

The use of lumbar X-rays to facilitate neuraxial anaesthesia during knee replacement surgery in patients who have had previous spinal surgery

Coetzer AP, MBChB, MMed, FFA(SA)

Private Practice, Stellenbosch

De Villiers RVP, MBChB, MMed

Drs Van Wageningen and Partners, Stellenbosch Mediclinic

Correspondence to: Andries Coetzer, e-mail: dries@cis.co.za

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Abstract

Background: Knee replacement surgery is an operation that is performed on older patients, with a few exceptions. Many of these patients have co-existing diseases and have had previous surgery, of which lumbar spinal surgery is of particular relevance. Neuraxial anaesthesia is the anaesthetic of choice.

Method: This study offers a practical approach to how anteroposterior and lateral X-rays of the lumbar spine contribute to the ease and safety of the neuraxial anaesthesia procedure. The study group comprised 100 patients, scheduled for knee replacement surgery. The patients had to have undergone previous lumbar spinal surgery. This was the only prerequisite.

Results: The success rate of neuraxial anaesthesia improved progressively during the study. It became clear that specific clinical aspects had potential for future application in this particular group of patients. Only four of a total of 23 combined spinal epidural procedures were not successful. There were three dural taps without any post-dural puncture headaches being experienced. Spinal blocks totalled 77, of which two were incomplete and five complete failures.

Conclusion: Calculated performance of neuraxial anaesthesia on patients who had undergone previous lumbar spinal surgery set the scene for a more predictable and largely atraumatic outcome.

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Introduction

The performance of knee replacement surgery, traditionally an operation that is performed on older patients, is ideally carried out under neuraxial anaesthesia. The anaesthetist is often confronted by co-existing diseases, as well as previous exposures to multiple operations, in this group of patients. Of particular relevance is the fact that a significant number of these patients have undergone lumbar spinal surgery which may have an impact on the ability to perform, as well as the success rate of, neuraxial anaesthesia.

The primary aim of this study was to determine whether the obtained information from lumbar X-rays could assist in the subsequent performance and increased safety of neuraxial anaesthesia in patients who had undergone previous lumbar spinal surgery.

Method

The study was conducted in a busy private practice in which the first author was the sole practitioner. All patients with previous lower spinal surgery were identified, and standard anteroposterior and lateral X-rays of the lumbar spine were performed preoperatively. Depending on the relevant clinical history, as well as the X-ray findings and type of knee surgery planned, an appropriate neuraxial anaesthesia approach was determined. This was discussed in great detail with the patient before obtaining the patient's informed consent. Ethics approval was not required or deemed necessary, as all of the performed procedures were routine.

During the study period, 11.5% of the patients who were seen had undergone previous lower back surgery. The first 100 of these patients who had experienced lower spinal surgery (as the only precondition) were included in this case

series. The average age of the patients was 67 years and their body mass index was 31.9. The average time that had elapsed since the last spinal operation was 13 years (ranging from eight months to 54 years). Eleven of these patients had had more than one back operation. The patients were often unsure as to the exact nature of the surgery that had been performed on them.

The back operations consisted of fusions with and without internal fixation, laminectomies, laminotomies and decompression operations.

The arthroplasty procedures that were carried out in this group of patients consisted of single, bilateral or revision knee replacements. Generally, unilateral knee replacements were performed under spinal anaesthesia, while longer procedures (bilateral and revision knee replacements) were performed under combined spinal-epidural (CSE) anaesthesia.

Taking into consideration the physique and age group of these patients, the neuraxial procedure was best performed in a sitting position. After local skin infiltration with lignocaine, standard doses of fentanyl (25 µg), and heavy bupivacaine (10-15 mg), were used for spinal anaesthesia. When prolongation of the block became a reality during

CSE, ropivacaine (7.5%) was injected through the epidural catheter. All of the patients were sedated using a propofol infusion.

Twenty-six gauge pencil-point needles were used for the spinal procedures, and 17 gauge epidural needles (with catheter and spinal needles) for CSE.

Interpretation of lumbar spine X-rays is relatively easy and can be used to decide on the neuraxial anaesthetic method. The technical detail of the back operation was of less importance than the X-rays themselves.

X-rays were studied in order to determine the most appropriate access route for the procedure. The dark areas on X-rays represent low-density areas between or around bone, whereas the denser bone shows up as lighter shades. The darker, low-density areas are areas that may represent an access route for neuraxial anaesthesia.

