



Total en-bloc spondylectomy through a posterior approach: technique and surgical outcome in thoracic metastases

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Abstract

Background In 1981, Roy-Camille et al. have firstly reported the total en-bloc spondylectomy (TES) through a posterior approach for cases of malignant spine tumors in order to reduce the local recurrence and to increase the patient's survival. By then, this surgery has been increasingly gaining recognition. However, it requires a high level of technical ability and knowledge of spinal anatomy, physiology, and biomechanics.

Method Herein, we report the patient's selection and technique to execute the TES for cases of thoracic metastasis.

Conclusion This surgery is technically demanding so the patient's selection requires a careful pre-operative evaluation. However, it can be suggested for patients affected by intracompartmental lesions with a good prognosis since the tumor's progression is "limited" by local barriers as demonstrated by histological studies.

Keywords Spinal metastases · Vertebrectomy · En-bloc vertebrectomy

Relevant surgical anatomy

In order to execute a posterior total en-bloc spondylectomy (TES), a wide knowledge of the thoracic spine anatomy and its surrounding structures is mandatory. A careful preoperative radiological assessment of the tumor and its surrounding structure is recommended. The aortic arch, the descending aorta, the pleural sac, sympathetic chain, and the intercostal nerves are at risk of damage with this approach. A preoperative angio-CT or angiography is helpful, in particular, they are useful to identify major vessels as the Adamkiewicz artery and to understand their course. During the vertebral body removal, we strongly recommend dissecting the surrounding structures bluntly with the fingers to avoid any injury. The navigation could be of great help in several aspects, as for identifying the tumor and its surrounding structures and for the positioning of the screws.

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Description of the technique

In Video 1, we report our technique in executing a TES.

The patient is positioned prone. Intraoperative fluoroscopy is used to identify the affected vertebra. Somatosensory evoked potentials and motor evoked potentials are continuously monitored during surgery.

A straight vertical midline incision is made over the spinous processes and is extended three levels above and three levels below the involved segment. The paraspinal muscles are subperiosteally dissected from the spinous processes and laminae and then retracted laterally.

Before heading on with any further steps, the vertebra is checked again using fluoroscopy. In the thoracic spine, the ribs on the affected level are transected 3 to 4 cm laterally to the costotransverse joint and the ribs are detached from the vertebral body. The intercostal artery and nerve are transposed below together with the parietal pleura.

The spinous process of one-level above is removed to expose the laminae of the involved vertebra and to detach it from the adjacent vertebrae.

The major steps in executing the en-bloc pediculo-laminotomy are summarized in Fig. 1a–e.

A Gigli saw is introduced below the laminae through the nerve root canal in order to execute an en-bloc pediculo-laminotomy (Fig. 2a, b).

