A Modified Anterior Approach to L 1 Vertebra: An Early Clinical Experience

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Purpose: To study the results of a new surgical approach to the L1 vertebra which is a modified anterior approach and is extrapleural and retroperitoneal in nature.

Materials and Methods: Five patients with fracture L1 vertebra underwent surgical decompression and stabilization via this modified anterior approach. In this approach, the L1 vertebra is approached anteriorly without invading the pleural cavity or the peritoneal cavity by gentle, blunt dissection (extrapleural and retroperitoneal approach)

Results: No significant complications, especially pulmonary complications, were noted in any of the 5 cases.

Conclusions: This modified anterior approach to L1 vertebra allows effective, circumferential decompression of the thoracolumbar spinal canal without the associated morbidity of the traditional anterior approach. However, comparative studies between the 2 approaches will be needed in the future to more accurately ascertain benefits of this approach.

Key Words: anterior approach—L1 vertebra—extrapleural—retroperitoneal.

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BACKGROUND

Traumatic fracture-dislocations involving T12 and L1 vertebrae are common as the thoracolumbar junction is a transitional zone between the relatively rigid thoracic spine and the mobile lumbar spine.[1,2] It is associated with gross neurological deficit which is both sensorimotor and autonomic (bladder, bowel, and sexual dysfunction) in 22% to 51% of the cases depending on the type of fracture.[3] This region is also the seat for various other pathologies like infections, neoplasms, and degenerative lesions.

We describe our early experience of a modified anterior approach to L1 vertebra which is extrapleural and retroperitoneal and is associated with relatively less soft tissue dissection and postoperative complications compared with the classical anterior approach.

ANATOMY

A clear understanding of the anatomy of the attachments of the diaphragm and pleura at this level is necessary to appreciate the details of this surgical technique:

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The authors declare that they have nothing to disclose.

For reprint requests, or additional information and guidance on the techniques described in the article, please contact Sarvdeep S. Dhatt, MBBS, MS, at saravdeepdrbones@gmail.com or by mail at Department of Orthopaedics, Postgraduate Institute of Medical Education and Research, Chandigarh, India. You may inquire whether the author(s) will agree to phone conferences and/or visits regarding these techniques.

Diaphragm Attachments[4]

The diaphragm is a dome-shaped muscle that covers the inferior thoracic aperture at the level of T12 to L1. Peripherally it consists of muscle fibers that originate radially from the circumference of the inferior thoracic aperture and converge centrally to be inserted into the "central tendon"—which is a strong tendinous aponeurosis. On the basis of the origin, the muscle fibers are grouped into 3 groups: (1) sternal portion (originating from the xiphoid process), (2) costal portion (which consists of muscular slips that arise from the internal surfaces of the inferior 6 ribs and their corresponding costal cartilages which in turn interdigitate with slips of the transversus abdominis muscle. The costal portion forms the left and right domes of the diaphragm which moves during respiration. (3) Lumbar portion (which is the most significantly manipulated area during anterior thoracolumbar junction surgeries). The lumbar portion has 2 origins: one from the medial and lateral arcuate ligaments and another from the crura.

The crura are musculotendinous bands of the diaphragm that extend along the anterolateral lumbar spine on each side.

FIGURE 1. Preoperative computed tomographic scan (sagittal section) view showing a compression fracture of L1 vertebral body.

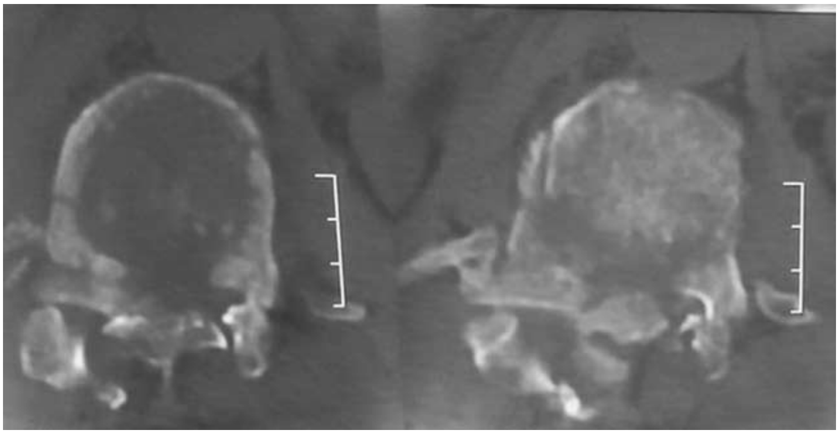

FIGURE 2. Preoperative computed tomographic scan (axial section) at the level of L1 vertebral body.

The left crus extends to L2, whereas the right crus, which is broader and longer, extends to L3, blending with the anterior longitudinal ligament of the vertebral column.