The following approach was used:

- The lumbar spinal vertebrae L1-L5 were identified and marked.
- The level of the iliac crest in relation to the identified lumbar spinal vertebrae was established. The height of the iliac crest may vary, as it may be at any level between L3 and L5. This acts as an important marker for neuraxial needle placement.

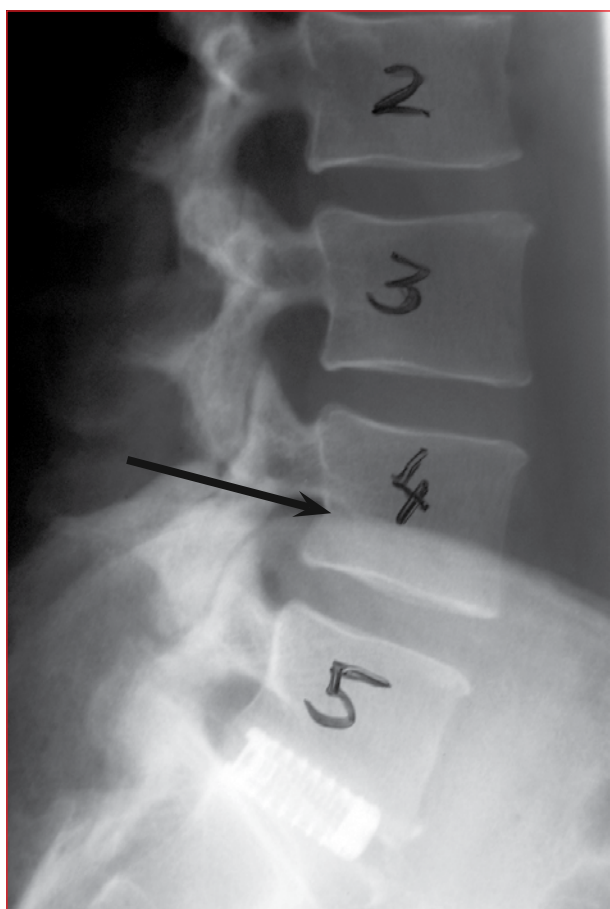


Figure 1: Lateral lumbar spine. Note the level of the iliac crest in relation to the L4 vertebral body.

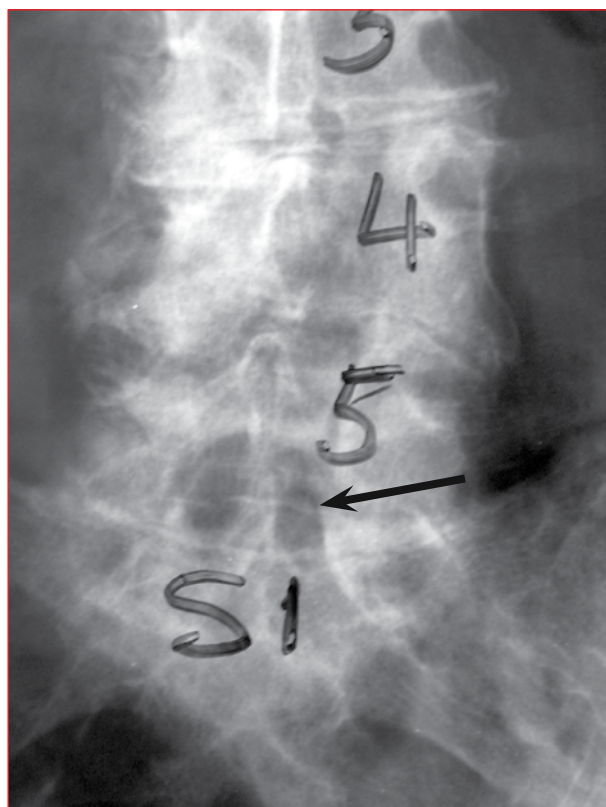


Figure 2: AP lumbar spine. Note the post-laminectomy changes to L4-5 and the bilateral spaces (low density) L5-S1 (arrow), the latter being potential neuraxial anaesthesia access routes.

