Interventional Pain Management Reports
ISSN 2575-9841 Volume 2, Number 4, pp127-131

Technical Note

Needle Tip Depth Assessment on Foraminal Oblique Fluoroscopic Views during Cervical Radiofrequency Neurotomy. A Technical Note

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Background: Precise needle tip visualization using fluoroscopy is critical to avoid injury to nearby neurovascular structures during cervical radiofrequency neurotomy (RFN). The contralateral oblique (CLO) view has been shown to be superior to the lateral view for needle tip visualization during cervical interlaminar epidural injection (CESI). It has been demonstrated that increasing the angle of obliquity during CESI causes the needle tip to appear to move dorsal and superficial on contralateral oblique views. Needle tip visualization for cervical RFN has been described using a foraminal oblique (FO) view, but the technique and effect of angle on needle tip depth have not been studied.

Objective: To analyze how the needle tip depth changes with varying oblique angles of FO views during cervical RFN.

Methods: Fluoroscopic views during cervical RFN between lateral and 50 degrees FO in a single subject were analyzed.

Results: The needle tip appears to move ventral and deeper with increasing angle of obliquity with respect to the lamina.

Conclusion: Contrary to the phenomenon noticed with contralateral oblique views in CESI, in this case the needle tip appears to move ventral and deeper with increasing angle of obliquity on foraminal oblique views during cervical RFN. It becomes crucial for practitioners to understand that during cervical RFN, with inadequate foraminal oblique angle, needle tip looks artificially superficial, which in turn may cause one to advance the needle to a dangerous depth.

Limitation: This is an observational study in a single subject; hence further larger studies are needed to confirm the findings in this technical report.

Key words: contralateral oblique, needle depth assessment, cervical radiofrequency neurotomy, cervical radiofrequency ablation, foraminal oblique, fluoroscopy views, fluoroscopy angles

Fluoroscopy is a valuable tool that when used effectively increases the safety and accuracy of interventional spine procedures. Interventional pain physicians typically use a trajectory view for initial needle placement, then multi-planar imaging to confirm accurate needle tip placement. In cervical radiofrequency neurotomy (RFN), the lateral view is often considered the “safety” view as it visualizes the needle tip depth as well as confirms that target medial branch nerves are covered in their longest course over the lateral articular pillars. Assessing safe needle tip depth with the lateral view during lower cervical RFN can be challenging or impossible at times due to overlying shoulders obscuring visualization (Fig. 1). Precise needle tip visualization is critical for accuracy and to avoid injury to nearby neurovascular structures

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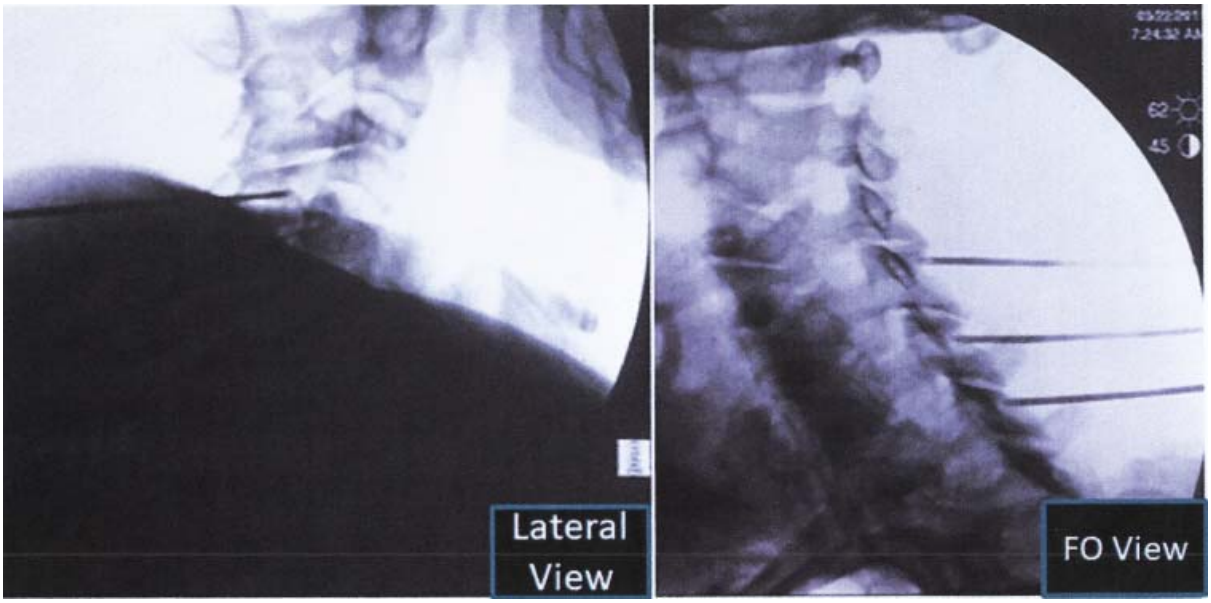