Pleural Attachments[5,6]

The parietal pleura covers the inner surface of the chest wall, mediastinum, and diaphragm. The inferior aspect of the pleural space varies from anterior to lateral to posterior, following the line of attachment between the diaphragm and the chest wall. On the right side, the pleural edge passes vertically down to the 6th costal cartilage, crosses to the 8th rib in midclavicular line, to the 10th rib in mid-axillary line, and to the 12th rib at the lateral border of the paravertebral muscles. On the left side, pleura deviates laterally at the 4th costal cartilage and descends on the lateral border of the sternum. After this it follows a path similar to the right side. A fat plane between the parietal pleura and the endothoracic fascia is present along most of the chest wall, allowing the pleura to be moved easily from the underlying structures.

MATERIALS AND METHODS

Five patients with fracture of L1 vertebra underwent surgical decompression and stabilization via this modified anterior approach. Preoperative x-rays and computed tomograms were obtained in all patients (Figs. 1, 2). Postoperative x-rays were obtained to assess the extent of spinal canal clearance and corpectomy.

Surgical Technique

The patient is placed in right lateral decubitus position (ie, left side up) with left arm abducted and extended ensuring adequate padding over potential pressure areas. A sand bag is placed under the thoracoabdominal junction to open up a wider area at the opposite side of the thoracolumbar junction. We prefer a left-sided thoracotomy as it is relatively easier to deal with aortic bleed as well as to mobilize it, if at all required, compared with the less muscular inferior vena cava. Another advantage of left-sided thoracotomy is that we do not have to deal with the difficult task of retracting the liver away as compared with the right side.

An inverted J-shaped incision is given which is ~10 cm in length and centered on the 11th rib (Fig. 3). The incision extends in a curvilinear manner from the proximal part of 11th rib to well above the costotransverse junction. Subcutaneous tissue is incised with an electrocautery until rib is isolated. The latissimus dorsi and serratus anterior muscles are cut and exposed in line with the skin incision. The muscles attached over superior border of rib are elevated in an anterograde

FIGURE 3. Incision over the 11th rib (patient placed in right lateral position—"left side up"). full color online

FIGURE 4. Image showing rib resection. Note that the rib has been cut anteriorly and is in the process of being disarticulated at the costovertebral joint. full color online

FIGURE 5. View after rib resection. Tip of forceps is pointing to the intact parietal pleura.

manner with a periosteum elevator and in a retrograde manner from the inferior border of the rib to minimize the amount of bleeding by cutting at the acute angle of insertion of muscle fibers. The anterior part of the rib is cut with a rib cutter, barring the anterior-most 2 cm, whereas posteriorly the rib is disarticulated from the costovertebral and costotransverse joints by semirotatory movements of the rib (Figs. 4, 5). The rib is stored for grafting. Adequate hemostasis is ensured at each and every step.

The pleura as well as the diaphragm are gradually mobilized anteriorly with a blunt sponge forceps. The pleura is gradually mobilized over and above the prevertebral fascia (Fig. 6). The psoas muscle is raised from its attachment over T12-L1 vertebrae and mobilized downwards. The prevertebral fascia is incised by bipolar cautery and the segmental vessels are taken care of either by ligation or by mobilization toward the right. The vertebral bodies are now fully exposed and corpectomy is performed as per etiological demand (Fig. 7).

FIGURE 6. Pleura and diaphragm have been mobilized anteriorly with sponges and lung retractor. Tip of forceps is pointing to the prevertebral fascia.

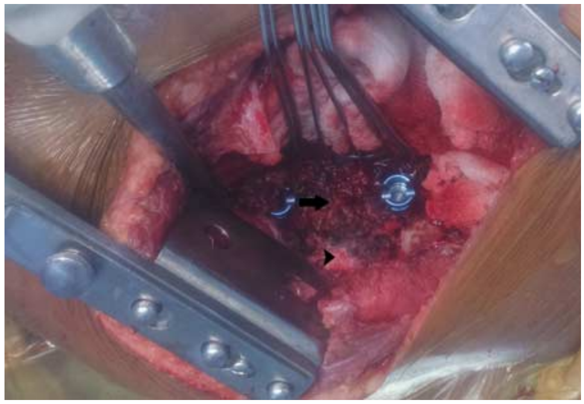

FIGURE 7. Post L1 corpectomy image. Two pedicle screws have been inserted 1 into T12 and L2 vertebrae. Black arrow points to the empty space after corpectomy and black arrowhead is pointing to the spinal cord.

Adequate spinal cord decompression is done under direct vision. Stabilization is achieved with a screw-rod construct and the strength of the construct is further supplemented by rib graft or cage-bone graft construct if necessary (Figs. 8, 9). The wound is now closed in layers over a negative suction drain. Postoperative radiographs in anteroposterior and lateral views are obtained to check position of implants and to ascertain the adequacy of canal decompression (Figs. 10, 11).