- The lateral view should always be taken into consideration when determining the level of the iliac crest (Figure 1). It is important to ensure that it is a true lateral X-ray, with the iliac crests superimposed exactly one on top of the other.
- If the level of the iliac crest is not easily identifiable, or if it is difficult to place it in relation to the lumbar spine, the lumbosacral junction can be used as a marker to determine the most suitable access route, calculated superiorly.
- Signs of previous surgery should be looked for, for example bony fusions without internal fixation (Figure 2) or with internal fixation (Figure 3), unilateral or bilateral laminectomies (Figure 4), or combinations of spinal procedures (Figures 3, 4 and 5).
- After the best access route for the neuraxial anaesthesia procedure was determined radiologically, measurements were noted on the X-ray. The patient's back was then examined physically to identify, where possible, the spinous processes of each vertebra individually. At the

same time, the level of the iliac crest and (if applicable) that of the lumbosacral junction were identified. The next step was to make corresponding marks on the skin in order to indicate the best X-ray approach. It is advisable to mark the most suitable, as well as the second best possible, access route in this fashion.

Results

The lessons learnt from this exercise were:

- The ease of the neuraxial anaesthesia may well vary, but meticulous planning is always necessary, regardless of previous success.
- When a CSE is not possible and prolonged surgery

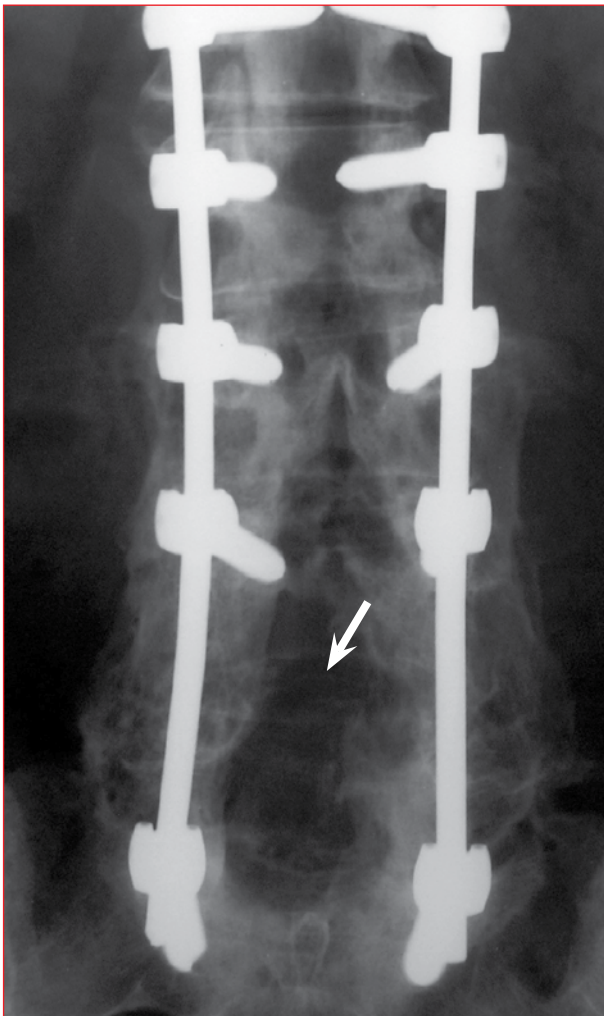


Figure 3: AP lumbar spine. Note the pedicle screws and rods with large laminectomy defect (arrow) which represents a potential access route.

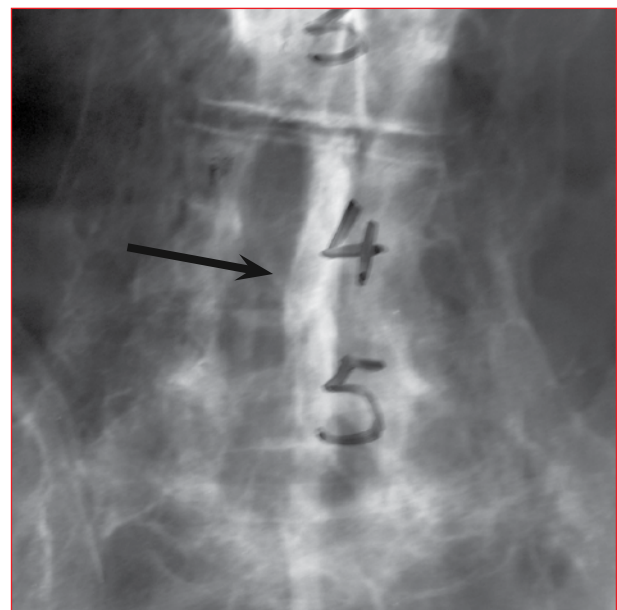


Figure 4: AP lumbar spine. Unilateral laminectomy L4/5. (Arrow shows an area representing a potential neuraxial anaesthesia access route.)

