



Technical Note

Spine and Peripheral Nerves

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A Novel Technique to Improve Intraoperative Visualization for the Lower Cervical Spine in Spine Surgery

Ajoy Prasad SHETTY¹, Juan Esteban MUÑOZ MONTOYA^{2,3}, Antonio José GÓMEZ DIAZ⁴

¹Senior Consultant Spine Service of Ganga Hospital, Spine Surgeon, Tamil Nadu, India

²Universidad Militar Nueva Granada, Neurosurgeon, Bogotá, Colombia

³Ganga Hospital, Spine Fellowship, Tamil Nadu, India

⁴Universidad del Tolima, Physician, Ibagué, Tolima

Corresponding author: Ajoy Prasad SHETTY ✉ juanesteban1285@gmail.com
✉ ajoyshetty@gmail.com

ABSTRACT

Localising the lower cervical spine intraoperatively using conventional fluoroscopy with lateral projections has limitations. The main factor limiting the adequate visualisation of the cervicothoracic spaces is the superposition of the shoulder's structures (soft tissue, muscle, and bone), which creates a significant obstacle when making intraoperative decisions. Various techniques have been described for this purpose. Some are complex and involve different X-ray projection angles or the creation of special devices. However, fluoroscopy techniques using conventional AP and lateral projections can be employed in conjunction with shoulder traction, dorsiflexion of the feet, and pushing the feet upward to accurately identify lower cervical spaces and even the cervicothoracic junction. This technique is unique in that it is cost effective, yielding favourable results without requiring investment in new or expensive devices. Both shoulders were secured to the operating table using shoulder traction, and dorsiflexion and pushing the feet upward bilaterally were performed simultaneously. Doing so enabled the capture of favourable images and the implementation of accurate surgical approaches to treat lower cervical structures. The usefulness of this new technique for visualising lower cervical spaces was demonstrated in the presented cases. Our technique facilitates the acquisition of fluoroscopic images with adequate magnification and accurate visualisation of the lower cervical spaces. The results were similar to those of other studies.

KEYWORDS: Methods, Cervical vertebrae, Fluoroscopy

INTRODUCTION

Successful spine surgery relies on meticulous surgical planning and accurate visualisation of the target area using fluoroscopy (3). However, these are significant challenges in the case of the cervical spine, particularly the lower segments, due to the overlap of bony structures and soft tissues in the shoulder area (3,4). This can result in distorted and misleading images, hindering an adequate surgical approach. Failure to reach a surgical level can lead to adverse outcomes, ranging from an inadequate approach to intraoperative and postoperative complications (2-4). Due to the difficulty of obtaining reliable images for the procedure, a technique is needed that

significantly improves the visualisation of the intervertebral spaces under fluoroscopy during the procedure using conventional projections without additional devices. We describe this new technique in detail, including its benefits for lower cervical spine surgery, and present two case studies in which it was applied.

MATERIAL and METHODS

Two patients over 40 years of age underwent anterior lower cervical spine surgery under general anaesthesia. They were admitted to the operating theatre and placed supine on the surgical table. Once anaesthetised and monitored with their

Ajoy Prasad SHETTY : 0000-0001-5885-7152
Juan Esteban MUÑOZ MONTOYA : 0000-0002-5003-4060
Antonio Jose GOMEZ DIAZ : 0009-0006-9532-9555



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face properly protected, a gel pad was placed on the posterior cervical spine to achieve adequate cervical extension while avoiding lacerations or wounds to the area. Medical tape was also applied to both shoulders to provide slight caudal traction and secure the patients to the surgical table, maintaining this position throughout the procedure (Figure 1).

Next, the fluoroscopy bow was used to take the first X-ray of the cervical spine in lateral projection. Doing so enabled the clinician to assess whether the lower levels were visible and whether the intervertebral spaces to be treated were sufficiently open and exposed (Figure 2).

Once the initial image was obtained, its usefulness was evaluated. It was identified that, despite the inferior traction of the shoulders, no adequate visualisation of the lower cervical spine could be made due to the superimposition of bone, muscle, and soft tissue structures. Accordingly, a surgical



Figure 1: Positioning of the patient in the supine position, cervical extension, and shoulder traction.

