Intra-operative localisation of thoracic spine level: a simple “K’-wire in pedicle” technique

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Abstract

Purpose of study To describe a simple and reliable method of intra-operative localisation of thoracic spine in a single surgical setting.

Summary of background Intra-operative localisation of thoracic spine levels can be difficult due to anatomical constraints, such as scapular shadow, patient’s size and poor bone quality. This is particularly true in cases of thoracic discectomies in which the vertebral bodies appear normal. There are several methods described in recent literature to address this. Many of them require a separate procedure which was performed often the previous day. We report a technique which addresses the issue of localising thoracic level intra-operatively.

Materials and methods After induction of general anaesthesia, the patient was placed prone and the pedicle of interest was identified using fluoroscopy. A K-wire was then inserted percutaneously into this pedicle under image guidance [confirmed in the antero-posterior (AP) and lateral views]. The wire was then cut close to the skin after bending it. The patient was now positioned laterally and the intended procedure performed through an anterior trans-thoracic approach. The ‘K’ wire was removed at the end of the procedure.

Results and conclusion We routinely used this technique in all our thoracic discectomies (four cases in 2 years). There were no intra-operative complications. This method

is simple, avoids the patient undergoing two procedures and requires no more ability than placing an implant in the pedicle under fluoroscopy. Placing the ‘K’ wire into a fixed point like the pedicle facilitates rapid intra-operative viewing of the level of interest and is removed easily at the conclusion of surgery.

Keywords Thoracic discectomy · Spinal level marking · Wrong level spinal surgery

Introduction

Identifying the correct level intra-operatively in spinal surgery is paramount not only for patients’ safety but also maximising clinical outcomes. Wrong level surgery on the other hand adds potential liability for the surgeon and enormous emotional distress to the patient [1]. Therefore it is imperative for the surgeon to accurately identify the correct spinal level intra-operatively. Fluoroscopy has been routinely used to identify the spinal level by counting the bony structures like ribs or vertebral bodies. More recently, pre-operative localisation techniques using cement [2] and metal coils [3] have been used effectively to accurately identify levels. However, such techniques often use two surgical procedures with separate general or local anaesthesia. Furthermore, there may be the added, albeit small, risks of cement injection. The authors describe a simple intra-operative localisation technique using a K-wire in the pedicle of the interested level. In the last 2 years, we have used this technique in four cases (Table 1) without any intra-operative complications. There was one post-operative complication of chest infection which resolved after intra-venous antibiotics.

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Table 1 Cases of thoracic discectomy using the ‘K’ wire in pedicle technique in the last 2 years

Patient number	Age (years)	Sex	Level of thoracic discectomy	Intra-operative complication	Post-operative complications
1	64	Female	T10/T11	None	Chest infection
2	69	Male	T11/T12	None	None
3	62	Female	T10/T11	None	None
4	31	Female	T11/T12	None	None

Case example

A 29-year-old lady presented with 5 days history of dribbling and incomplete bladder emptying with numbness of her right inner thigh. A whole spine MRI and thoracic CT scan showed spinal stenosis at the T11/T12 level in a relatively narrow canal from a calcified disc prolapse causing cord compression (Fig. 1). On examination, she had MRC grade 4 power in her hip flexors (L2) bilaterally, right knee extensors (L3) and ankle dorsiflexors (L4). Sensation was diminished in her right L2, L5 and S1 dermatomes with normal anal tone and peri-anal sensation. After informed consent and discussion regarding risks and benefits of the procedure, we decided to perform a discectomy at T11/T12 through an anterior trans-thoracic approach in order to decompress the ventral theca. Pre-operatively, the images were reviewed to identify the correct level of pathology. Counting the vertebral levels up from sacrum, T11/12 was identified as the target level. An AP X-ray of the lumbar spine including the lower thoracic spine confirmed that the last rib was inserted at the T12 level and that five lumbar vertebrae were present (Fig. 2a). This was routinely done to check for any lumbo-sacral transitional vertebrae.

Technical details

After the administration of general anaesthesia, the patient was brought into the operating room and initially positioned prone on a radiolucent table (on bean bag/pillows). Once again by counting from sacrum the T12 level was identified using fluoroscopy. After suitable prepping, a 2.5 mm ‘K’ wire was inserted percutaneously into the T12 pedicle under fluoroscopic guidance in the AP plane. The ‘K’ wire was ‘tapped’ in until the wire tip was just seen to hit the medial pedicle wall. We then used the lateral image, to tap the wire in further beyond the pedicle into the vertebral body (but was not advanced further so as not to interfere with our vertebral body screw; Fig. 2b, c).

The K-wire was then cut flush with the skin and duly recorded by theatre staff. The patient was then appropriately positioned onto her left lateral side. The ‘K’ wire was now easily visualised with fluoroscopy in the T12 pedicle. Through an anterior trans-thoracic approach the discectomy was performed in the usual fashion and was reconstructed anteriorly with femoral ring allograft and screws/single rod (USS-2, Synthes) (Fig. 3). At the end of the procedure, the K-wire was removed from the pedicle with simple pliers.

Fig. 1 A sagittal CT (a) and MRI (b, c) showing cord compression at T11/12 by a partially calcified disc (arrow)

Fig. 2 Pre-operative antero-posterior lumbar spine radiograph to identify any lumbo-sacra; transitional vertebra (a); intra-operative lateral (b) and antero-posterior (c) fluoroscopic images of K-wire into the T12 pedicle

Fig. 3 Post-operative antero-posterior (a) and lateral (b) radiographs showing good position of graft and instrumentation

Discussion

We describe a simple K-wire in pedicle technique which is performed intra-operatively during single stage surgery. In our experience, it is reliable and utilizes an additional inexpensive implant. It must of course, be performed by surgeons who are familiar with pedicle anatomy and doing procedures under image guidance as there are inherent risks of neurological injury. The incidence of wrong level/site surgery ranges from 0.09 to 4.5 per 10,000 surgeries

performed [3, 4]. Needless to say, this has dire consequences for the patient necessitating further surgery and medico-legal implications for the operating surgeon. A number of techniques have been described in the literature to reduce the incidence of wrong level surgery. [2, 3, 5–13]. Fluoroscopy has been successfully used for intra-operative localisation of cervical and lumbar spine levels by counting the bony landmarks. It may be quite challenging and time consuming in the thoracic spine. Pre-operative skin markers have been used for surgical

planning of intra-dural lesions of the thoracic spine [12]. However, the skin being mobile can shift the marker and lose position of the correct level. Pre-operative injection of dye [6, 7] has also been described as a method to identify spine levels, but for posterior spinal surgery only. Others have performed pre-operative localisation of thoracic spine level in disc surgery by placing coils at or near the pedicle of interest [3, 10]. Hsu et al. [2] placed cement into the thoracic vertebral bodies pre-operatively. Both these techniques utilise radio-opaque markers into fixed points which does minimise any errors of movement. However, these techniques sometimes necessitate a separate procedure requiring local/general anaesthesia. Furthermore, there are risks of cement extrusion or embolism [14–16].

Conclusion

In our experience, intra-operative placement of a K-wire into a ‘fixed point’ like the pedicle of interest is a simple method of localising the correct thoracic spine levels. It is especially useful in cases of thoracic discectomy, where ‘normal’ bony anatomy might make identification of the correct level intra-operatively more difficult. Further intra-operatively, it avoids re-counting from the lumbo-sacral junction and positioning/re-positioning of the fluoroscopy machine over an open wound with (bulky) retractors in situ.

Conflict of interest None.

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