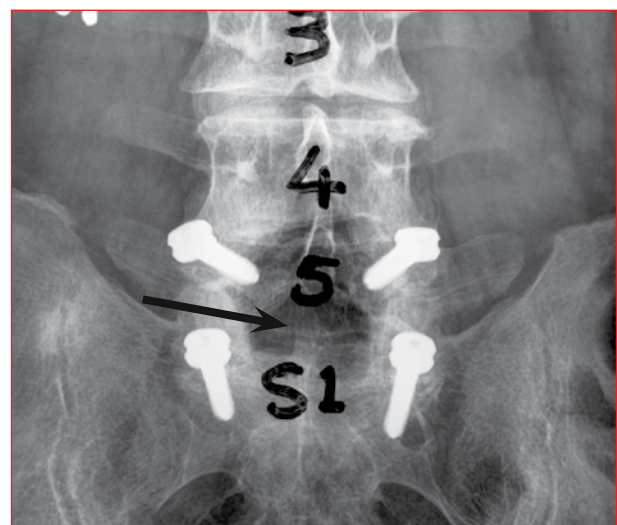


Figure 5: AP lumbar spine. Internal fixation and laminectomy at the L5/S1 level (arrow). This indicates a potential access route.

is planned, it is advisable to proceed with a spinal anaesthetic, as it is easy to convert to a general anaesthetic if required.

- Carrying out neuraxial anaesthesia after previous back surgery always carries the risk of a failed or incomplete block.¹⁻⁴
- Pedicle screws with rods usually allow enough space between the rods for neuraxial anaesthesia access (Figure 3).
- An epidural or spinal needle that encounters bone does not cause damage, provided that the necessary care and skill are applied.
- With multiple areas of disc-space narrowing, as well as associated anterolisthesis, a neuraxial anaesthesia procedure in the space immediately above the level of the iliac crest often remains a good choice.
- Although the skin scar left as a consequence of previous back surgery is insignificant, and is generally of no assistance in determining the nature of such back surgery, the presence of either a very low or high scar may indicate easy access above or below the level of the scar. However, it should be borne in mind that blindly inserting a needle above the scar might be too high when considering the level of the spinal cord during spinal anaesthesia.
- Even the presence of a very small or oblique area of low-density tissue, as indicated on the X-ray in Figure 2, can

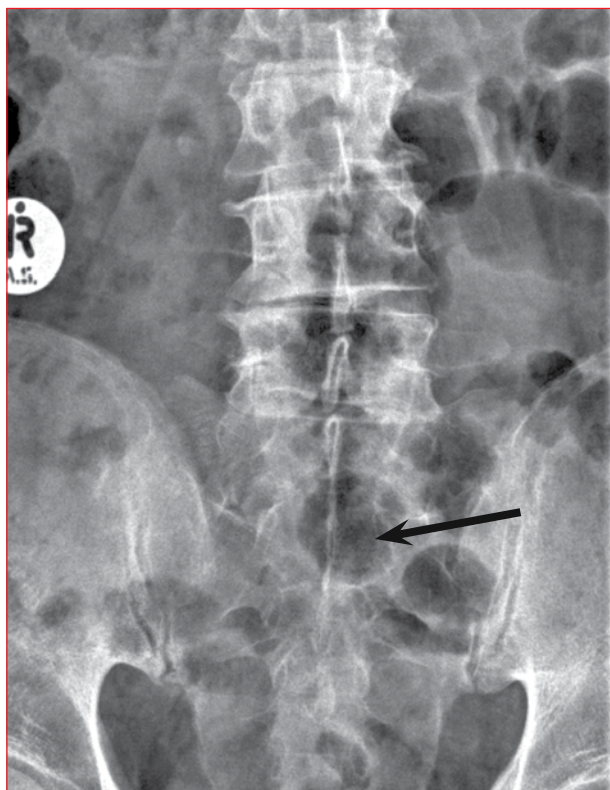


Figure 6: AP lumbar spine. Note the presence of bowel gas shadows (arrow), which may simulate laminectomy defects.

be used for spinal anaesthesia, although at times only by using a posterolateral access route.

