated neurological deficit (almost 100% in many studies) [72]. The complications associated with traumatic dural tears are significantly less than those associated with iatrogenic dural leaks, and the incidence of complications [pseudomeningocele, meningitis, arachnoiditis, epidural abscess, dura-cutaneous fistula, hematoma, entrapment of nerve root, wound complications, headache, and return to operating room (OR)] has been reported between 1.8 to 3.4% [73-75]. This could potentially be due to the more favorable healing potential created by the inflammation and hematoma formation during the post-trauma period [73]. Only around 80% of these dural tears are reported to be amenable to some form of closure, which is significant less than iatrogenic lacerations [73]. The principles of managing these dural lacerations are similar to dural tears in non-trauma situations, and include procedures like conventional dural repair, tisseal (Baxter, Deerfield, IL, USA), grafts like Duragen (Integra, Plainsboro, NJ, USA), Gelfoam (Baxter, Hayward, CA, USA), fat, fascia, or muscle [76].

Fusion after fixation

Another issue of controversy in the management of TL fractures includes the role of fusion versus instrumentation-sans-fusion approach in TL fractures. While several studies had recommended posterior fusion in AO type A fractures [77,78], some studies claimed no additional benefit [79-81]. Jindal et al. [81] reported in 2012 that fusion offered no additional benefit in TL AO type A3 or A4 fractures. In a recent meta-analysis too, there was no improvement of clinical or radiological outcomes following fusion procedure, with additional risks of increased surgical time and intraoperative bleeding. More recent studies have supported the role of percutaneous pedicle screw fixation, as an alternative means to provide "internal bracing" for the AO type A fractures [82] (fig. 4). Traditionally, AO type B and C fractures have been managed by open posterior fusion with long segment fixation. AO type B1 fractures usually heal well once the anatomical alignment is achieved. Therefore, these injuries are also amenable to posterior instrumentation without fusion [83]. Grossbach et al. [84] compared the outcome of percutaneous "internal fixation" and open posterior fusion in patients with AO type B2 fractures. They concluded that there was no difference in kyphosis between these two groups, and MIS group was not associated with any progression of kyphosis with time. They recommended that the posterior implants in these patients may not be routinely removed, unless specifically indicated or symptomatic. In a recent literature review, Chu et al. concluded that although the early results so far have been encouraging, there is still inadequate literature to definitely support the role of instrumentation-sans-fusion surgery in patients with AO type B2 fractures [83,85].

Conclusion:

Thoracolumbar fractures are a diverse group of injuries. Apart from the fracture morphology, general condition of the patient (and co-morbidities) and neurological status play an important role in decision making and management of these injuries. Recent fracture classifications have tried to incorporate these factors too into consideration. Overall, there is still a lot of ambiguity in the management of these fractures, and the line of management must depend not only upon the general guidelines, but also tailored specifically on a case-to-case basis depending upon the patients' needs. We have comprehensively described the various aspects of management of these complex injuries and would like to emphasize that future large scale randomized controlled trials focusing on diverse issues related to these fractures can help us understand these injuries better and ameliorate the patient care.

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