DISCUSSION

The rationale of this surgical approach is based on the presumption that the soft tissues attached to T12-L1 junction must be mobile, considering the fact that the T12-L1 junction itself is mobile. This inherent mobility enables us to develop a plane between the prevertebral fascia and the parietal pleura by blunt dissection. The extravasation of blood between the prevertebral fascia and parietal pleura in posttraumatic L1 vertebra fracture may also be one of the reasons for the relative ease in developing this plane by blunt dissection.

The surgical approach described above has multiple advantages. The parietal pleura possesses a rich nerve supply.[5,6] By avoiding the incision of parietal pleura, postoperative pain is

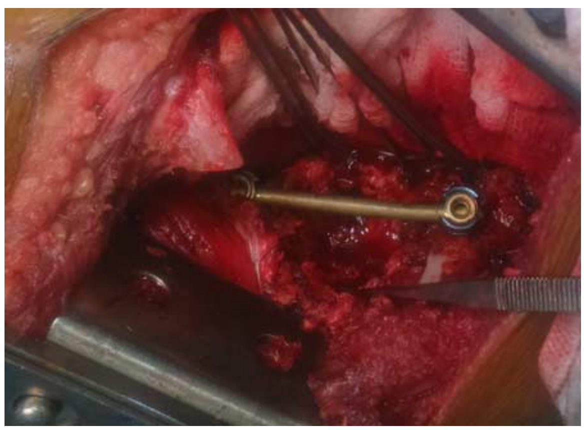

FIGURE 8. Docking of rod into the pedicle screws.

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FIGURE 9. Rib autograft placed in L1 body region (black arrowhead). full color online

brought down drastically.[7] There is significant decrease in chest complications like pneumonia, lung atelectasis, breathing difficulties, chest tube blockage as there is no need of thoracotomy and hence no need of chest drain insertion.[8,9]

At the same time, this exposure does not compromise on the wide, adequate exposure of the diseased site offered by the anterior approach enabling surgical decompression under direct vision. Also, the duration of hospital stay and blood loss may be less compared with standard anterior approach but this needs to be validated further via comparative studies. Chances of diaphragmatic hernia are reduced as the diaphragm is not cut or raised.

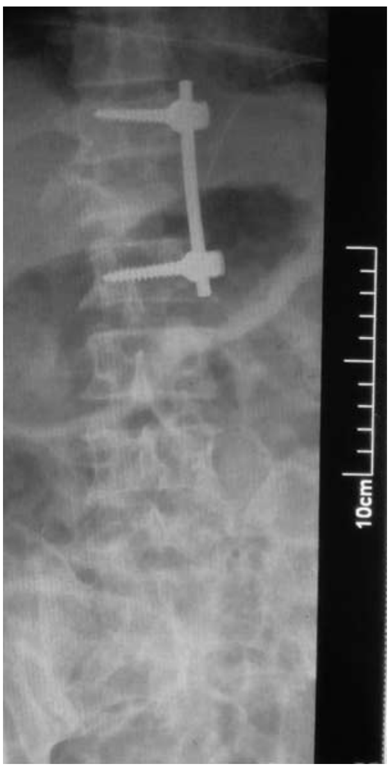

FIGURE 10. Postoperative x-ray in the anteroposterior view.

FIGURE 11. Postoperative x-ray in the lateral view.

CONCLUSIONS

The modified anterior approach to L1 vertebra described above is extrapleural and retroperitoneal allowing effective, circumferential decompression of the thoracolumbar spinal canal without the associated morbidity of the traditional anterior approach.

REFERENCES

1. Wood K, Buttermann G, Mehbod A, et al. Operative compared with nonoperative treatment of a thoracolumbar burst fracture without neurological deficit. A prospective, randomized study. *J Bone Joint Surg Am*. 2003;85-A:773–781.
2. Vaccaro AR, Zeiller SC, Hulbert RJ, et al. The thoracolumbar injury severity score: a proposed treatment algorithm. *J Spinal Disord Tech*. 2005;18:209–215.
3. Knop C, Blauth M, Bühren V, et al. Surgical treatment of injuries of the thoracolumbar transition. 1: Epidemiology. *Unfallchirurg*. 1999;102:924–935.
4. Fell SC. Surgical anatomy of the diaphragm and the phrenic nerve. *Chest Surg Clin N Am*. 1998;8:281–294.
5. Finley DJ, Rusch VW. Anatomy of the pleura. *Thorac Surg Clin*. 2011;21:157–163.
6. Wang NS. Anatomy of the pleura. *Clin Chest Med*. 1998;19:229–240.
7. Hughes R, Gao F. Pain control for thoracotomy. *Contin Educ Anaesth Crit Care Pain*. 2005;5:56–60.
8. Fessler RG, Sturgill M. Review: complications of surgery for thoracic disc disease. *Surg Neurol*. 1998;49:609–618.
9. Uribe JS, Dakwar E, Cardona RF, et al. Minimally invasive lateral retropleural thoracolumbar approach: cadaveric feasibility study and report of 4 clinical cases. *Neurosurgery*. 2011;68(ONS suppl 1):ons32–ons39.