- If more than one access route has been identified on the X-ray, it is good practice to anaesthetise at least the two most likely access routes, because a failed attempt at one level may necessitate a second attempt at a different level. Further injection of local anaesthetic would not be necessary if the second identified route was used.
- When an epidural catheter cannot be passed through a Tuohy needle, the catheter should be removed and replaced with a new catheter, as this is usually successful.⁵ An indication of correct catheter placement during CSE must be confirmed by the application of negative pressure on the catheter and filter end. A 2-ml syringe should be used for this purpose. The aspiration of fluid is indicative that the dura has been penetrated. The catheter can then be used as a spinal catheter.⁶ However, it is important to note that negative pressure on the catheter can cause the tip of the catheter to suck fast to the dura, thereby giving a false negative. It may be prudent to apply the suggested test, but also to let the external tip of the catheter simply hang lower than the puncture site in order to determine whether fluid flows back into the catheter.
- It should be noted that the presence of a bowel gas pattern can be misleading, specifically to the untrained eye, as it can be interpreted incorrectly as a potential laminectomy space (Figure 6).
- Because of the interference with normal tissue as a result of spinal surgery, the lack of epidural space (in the case of total laminectomies) and the resultant obscuring of the usual tactile landmarks, the execution of epidurals, in particular, is difficult to almost impossible.^{1,3,7} As indicated previously, this can be avoided by the performance of a block above or below the level of the scar, or through the scar tissue at the level of L5-S1, using Taylor's approach.⁸
- Taylor's approach relies on the fact that the L5-S1 interlaminar space is the widest,⁹ and the space that is affected least by degenerative changes. This disc space presents a potential epidural⁸ (provided that total laminectomies have not been performed at that level) as well as potential spinal¹⁰ access route after previous spinal surgery, with a simultaneously reduced possibility of post-dural puncture headache.¹¹ In addition, this space is relatively easily palpable on the skin surface, even in the obese.
- The incidence of post-dural puncture headache in the higher age group is relatively low, in spite of the use of thicker spinal needles.^{12,13} The use of a 22 gauge, 3.5-inch (Quincke-type point) lumbar puncture needle is recommended if the skin and subcutaneous tissue are unusually rigid and thickened, in older patients with narrowed and difficult palpable interspinous spaces,

Table I: Summary of results

Neuraxial anaesthesia procedure	Combined spinal-epidural anaesthesia	Spinal anaesthesia
Total	23 (14 Taylor's approach)	77
Failures	4 (3 Taylor's approach with dural tap)	7 (2 incomplete)
Complications	Nil (no post-dural puncture headache)	Nil

in dense bony fusions, after multiple spinal surgical procedures and after unsuccessful penetration attempts with a 25 gauge or 26 gauge spinal needle. If high resistance is felt during local anaesthetic skin infiltration before neuraxial anaesthesia, it may be an early indication for the use of a 22 gauge needle.

The results from the 100 patients are summarised in Table I.

Discussion

Neuraxial anaesthesia remains the most suitable anaesthetic for knee replacement surgery, but because of the fact that a significant number of patients have had previous lower spinal surgery, it creates a challenge and places an additional burden on the anaesthetist. The injudicious use of neuraxial anaesthesia techniques in these patients sets the scene for possible complications.

Neuraxial anaesthesia is technically more difficult and patients are also exposed to, inter alia, unintentional dural puncture, traumatic needle placement, and incomplete or patchy blocks. Epidural needle placement, in particular, may be extremely difficult, unless Taylor's approach is used under selected circumstances.

The study was not intended to be a comparison with other methods or aids used during the performance of neuraxial anaesthesia. The aim was to determine whether, through the judicious use of X-rays, ease of execution could be improved and whether it could contribute to the safety of neuraxial anaesthesia. As a consequence, guidelines can be drawn up for future application.

It is important to note that the possibility of complications always exists, but we believe that, with the use of X-rays, the risks are at least calculated and, we believe, reduced.

Conclusion

The use of neuraxial anaesthesia procedures after previous spinal surgery has been performed is technically difficult and a source of concern to the anaesthesiologist. The use of anteroposterior and lateral X-rays makes neuraxial

anaesthesia procedures easier, largely atraumatic and more predictable. It is recognised that patients are still at risk, but it is also noteworthy that patients who qualify for knee replacement surgery are in an older age group with a higher disease profile, making neuraxial anaesthesia marginally safer, as well as more appropriate.

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