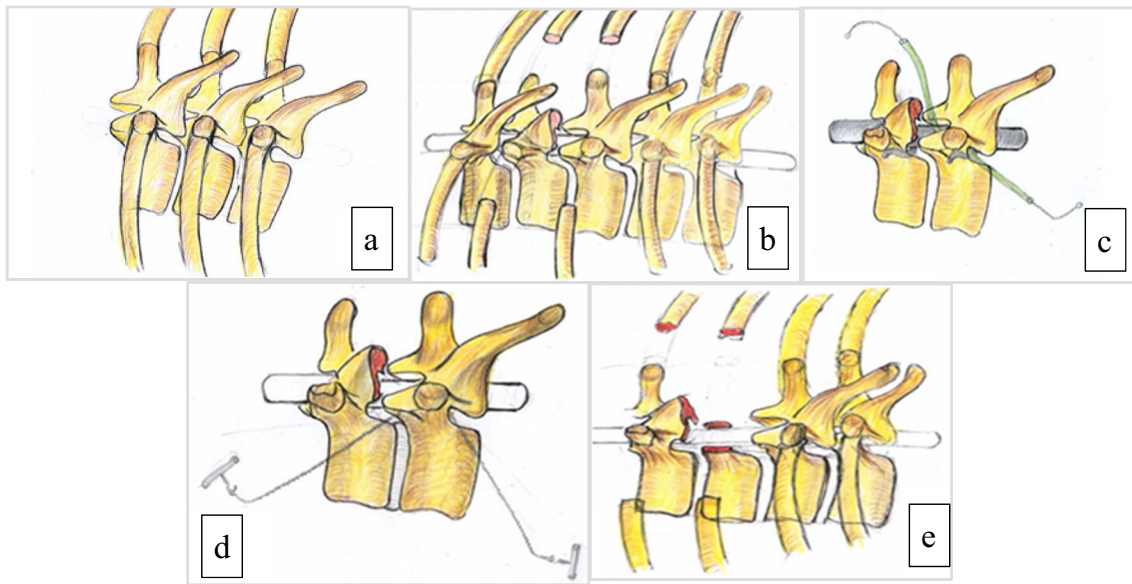


Fig. 1 a–e The affected vertebra is identified (a). The spinous process of one vertebra above is removed and the costo-trasversectomy is executed (b). The en-bloc peducolo-laminotomy is performed introducing the Gigli saw in the nerve root canal (c–e)

It is necessary to apply a monolateral spinal fixation to give stability to the spine and to avoid a spinal cord injury. On the left side, a transverse process hook and an infralaminar hook are applied to the level above the tumor; a transpedicular screw is inserted the level below the tumor. On the right side, a transpedicular screw is inserted the level below the tumor. The insertion of the screws has to be performed before the vertebral body removal to avoid any spinal cord injury. The spinal fixation is completed on the left side linking the hooks and screw to a rod. Afterwards, the surgeon separates the vertebral body from the pleurae and the other surrounding structures using his fingers passing laterally to the vertebral body and they encounter anteriorly to it (Fig. 3).

An en-bloc discectomy and spondylectomy is performed using a Gigli saw. It is introduced laterally and exits contralaterally to the vertebral body (Fig. 4).

The Gigli saw can be used to resect the entire vertebral body or its two third and the residual part is drilled. The Gigli saw has to be carefully used during the transdiscal resection in order to avoid any spinal cord injury. The posterior part of the resection has to be performed using a drill or a

scalpel. The vertebral body is extracted laterally to the spinal cord trough a rotational movement (Fig. 5a, b). The monolateral fixation will prevent the spinal instability.

Finally, the vertebral reconstruction is performed using a vertebral body prosthesis and spinal fixation on the contralateral side (Fig. 6a, b). The prosthesis presents artificial pedicles that are linked to the posterior construct.

The insertion of the vertebral body prosthesis does not require any nerve roots' sacrifice; the nerve roots are gently shifted during its insertion.

Indications

Basing on the literature [1–10] and for our experience, we sustain the TES through a single posterior approach for intracompartmental lesions in which a total cleavage of the lesion is achievable. On the other hand, if the lesion is extracompartmental, the patient's age is advanced, and the prognosis is poor, this technique is contraindicated for its high morbidity and demanding follow-up.

Fig. 2 a, b The figures show the insertion of the Gigli saw through the nerve root canal (a) and the en-bloc removal of the posterior arch of the affected vertebra (b)

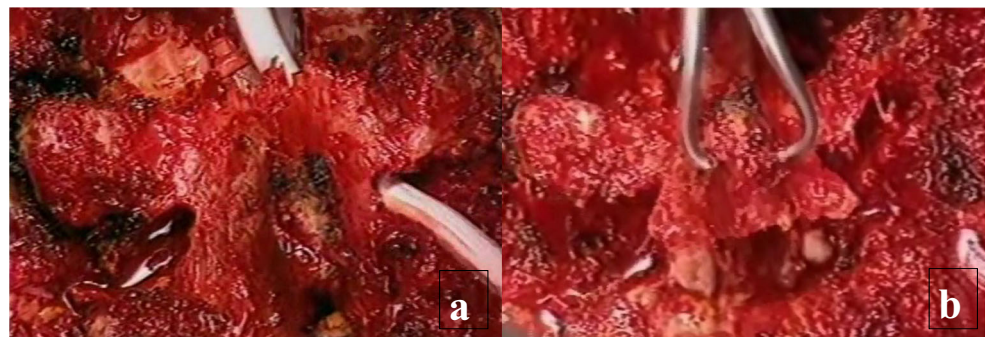




Fig. 3 The fingers detach the vertebral body from its lateral and anterior structures

