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Management of Post-Traumatic Lumbar Fractures

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Abstract

Spinal fractures can vary widely in severity and treatment. They can be caused by: A high-energy trauma, such as a motor vehicle collision and a low-energy event, such as a minor fall, in an older person whose bones are weakened by osteoporosis. There are many factors that influence the treatment of spinal fractures, including the severity of the fracture and whether the patient has any associated injuries. The T10-L2 thoracolumbar region is the most common area of injury to the spine from trauma due to the specific biomechanics of this segment of the spine. Specifically, this is a transition area from the rigid and less mobile thoracic spine (due to the presence of the ribs which attach to the spine bilaterally) to a more flexible lumbar spine. Injury to this area can result in a permanent neurological deficit from compression or direct injury to the nerve roots of the cauda equina or the conus medullaris and warrants immediate attention and assessment. This study reviews the management of thoracolumbar junction fractures.

Keywords: Traumatic, Lumbar Fractures, spine.

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1. Introduction

In one series, 4.4% of all patients arriving at a Level I trauma center were diagnosed as having a fracture of the thoracolumbar spine. Because of the confounding aspects of the various organ injuries, the incidence of missed injuries of the thoracolumbar spine has been reported as high as 20%, especially in those with blunt trauma caused by high-energy impact and those with altered mental status [1]. The initial spine evaluation pays close attention to the history and assesses for reports of any acute back or neck pain, transient neurology, weakness, or even paralysis at the time of the injury. A full motor and sensory examination should be performed with the cooperative patient and scored according to the ASIA (American Spine Injury Association) classification scheme [2]. If the level of neurology and the apparent spinal level of injury do not closely align, then a magnetic resonance (MR) of entire spine should be obtained to try to verify actual cause of deficit. The bulbocavernosus reflex is tested by gently squeezing glans penis or clitoris or tugging on the Foley. If absent, patient is felt to be in spinal shock (which can persist for up to 72 hours) or may have just suffered damage to caudal segments of conus medullaris.

If hyperactive, it would suggest disinhibition because of a complete spinal cord injury [3]. If the patient appears stable neurologically, a careful log-roll maneuver can be performed to palpate the spine for kyphotic angulation, step-offs, and point tenderness such as with ligamentous injuries. If there is a neurologic deficit, radiographs should be obtained first, typically three- dimensional (3D) computed tomography (CT) in modern trauma facilities. Rectal exams are done to assess tone, voluntary control, and the bulbocavernosus reflex [4]. Up to 25% of patients with thoracolumbar fractures have vertebral fractures elsewhere, usually the cervical spine. Those unconscious, combative, or sedated individuals who are unable to provide a valid examination should be assumed and protected and studied radiographically as if one exists [5].

2. Imaging

Plain radiographs, and especially if CT added, will demonstrate most bone injuries. Stable fractures such as compression fractures and mild burst fractures (AO type A) often need little other imaging. Significant soft-tissue disruptions can be missed, however, as CT and plain radiographs often cannot adequately visualize and describe the spinal canal and other associated ligaments [6]. Magnetic resonance imaging and CT are both capable of providing 3D images of injured segment in great detail. Magnetic resonance is well capable of visualizing neural elements, supporting segmental ligaments, contents of spinal canal, and status of intervertebral discs [7]. Magnetic resonance is also valuable as entire thoracolumbar spine can be visualized helping to identify distant fractures, cord injuries, or epidural space occupying lesions. Computed tomography-myelography is used much less commonly than in previous decades but remains a procedure of choice if an MR is contraindicated (intraocular contents, pacemaker, and so forth) [8]. Most Level I trauma centers now equipped with rapid high-resolution CT. Helical CT is faster, with no more radiation than plain radiographs, identifies and describes bony de- tail of fractures better, and lessens time for fracture pre- cautions. Helical truncal CT is 99% accurate in identifying acute spinal

fractures versus 87% when plain radiographs are used [9]. Computed tomography imaging of bony spine can allow reformatted axial collimation of images into 2D and 3D images. As most blunt trauma patients require CT to screen for other injuries, this method would appear to most effective and cost-efficient manner to identify fractures of spine [10].

