MRI-Guided Femoral Nerve Localization: Interobserver Reliability Study for Preoperative LLIF Planning

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INTRODUCTION:

The benefits of transpsoas LLIF, whether in the lateral decubitus or prone position, are well documented. So too are its complications, most notably femoral neuropraxia. Since Moro's seminal cadaveric study on lumbar plexus safe zones, subsequent work including radiographic studies has supported the notion of an anteriorly migrating plexus and narrowing safe corridor at L4–5. However, prior studies have focused solely on identifying the femoral nerve at the L4–5 disc space rather than tracing its constituent roots as they course through the psoas.

At our institution, femoral nerve localization is performed by tracing the L2, L3, and L4 ventral rami on T2-weighted axial MRI from cranial to caudal until they converge within the psoas. Though routinely used in clinical planning, this technique has not been formally validated. This study aims to quantify the interobserver reliability of this MRI-based nerve-tracing method.

METHODS:

Fifteen patients undergoing LLIF at L4–5 were randomly selected from a prospective spine registry. Preoperative lumbar MRIs were retrospectively analyzed using PACS, with acquisition parameters reflecting routine clinical variability. Four observers: a fellowship trained spine surgeon, neuroradiologist, PGY-3 resident orthopedic surgery resident, and postdoctoral clinical research fellow independently traced the L2–4 ventral rami on T2-weighted axial images. Reference lines were established on the most caudal axial slice intersecting the L4–5 disc: a vertical line normalized midline orientation, and a perpendicular horizontal line served as the zero-reference for anteroposterior measurements. Nerve tracing followed L2–4 fascicles from their foramina into the psoas. Interobserver reliability was calculated using intraclass correlation coefficients.

RESULTS:

Interobserver reliability at L4–5 was consistently good. The anteroposterior disc-space width yielded an intraclass correlation coefficient (ICC) of 0.86 (95 % CI 0.82–0.97). Localization of the left femoral nerve/L2–3 bundle showed a comparable ICC of 0.85 (95 % CI 0.75–0.96), while the right-sided measurement produced an ICC of 0.83 (95 % CI 0.69–0.94). According to conventional thresholds (poor < 0.50, moderate 0.50–0.75, good 0.75–0.90, excellent > 0.90), all three values fall within the good-reliability category.

DISCUSSION AND CONCLUSION:

MRI-based tracing of the L2–4 ventral rami to localize the femoral nerve within the psoas demonstrates good interobserver reliability, supporting its use in preoperative LLIF planning. This reproducible technique offers a practical method to identify plexus anatomy at L4–5, identify patient specific safe-zones, and may help mitigate the risk of femoral nerve injury by guiding dilator and retractor trajectory.