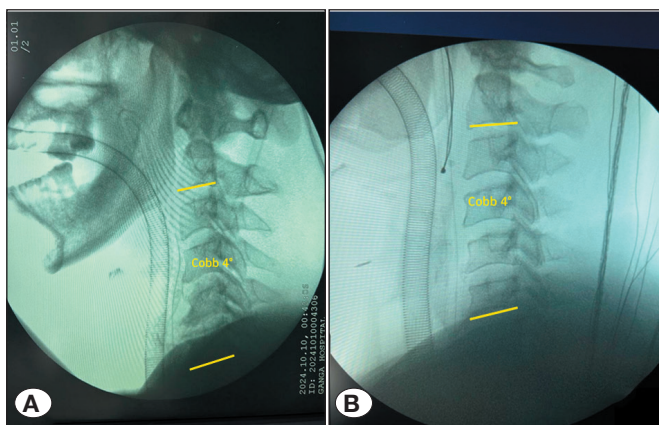


Figure 2: Initial visualisation of the lower cervical spine under intraoperative fluoroscopy. **A)** In the first case, the initial image obtained was unsatisfactory, as it only visualised up to the vertebral body of C5 without providing an adequate view of the lower cervical spaces. **B)** In the second case, the cervical spine was visible up to a small portion of the C6 vertebral body. However, this image was also unsatisfactory given the procedure to be performed on this patient.

team member was instructed to dorsiflex both feet while pushing upward with equal intensity on each foot simultaneously (Figure 3). Doing so improved the visualisation of the lower cervical intervertebral spaces.

RESULTS

Fluoroscopy was again used to perform a radiographic control, which revealed a change in the amplitude and visualisation of the lower cervical intervertebral spaces after manoeuvring (Figure 4).

Once adequate visualisation of the lower cervical intervertebral spaces was achieved, with an optimal width of the spaces to be intervened in, the surgical procedure could continue. It concluded without issues and yielded excellent results (Figure 5).

The shoulder traction, the dorsiflexion of the feet, and pushing the feet upward bilaterally simultaneously improved the visualisation of the cervical spaces, particularly the lower ones. This finding demonstrates the technique's utility for surgical procedures involving the cervicothoracic junction. No modifications are required to conventional fluoroscopy projections (anterior–posterior and lateral), and new or expensive devices are unnecessary. Furthermore, it eliminates artefacts caused by the superimposition of thoracic and shoulder structures. Moreover, this technique minimises the occurrence of intraoperative and postoperative complications.

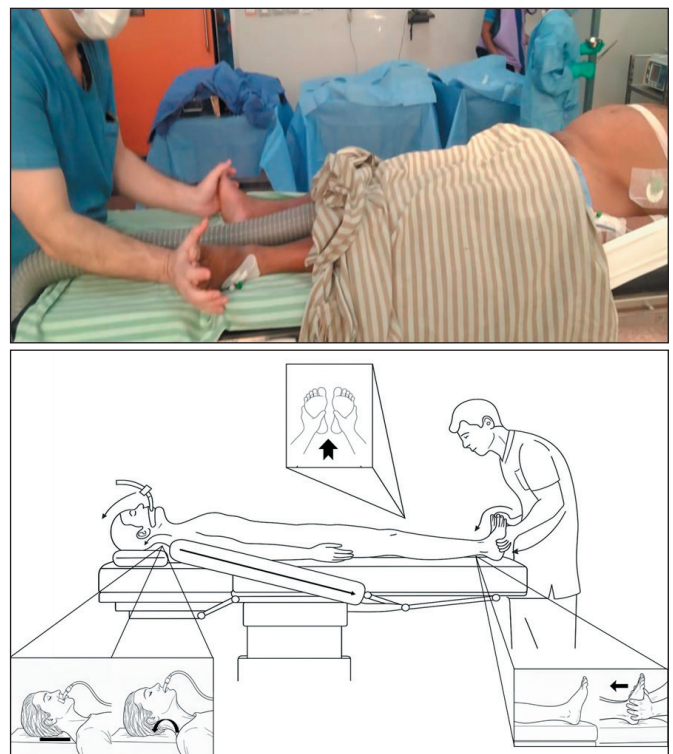


Figure 3: Dorsiflexion manoeuvre and pushing the feet upward, bilaterally and simultaneously.

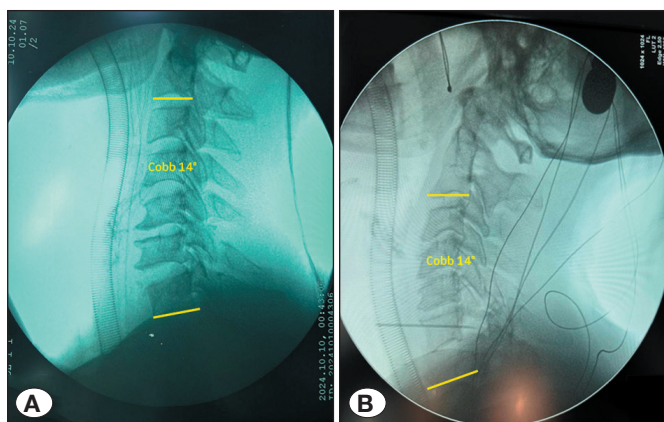


Figure 4: Improved visualisation of the lower cervical spine under intraoperative fluoroscopy was achieved by dorsiflexing and pushing both feet upward, bilaterally and simultaneously. **A)** In our first case, we achieved visualisation of almost the entire C7 body, which had previously been impossible. **B)** In our second case, complete visualisation of the C7 body was achieved, demonstrating a significant improvement in the visualisation of the lower cervical spaces compared to the initial image.