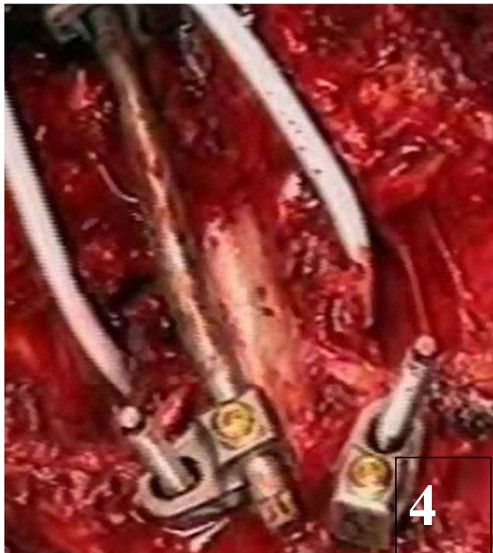
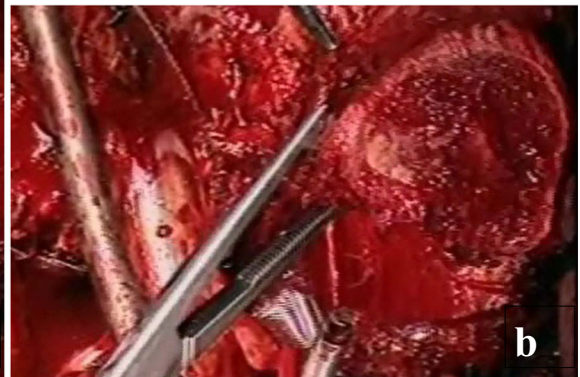


Fig. 4 The Gigli saw cuts the superior and inferior intervertebral discs

Fig. 5 a, b The vertebral body is extracted laterally to the spinal cord



In order to exalt our indications, we report one of our cases of TES through a single posterior approach in a 39-year-old woman affected by a thoracic metastasis from breast cancer. She underwent a left mastectomy 2 years before and her radiological follow-up was negative until the last CT scan.

Limitations

This is a technically demanding surgery that requires an accurate clinical and oncological preoperative evaluation of the patient. The patient's selection requires a preoperative discussion of the case in a multidisciplinary meeting. This surgery can be proposed only to patients with a good oncological prognosis affected by a single intracompartmental lesion. Only in these circumstances it is able to increase the patient's survival.

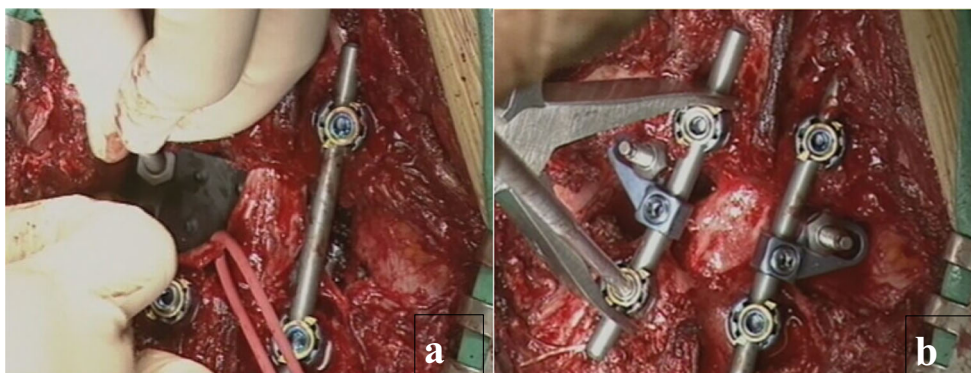
How to avoid complications

An accurate patient's selection is mandatory. During the operation, the intraoperative blood loss assessment is necessary as well. The positioning of a monolateral spinal fixation with screws and rod will prevent a spinal cord injury during the vertebral body removal. The postoperative complications will be reduced managing the patient in an intensive care unit.