Fig. 1. Fluoroscopic views in a single subject during cervical radiofrequency neurotomy – Lateral and foraminal oblique (FO) views. Notice the needles obscured by shoulder in lateral view are better visualized in foraminal oblique view.

during cervical RFN (1). Contralateral oblique (CLO) view has been shown to be superior to lateral view for needle tip visualization and in providing a consistent landmark for epidural access during cervical interlaminar epidural injection (CESI) (2). Needle tip visualization for cervical RFN has been described using a foraminal oblique (FO) view for additional depth verification dorsal to the neuroforamen as well as for when lateral view is obscured by overlying bony structures at lower cervical levels (3). However the technique and effect of foraminal oblique angle on needle tip depth have not been studied.

Furman describes proper final needle tip depth on lateral view at, but no further than the ventral margin of the articular pillar (3). The proper oblique angle and how the needle tip correlates to the ventral articular pillar on lateral view and posterior lamina on the foraminal oblique view is unknown. This is vitally important for accuracy, efficacy and safety, particularly when the lateral view is not clear.

The impetus for this study came from the authors' experience of performing motor test stimulation at the C6 and C7 levels where only foraminal oblique view provided needle tip visualization and lateral view was completely obscured by the shoulders. While motor testing is not necessary when utilizing a clear lateral view (4), we routinely conduct motor testing when foraminal oblique view is solely relied upon for depth verification. Despite the needle tip appearing behind posterior lamina and neuroforamen at an arbitrary angle of obliquity, motor test stimulation reproduced paresthesia in the respective dermatome on several occasions. No standard foraminal oblique angle or distance behind posterior lamina in foraminal oblique view has been studied to guide needle placement in cervical RFN. This becomes even more important in cases where one or more needle tip is not able to be visualized on lateral view for depth reference, and the foraminal oblique angle must be completely relied upon for proper placement.

METHODS

Fluoroscopic views in a single subject were analyzed (Fig. 2A and 2B). Radiofrequency neurotomy was performed via posterior approach with 18 gauge curved 10 mm active tip RF needles placed along the course of corresponding medial branch target zone over the