3. Treatment

Nonoperative

Fortunately, most thoracolumbar spine fractures are stable and do not require surgery. Nonoperative treatment with a well-molded brace or hyperextension cast has been shown in numerous studies to be very effective. The days of prolonged bed rest are gone, as we have come to understand the stability of the injured spine, including the ability to mobilize relatively quickly without an operation [11]. Simple compression or stable burst fractures (no significant posterior osteoligamentous disruption) without neurologic complications can typically be treated with off-the-shelf braces or well-molded orthoses that permit early ambulation. There are studies that have even demonstrated the ability to care for stable burst fractures with early ambulation and no external support at all [12]. Flexion-distraction injuries, if they constitute a division principally through the bony elements (AO B2), can be effectively treated with a hyperextension cast, or brace, especially in the relatively young individual. Older individuals or situations with wide displacement of the bony fragments, and hence with more soft-tissue interposition, may not be suitable [13].

Also, not necessarily suitable for cast immobilization are those with abdominal in- juries, prolonged ileus, chest trauma, or multiple extremity fractures. Those whose fracture line extends principally through the soft tissues of the posterior ligaments and the disc are more commonly treated with surgical repair of the posterior tension band with instrumented fusion [14]. Fracture-dislocation with anatomic disruption of not only both bony columns but also the supporting ligamentous structures are inherently unstable and are typically treated with operative reduction and stabilization. Even individuals with complete spinal cord injuries may benefit from early surgical stabilization as it has been suggested to facilitate early and productive rehabilitation, with fewer complications. This, however, has never been borne out in the literature in any form of controlled study [15].

Operative treatment

Operative treatment of thoracolumbar fractures does offer a few advantages over the nonoperative approach, especially for those who cannot tolerate months in an orthosis or cast such as those with multiple extremity injuries, skin lesions, obesity, and so forth. Prompt surgical stabilization allows immediate mobilization and earlier rehabilitation and may restore sagittal alignment more reliably in certain situations [17]. Surgical decompression also more reliably and more effectively clears a compromised spinal canal and can more effectively restore neurologic function and improve rehabilitation. The benefits of surgical treatment must be carefully weighed against the potential morbidity associated with the operation. In the acute trauma population, conventional open surgical techniques can be associated with significant morbidity because of approach-related injury, increased infection rates, and higher blood loss [18].

Compression fractures

The vast majority of compression fractures are stable as only the anterior column is involved and can be effectively treated with simple observation or an orthosis. Compression fractures in a setting of osteoporosis represent a special subset and are discussed subsequently. Coronal split com- pression fractures (A2) frequently fail to unite and may be a source of painful nonunion. Operative treatment is, thus, more commonly considered, especially in the lower lumbar spine [19].

Burst fractures

Burst fractures can be considered mechanically stable as long as there remains preservation of the posterior osteoligamentous complex and facet capsules. Disruption of these structures, thus, is key to stability and should be considered whenever large degrees of axial compression. Any neurologic injury is also a sign that additional searching for potential patterns of mechanical instability should be performed [20]. The decision for surgery depends on the location of the fracture, the degree of vertebral destruction, any neurologic involvement, the degree of kyphosis, and the stability of the posterior column structures. With burst fractures, the degree of canal compromise, for example, can be quite variable and thus, without neurologic involvement, can be difficult to establish specific rules for surgical intervention. In addition, it has been demonstrated in numerous reports that retropulsed bony fragments do resorb and the canal re-models up to 50% of the occlusion over time [21]. Stable burst fractures can effectively be treated with a well-molded orthosis or a hyperextension cast as long as there are no significant abdominal or thoracic injuries.

