Editorial

Total *en bloc* spondylectomy

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Total *en bloc* spondylectomy (TES) is a surgical technique that is indicated for primary malignant bone tumours, aggressive benign tumours and infrequently solitary metastatic lesions. Primary bone tumours in the axial skeleton are rare. It's estimated they comprise 11% of all primary bone tumours and only 4% of all tumours found in the spine (1,2). Conversely metastatic spine disease is a significant health burden. Ten percent to 30% of patients with metastatic disease to the spine will be symptomatic, and up to 90% of patients with terminal disease demonstrate evidence of spinal metastases (3). Almost exclusively metastatic spinal disease is not suitable for TES, whereas in many cases of primary spinal tumours, radical resection has been proven to be the most important factor influencing the oncological outcome (4). The overall incidence of spinal tumours amenable to TES currently remains undefined, as does the role TES has to play in these fundamentally different disease processes.

Spondylectomy was first described by Lièvre *et al.* as a two-stage procedure to remove a giant cell tumour (GCT) from the lumbar spine (5). This technique has been modified numerous times over subsequent decades with Roy-Camille, Boriani and Tomita *et al.* all describing techniques for *en bloc* spondylectomy that have become the current standard in spinal oncology (2,6,7). In general, an all posterior approach is recognized as achievable for a majority of thoracic tumours, however combined posterior/antero-lateral approaches are also necessary to achieve satisfactory margins or to improve ease of dissection. The risk of morbidity and mortality associated with great vessel injury from isolated posterior approaches is a strong indication in utilization of combined approaches.

More challenging is the lumbar spine, in particular lower lumbar region with a range of approaches described. Several authors utilize the technique as devised by Tomita (8-11). Although the insertions of psoas and iliacus muscles may present a challenge in a posterior only approach, they do not preclude its use (10). Isolated posterior approaches may be effectively utilized where adequate anterior soft tissue release can be achieved from the back and the tumour is isolated to posterior elements or the vertebral body. A single posterior approach may not be viable in the presence of invasion of anterior structures, adhesions from previous surgery, inability to mobilise or deliver a large tumour through a posterior incision, and involvement of the neural arch (12). Due to potential encroachment of the iliac wings in blocking access to L5 and possibly L4, Stener (13) suggests a combined approach at these levels. Tomita similarly highlights the need for posterior laminectomy and stabilisation followed by anterior *en bloc* corpectomy for spinal tumours at the level of L5 (and possibly L4) due to the anatomy of the iliac wing and lumbosacral plexus (14). Abe *et al.* (8) recommended posterior TES for L1 or L2 lesions (necessitating ligation of nerve roots and longer fusion constructs) and combined anterior and posterior approaches for L3 to L5 lesions or extra vertebral extension. Liljenqvist *et al.* (15) describes a single stage combined posterior-anterior approach and corpectomy through a lateral extraperitoneal approach with simultaneous control of the neural elements posteriorly and

viscera anteriorly. Kawahara *et al.* (10) reports a combined approach. If tumours did not have paravertebral extension then an anterolateral extraperitoneal approach was used. If a paravertebral mass compressed major vessels anteriorly then a midline transperitoneal or bilateral extraperitoneal approach was utilised. A second posterior approach was done if using titanium mesh cage (to compress the rods) and an AP-connecting device inserted if more than 2 levels were resected. As can be appreciated from the wide array of described techniques TES is patient specific surgery of high complexity necessitating comprehensive pre-operative workup, specialist spinal oncologic management and detailed surgical planning. Additionally, it is not clear to what extent the varied approaches influence outcome.

Currently the outcomes informing practice in TES remain relatively ill-defined. The data guiding practices are the results of limited heterogeneous case series of variable quality, utilising different techniques across multiple spinal levels for a range of pathologies (1,6,7,16-19). As such, there are widely varying quoted rates of overall complication (between 43–100%) (12,15), instrumentation failures (in the region of 40%) (11,20), mortality (0–7.7%) (19) and 5-year local control rates (between 69–96%) (21).

In the presented paper a team of experienced surgeons describes variation of the traditional TES introduced by Tomita *et al.* (7). In order to minimize the risk of vascular injury authors tend to stage the procedure performing posterior part of the exposure and instrumentation first. After roughly 7 days of the recovery from operation-induced systemic inflammatory reaction (SIR) patients undergo the second—anterior (or more precisely: antero-lateral) stage during which the specimen is carefully dissected from large vessels and surrounding soft tissues to be completely removed. Anterior reconstruction is routinely performed with the use of an expandable cage and vascularised graft. The vast majority of patients (88%) were treated with high (50 Gy) radiotherapy prior to the operation, unsurprisingly delayed deep wound infections and symptomatic non-unions requiring reoperations were frequent—noted in 44% of cases.

The main advantage of this modification to the widely known technique was decreased risk of vascular complications due to the fact that the osteotomy cuts through the unaffected parts of the vertebral bodies adjacent to the diseased one are being performed in the direction away from the dura as well as from the large vessels under a direct visual control. Indeed, the rate of intraoperative complications was low (27%), all of them were dural tears out of which only one was related to passage of the T-saw. Interestingly overall surgical time was long, at an average of 14 hours. Blood loss averaged 6 litres and the median length of the hospital stay was 17 days. This highlights the complexity of such cases and the requirement for experienced multidisciplinary teams in order to get the best possible results.

The technological advances in the management of primary bone tumours of the spine may herald a decline in rates of TES surgery. The use of proton/photon beam/carbon ion radiotherapy has shown potential for more effective non-surgical treatment, which may ultimately render TES surgery less feasible. Alternatively horizon technologies may present new opportunities. For example, the use of re-implanted nitrogen frozen vertebral *en bloc* resections as autograft in patients with metastatic lesions may stimulate an anti-tumour immunologic response (22,23). This may result in a greater demand for TES surgery. However, these new treatments are in their relative infancy and thus TES remains the gold standard treatment for resectable and thus potentially curative disease. There remains a clear need for more comprehensive standardised reporting of results and techniques in order to better inform practice when undertaking *en-bloc* surgery. This will allow for better informed decision making and pre-operative counselling of patients.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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