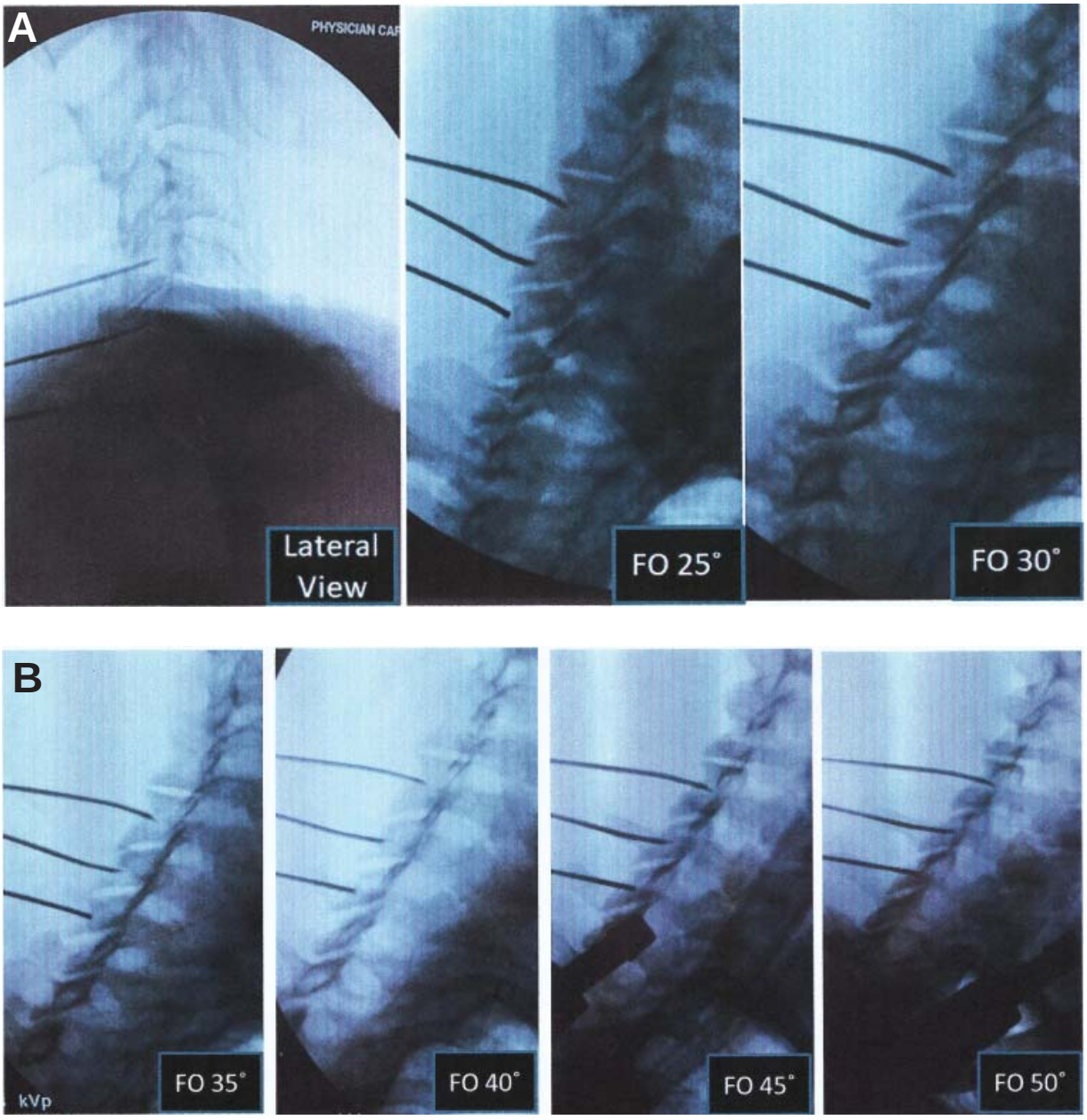

Fig. 2. A) Fluoroscopic views in a single subject during cervical radiofrequency neurotomy –Lateral and foraminal oblique (FO) views from 25 to 30 degrees. Caudal tilt is utilized to visualize the joint spaces under foraminal oblique views, therefore the needles do not appear parallel to medial branch nerve as they do on lateral view. The needle tip appears to move ventral and deeper with increasing angle of obliquity with respect to the lamina. Needle is not advanced to maximal ventral placement on lateral view here. Ideally final needle tip should be at the ventral margin of the articular pillar on lateral view as per Spine Intervention Society (SIS) practice guidelines. B) Fluoroscopic views in a single subject during cervical radiofrequency neurotomy – Foraminal oblique (FO) views from 35 to 50 degrees. The needle tip appears to move ventral and deeper with increasing angle of obliquity with respect to the lamina.

lateral articular pillars. Once the desired placement was achieved on anteroposterior (AP), foraminal oblique and lateral views, 2 lesions per nerve were then generated to fully cover the medial branch target zones. Lesions were performed at temperature of 80 degrees Celsius maintained for 90 seconds.

During performance of cervical RFN, true AP and lateral views were obtained with patient lying prone, documenting clear needle tip position. The image intensifier was adjusted to foraminal oblique position (contralateral to RF needle insertion side) and images were obtained at 25 degrees (from AP) and then 5 degree increments to 50 degrees of obliquity (Fig. 2A and 2B). Images were stored and later analyzed.

RESULTS

Fluoroscopic views during cervical RFN between lateral and 50 degrees foraminal oblique were analyzed for needle tip distance to the posterior lamina at each angle and compared to the distance to ventral articular pillar on lateral view. With increasing angle of obliquity, it was noted that the distance to the posterior lamina decreased. In other words, the needle tip appears to move ventral and deeper with increasing angle of obliquity with respect to the lamina. Interestingly, this is opposite to what is observed in contralateral oblique views during cervical interlaminar epidural injection. Gill et al (2) has demonstrated that increasing the obliquity angle during cervical interlaminar epidural injection causes the needle tip to appear to move dorsal and superficial on contralateral oblique views.

CONCLUSION

Foraminal oblique view is an option for lower cervical RFN where the needle tip cannot be adequately visualized on lateral view. Contrary to the phenomenon noticed with contralateral oblique views in cervical interlaminar epidural injection, in this case the needle tip appears to move ventral and deeper with increasing angle of obliquity on foraminal oblique views during cervical RFN. An oblique view parallel to the contralateral lamina provides the true relationship of the needle tip to the ventral laminar margin (5). We theorize that the divergent needle tip depth phenomenon seen in cervical interlaminar epidural injection and contralateral oblique vs RFN and foraminal oblique occurs due to the following: As the needle tip in the epidural space lies anterior to the ventral laminar line, it appears to move dorsally with increasing obliquity on contralateral oblique views. Since the RFN needle tip lies posterior to the dorsal laminar line, it appears to translate ventrally with increasing obliquity on foraminal oblique views (Fig. 3).