It has been shown that some settling of the fracture takes place, and the kyphotic angulation often approaches that of the immediate injury, but there still remains no relationship between kyphosis measured and clinical results [22]. If the decision is made to proceed with surgical repair of a thoracolumbar burst fracture, posterior pedicle screw fixation has been shown to be efficient, reliable, and safe for the reduction and stabilization of most traumatic fractures all the while only fixating the adjacent levels. It remains the most popular technique today, although not entirely free of complications, including instrumentation failure, pseudarthrosis, infection, and the need for late instrumentation removal [23]. Unstable burst fractures with significant disruption of the posterior osteoligamentous complex are typically treated with an operative approach, as the healing capacity of torn ligmaentous structures is much less than that of bone. Depending on the degree of anterior comminution and kyphotic angulation, both anterior reconstruction with plate or rod instrumentation and short-segment posterior pedicle screw fixation have been shown to be effective [24].

Flexion-distraction injuries

Because the injury in these fractures is principally to the posterior osteoligamentous complex, it is best treated with a posterior compression type construct and fusion to restore the normal sagittal contour. Care must be taken, however, not to overly compress or lordose the fracture site as there have been reports of injured intervertebral disc fragments or discal end-plate elements being forced back into the canal resulting in neurologic sequelae [25].

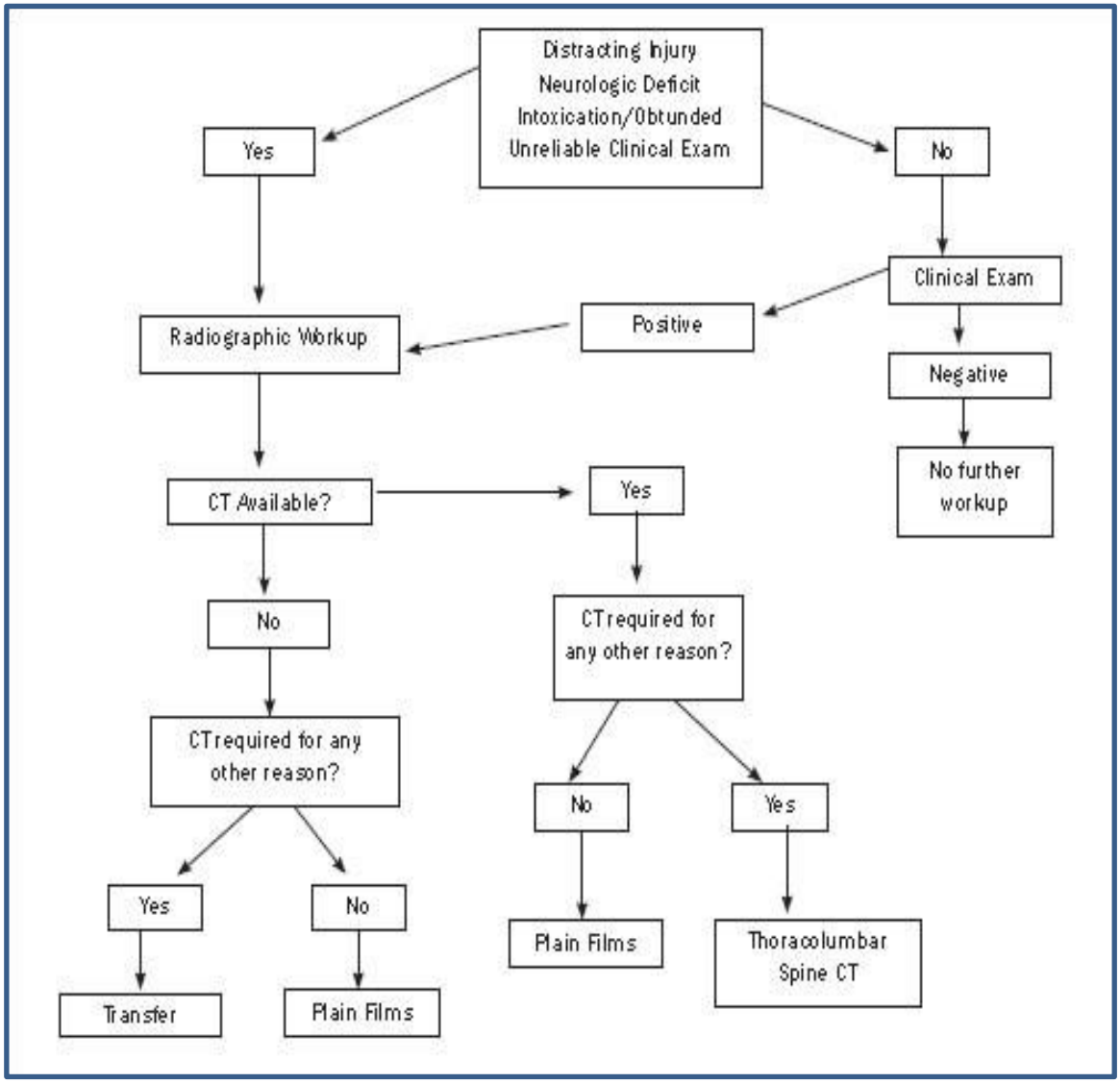

Figure (1): Management plan for lumbar fractures [16].

Hence, most specialists advise postural reduction by positioning, gentle compression and lordosing, and laminectomy to visualize the canal either directly or via intraoperative ultrasound. Modern anterior fixation systems are also strong enough now that there are reports of anterior short-segment instrumentation being effective even in the setting of disrupted posterior facets and ligaments [26].

- ***Fracture-dislocations***

As stated previously, fracture-dislocations are often the result of very high-energy trauma and are the fracture type most often associated with neurologic damage and associated skeletal injuries. Both bony columns and associated ligamentous structures are disrupted through combinations of shear rotation and flexion-extension. In the setting of an in- complete spinal cord injury, early decompression and fusion have been shown to be more effective than nonoperative treatment [27]. Because of the severe nature of the bony disruption, realignment and fixation are best accomplished through posterior positioning, reduction, multilevel instrumentation, and fusion. Most fracture-dislocations do not require anterior surgery, although there may be on occasion, injuries with still deficient anterior columns after posterior reconstruction necessitating a second-stage anterior approach [2].