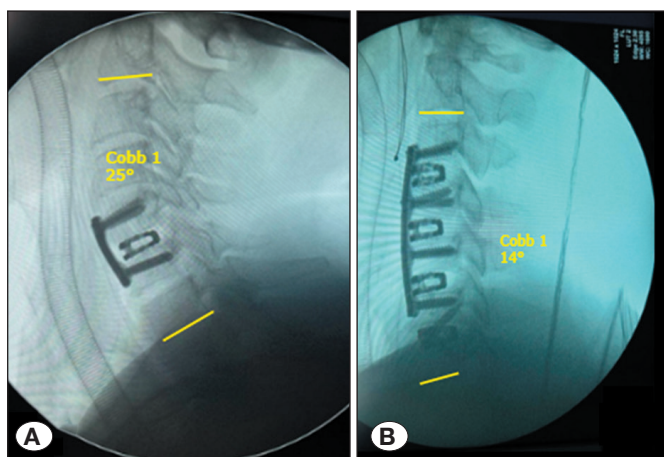


Figure 5: Control image taken at the end of the surgical procedure, showing adequate visualisation of the lower cervical spinal spaces without any overlap with other structures. **A)** In the first case, the product of a discectomy with cage placement, as well as anterior C5-C6 fusion. **B)** In the second case, the result of multiple discectomies with cage placement at C3-C4, C4-C5, C5-C6, and C6-C7, in addition to anterior C3-C6 fusion.

DISCUSSION

Spine surgery, especially lower cervical spine surgery, is challenging for surgeons because poor preoperative planning and incorrect identification of the surgical site during the procedure can lead to various surgical and post-surgical complications. Operating at the wrong level is one of the most common complications in spine surgery. Singh et al. stated that errors in the cervical and thoracic spine account for up to 29% of cases (3).

Consequently, several localisation techniques have emerged to improve surgical outcomes. Singh et al. performed a technique involving fluoroscopy and a modified oblique projection to obtain a clearer image of the lower cervical and upper thoracic spaces (3). Huang et al. also presented an oblique fluoroscopic projection technique involving the injection of methylene blue as a radiographic marker to enable the precise identification of the vertebral spaces to be treated (1). While both studies used a similar method, one required preoperative preparation and was more invasive than the other, resulting in substantial differences in surgical time and the presentation of associated surgical complications. However, both studies found that successful outcomes were directly proportional to the experience and expertise of the personnel in charge, as less-experienced physicians increased surgical time and radiation exposure (1).

Marangoz et al. described a device for shoulder traction during surgery that is easy to manipulate and demonstrates good intraoperative results (2). Witiw et al. created a device known as the Citow Cervical Visualiser (CCV), which is placed on the acromion, acromioclavicular joint, or distal clavicle of the patient and temporarily displaces the shoulders (5). Truong et al. also developed a shoulder traction system known as Cervision, which aimed to exclude the shoulders from the fluoroscopic field, thus improving the visualisation of the lower cervical spaces. Although the authors used different devices, they both intended to achieve the same result: simultaneous traction of both shoulders to move them downward temporarily, allowing better visualisation of the lower cervical spaces (4).

However, since this technique is temporary and adjustable, it is operator-dependent, meaning that the results depend on how familiar the staff members are with the device. Our technique offers the advantage of fixed shoulder traction, which prevents uneven positioning and alters the lower cervical spine visualisation, thus reducing fluoroscopy exposure time.

Furthermore, a study by Truong et al., which evaluated the effectiveness of this system compared to adhesive tape for shoulder traction, found no significant differences in visualisation effectiveness or potential complications, such as brachial plexus damage, between the two groups (4).

Although our technique involves downward shoulder traction, as do the other methods described in the literature, we do not use medical devices that may not significantly improve visualisation or reduce the risk of complications, such as brachial palsy. What makes our technique novel is that it involves not only shoulder traction in isolation but also dorsiflexion and an upward push with both feet. This generates cervical hyperextension and improves the visibility of cervical spaces.

CONCLUSION

Although few research articles have examined this technique, our experience in daily clinical practice leads us to conclude that, with some modifications and variants, this new technique is beneficial and effective for ensuring the correct intraoperative visualisation of the intervertebral spaces in the lower cervical spine. It achieves better radiographic exposure of the

spaces to be intervened under fluoroscopy, contributing to improved surgical results and minimising possible intraoperative and postoperative complications.

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AUTHORSHIP CONTRIBUTION

Study conception and design: APS, JJEMM, AJGD

Data collection: APS, JJEMM, AJGD

Analysis and interpretation of results: APS, JJEMM, AJGD

Draft manuscript preparation: APS, JJEMM, AJGD

Critical revision of the article: APS, JJEMM, AJGD

Other (study supervision, fundings, materials, etc...): n/a

All authors (APS, JJEMM, AJGD) reviewed the results and approved the final version of the manuscript.

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