Specific perioperative considerations

There is a risk of major blood loss. The postoperative period requires a careful patient's evaluation. The patient has to be gradually mobilized and a thoracic brace is necessary to achieve a bone fusion. The patient undergoes thoracic radiography in order to exclude the presence of pneumothorax after

Fig. 6 a, b The figures show the spinal reconstruction and posterior fixation



surgery. A CT scan will verify the correct positioning of the hardware and the spinal alignment. These patients will require a clinical and radiological evaluation in the following months and an oncological work-up.

Specific information to give to the patient about surgery and potential risks

This is a technically demanding surgery that is proposed only in limited circumstances. The purpose of the operation is to increase the patient's survival. The major risk of the operation is the blood loss. There is also a risk of spinal injury. A period in intensive care unit is highly suggested. The spinal reconstruction and fusion will require a clinical and oncological follow-up.

Summary of 10 key points

- 1 This is a technically demanding surgery that is proposed only in limited circumstances.
- 2 The patient's selection requires a preoperative discussion of the case in a multidisciplinary meeting.
- 3 This surgery can be proposed only to patients with a good oncological prognosis affected by a single intracompartmental lesion.
- 4 Only in these circumstances it is able to increase the patient's survival.
- 5 The first part of the operation consists in executing an en-bloc pediculo-laminotomy.
- 6 In order to execute it, a Gigli saw is introduced below the laminae through the nerve root canal.
- 7 Applying monolateral trans-pedicular screws and rod will give stability to the spine and will prevent from a spinal cord injury.
- 8 Afterwards, the surgeon separates the vertebral body from the pleurae and the other surrounding structures using his fingers passing laterally to the vertebral body and they encounter anteriorly to it.

- 9 An en-bloc discectomy and spondylectomy is performed using a Gigli saw.
- 10 Finally, the vertebral reconstruction is performed with the insertion of a vertebral body prosthesis and spinal fixation on the last side.

Compliance with ethical standards

Informed consent The patient has consented to the submission of the manuscript to the journal.

Conflict of interest The authors declare that they have no conflict of interest.

References

1. Boriani S, Biagini R, De Iure F, Di Fiore M, Gamberini G, Zanoni A (1994) Vertebrectomia lombare per neoplasia ossea: tecnica chirurgica. *Chir Organi Mov* 79:163–173
2. Enneking WF, Spanier SS, Goodmann MA (1980) A system for the surgical staging of musculoskeletal sarcoma. *Clin Orthop* 153:106–120
3. Harrington KD (1986) Metastatic disease of the spine. *J Bone Joint Surg Am* 68:1110–1115
4. Roy-Camille R, Saillant G, Bisserie M, Judet TH, Hautefort E, Mamoudy P (1981) Resection vertebrale totale dans la chirurgie tumorale au niveau du rachis dorsal par voie posterieure pure. *Rev Chir Orthop* 67:421–430
5. Sciubba DM, De la Garza RR, Goodwin CR, Xu R, Bydon A, Witham TF, Gokaslan ZL, Wolinsky JP (2016) Total en bloc spondylectomy for locally aggressive and primary malignant tumors of the lumbar spine. *Eur Spine J* 25(12):4080–4087
6. Stener B (1989) Complete removal of vertebrae for extirpation of tumors. *Clin Orthop* 245:72–82
7. Sundaresan N, Rosen G, Huvos AG, Krol G (1988) Combined treatment of osteosarcoma of the spine. *Neurosurgery* 23:714–719
8. Tokuhashi Y, Matsuzaki H, Toriyama S, Kawano H, Ohsaka S (1990) Scoring system for the preoperative evaluation of metastatic spine tumor prognosis. *Spine* 15:1110–1113
9. Tomita K, Kawahara N, Baba H, Tsuchiya H, Fujita T, Toribatake Y (1997) Total en bloc spondylectomy: a new surgical technique for primary malignant vertebral tumors. *Spine* 22:324–333
10. Yokogawa N, Murakami H, Demura S, Kato S, Yoshioka K, Tsuchiya H (2018) Incidental durotomy during total en bloc spondylectomy. *Spine J* 18(3):381–386