It becomes crucial for practitioners to understand that during cervical RFN, with inadequate foraminal oblique angle, the needle tip looks artificially superficial, which in turn may cause one to advance the needle to a dangerous depth given proximity of exiting nerve roots and vertebral artery. The gold standard views for determining needle tip location for cervical RFN remain AP and Lateral as per Spine Intervention Society (SIS) practice guidelines (4). Due to the occasional difficulty in needle tip visualization at the lower cervical levels on lateral view, a foraminal oblique may be used, although it must be noted that this view cannot guarantee appropriate needle tip positioning. Although an appropriate foraminal oblique angle will require further studies with large sample size and geometric analysis, we recommend at least 45 degree angle to assess needle tip depth while performing cervical RFN as it best correlates to bony landmark of posterior lamina and ventral pillar on lateral view. While SIS practice guidelines state that sensory and motor stimulation is not necessary before lesioning when proper anatomic placement of electrodes is utilized, we strongly recommend using motor and/or sensory test stimulation when electrode placement is done solely under foraminal oblique view. We also recommend larger studies to confirm the findings in this technical report.

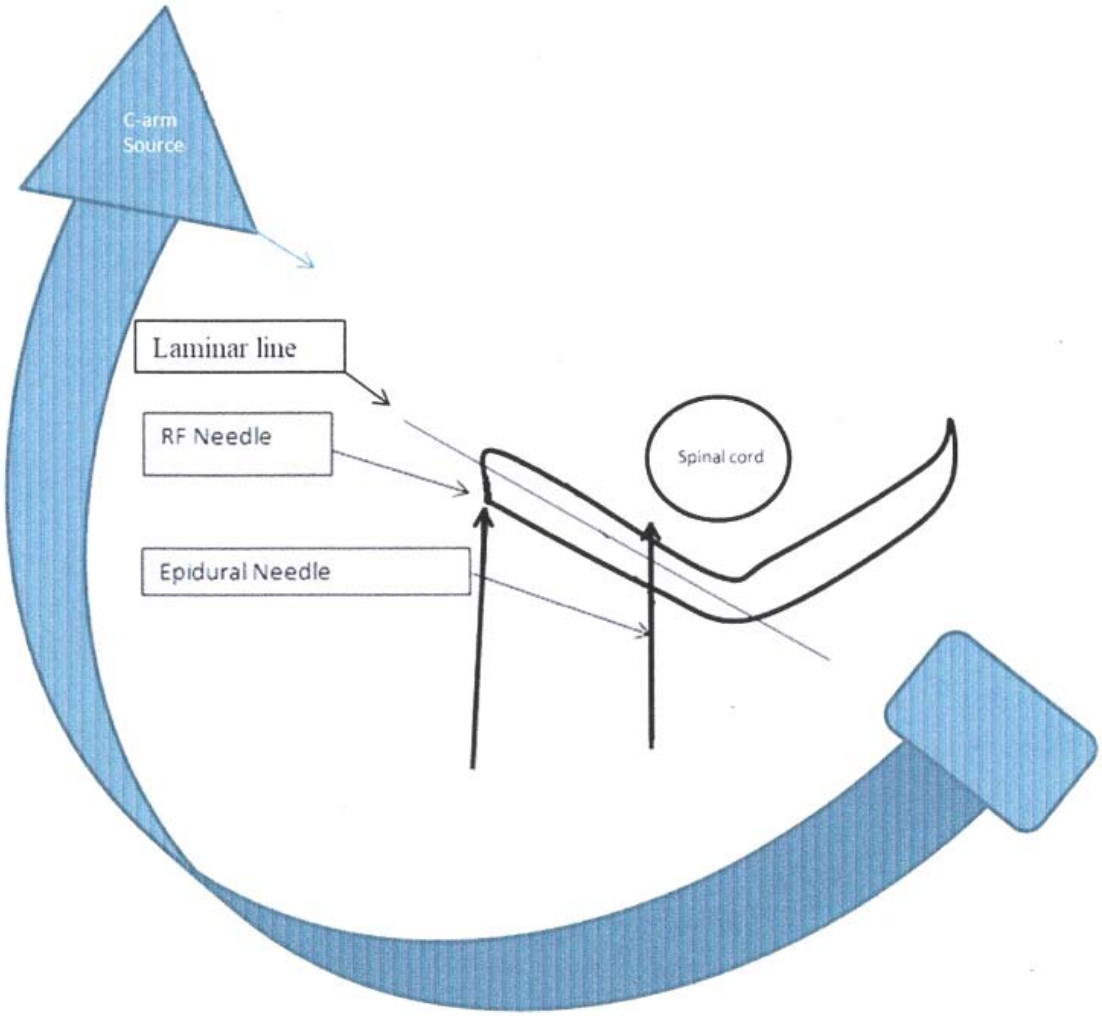

Fig. 3. Diagrammatic representation of C-arm position in foraminal oblique view in relation to radiofrequency (RF) needle.

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