- ***Minimally invasive approaches***

Over the past decade, as more and more spine surgeons have developed technology aimed at reducing the invasiveness and morbidity of surgery, so, too, have those treating thoracolumbar spine trauma. When feasible, the thoracoscopic approach to thoracolumbar fractures offers the potential advantages of reduced pain, better cosmesis, lower perioperative morbidity, and earlier return to activity [4].

- ***Osteoporotic thoracolumbar fractures***

Compression fractures are a frequent sequelae of osteoporosis, the most common metabolic disorder of bone. Accurate diagnosis and appropriate treatment are imperative for vertebral compression fractures can lead to chronic back pain, pulmonary dysfunction, and severe compromise of the activities of daily living including depression and so forth [1]. Once one fracture is found, the risk of subsequent fractures

rapidly begins to multiply. The risk of sustaining a new vertebral fracture after a previous fracture untreated may be as high as 20% within the first year. Also, patient mortality correlates strongly with the number of involved vertebrae [2]. Standard fracture treatment historically has been a short period of reduced activity or bed rest followed by gradual mobilization. Orthotic containment is commonly considered; however, bracing is less and less tolerated as the decades pass. To date, there have been no randomized studies comparing the efficacy of bracing versus no bracing in terms of pain relief nor has bracing ever been shown to prevent further vertebral collapse and additional fractures [3].

Newer vertebral cement augmentation techniques such as vertebroplasty or kyphoplasty now offer the patient the prospect of a minimally invasive alternative to prolonged bed rest or major spine surgery with relatively low risk and reportedly high clinical success rates [2]. Some recent reports, however, have studied vertebroplasty in a prospective randomized fashion and concluded questioning some of the differences between cement augmentation and traditional nonoperative treatments. Pain relief is felt to come through fracture stabilization at the fracture site and the end plates, although thermal or chemical ablation of nerve endings may also be possible [3]. Vertebroplasty is the percutaneous introduction of PMMA into the fractured vertebral body either via a posterior transpedicular or extrapedicular approach, for those with pedicles less than 5 mm (usually above T8). Although low complication rates are generally reported for vertebral augmentation procedures, potentially serious nature of many of these complications merits discussion [1].

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