

Randomized Trial

e Comparison of Intravascular Uptake and Technical Ease Between Anteroposterior and Oblique Views During Lumbar Medial Branch Block

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Background: Inadvertent intravascular injection of local anesthetics can lead to false-negative results following lumbar medial branch block (MBB) performed to diagnose facet joint origin pain. A previous study demonstrated that the type of approach method could affect the incidence of intravascular injections and technical ease of the procedure.

Objectives: The primary objective of our study was to compare the incidence of inadvertent intravascular injection and technical ease of the MBB between anteroposterior (AP) and oblique (OB) views.

Study Design: Prospective randomized trial.

Setting: An interventional pain management practice in South Korea.

Methods: The incidence of intravascular uptake of contrast medium was compared using AP and OB fluoroscopic views during lumbar MBB. Injection time, radiation dose, and patient discomfort during lumbar MBB were also compared. Risk factors associated with a longer procedure time and a higher radiation dose were analyzed.

Results: The incidence of intravascular injection was 22.5% (23/102) in the AP group and 17.6% (18/102) in the OB group ($P = 0.382$). A significantly longer injection time and a higher dose of radiation were required to complete 3 levels of MBB in the OB group than in the AP group (45.9 seconds vs 61.9 seconds, $P = 0.001$; 27.4 centigray [cGy]/cm² vs 42.2 cGy/cm², $I = 0.004$). The OB approach and left side injection were the risk factors associated with a longer total procedure time (odds ratio [OR] = 6.64, 95% CI, 1.99-22.17, $P = 0.002$; OR = 0.20, 95% CI, 0.06-0.67, $P = 0.009$, OB and AP, respectively).

Limitations: The physician performing the MBB could recognize the AP or OB fluoroscopic view during procedure.

Conclusion: The overall incidence rate of intravascular injection during lumbar MBB showed nearly 20% in both approach methods groups. The OB approach and left side MBBs were associated with a longer total procedure time and a higher radiation dose.

Key words: Anteroposterior, intravascular injection, medial branch block, oblique, procedure time, radiation dose

Trial registry number: Clinical trial registry information service (NCT05362084).

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Approximately 15% of patients with chronic low back pain experience their pain due to lumbar facet arthropathy. Lumbar facet

joint pain manifests with an insidious onset with localized right- or left-sided back pain. Degenerative disc disease, spondylolisthesis, and old age are well-

known predisposing factors (1,2). Both low volume intraarticular injection and medial branch block (MBB) are accepted methods to diagnose pain arising from the lumbar facet joints. However, both of these methods are associated with high false-positive rates (1,3).

In order to minimize false-positive or false-negative blocks, reducing inadvertent intravascular (IV) injection is important. Recently reported IV injection rates during lumbar or cervical MBB range from 3.7% to 13.9% (3-6). One preferred method to avoid IV injection is using fluoroscopic real-time or digital subtraction imaging during lumbar MBB (3,4,7-10).

For lumbar MBB, both anteroposterior (AP) and oblique (OB) fluoroscopic views can be used. In clinical practice, the approach method used is generally determined by the pain physician's preference. The final target point for the lumbar MBB is the junction between the superior articular process and the transverse process. This target point can be easily confirmed by the "Scottie dog" appearance of the lumbar spine. This "Scottie dog" appearance is more readily identifiable under fluoroscopic OB view of 15°- 30°, enabling the pain physician to confirm the bony landmark more easily for lumbar MBB (9,11).

Particularly for physicians beginning their pain practice, the OB approach, compared to the AP approach, seems to provide advantages in identifying bony landmarks more easily. In a previous report, the use of an OB fluoroscopic view during an S1 transforaminal injection was shown to be technically easier, with fewer episodes of IV injection (11,12). However, it is uncertain whether using the OB view during a lumbar MBB can provide a similar technical ease and fewer IV injection incidences compared to the AP view.

The primary endpoint of our study was to compare the inadvertent IV injection incidences and the technical ease of lumbar MBB between AP and OB views.

METHODS

Patients

This prospective, randomized, open label study was approved by the Institutional Review Board (IRB #2021-07-014-002) of our institution. The potential benefits and risks of our study were fully explained to each patient before enrollment; all patients provided informed consent. Our study was registered on clinical trials.gov (NCT05362084) prior to patient enrollment.

Inclusion and Exclusion Criteria

The enrollment period for our study was from September 2021 through April 2022. Patients with more than a 3-month duration of axial low back pain radiating to the buttock that was suspicious for facet joint pain based on computed tomography (CT) and physical examination were included in our study. If a patient demonstrated severe paraspinal tenderness overlying the lumbar facet joint, with CT imaging showing facet joint hypertrophy or arthropathy, that patient was considered to have facet joint pain. Three patients declined to participate in our study. Therefore, a total of 68 patients between 20 and 80 years of age received 204 MBB injections and were included in our study.

Patients with an allergy to local anesthetics or contrast medium, coagulopathy, spine deformity, neurologic deficit with worsening of pain, hyperreflexia, bowel or bladder dysfunction, or motor weakness were excluded. Patients showing neurogenic claudication due to severe narrowing of the spinal canal were also excluded.

Randomization

These 68 patients were assigned randomly to either the AP or OB group using a randomization number table. This randomization number table was concealed in a sealed envelope. A clinical assistant prepared the type of fluoroscopic approach method according to the randomization number.

In the OB group, the C-arm was rotated to 30° on the lateral side to visualize the facet joints and junction between the transverse process and the superior articular process. In the AP group, the C-arm was positioned in a neutral position without any rotation to the lateral side.

All patients in our study received 3 levels of right- or left-sided MBB from L2 to L4. During the MBB, Quincke needles (22G, 9 cm, Taechang Industrial Co) were used for both groups.

MBB Procedure

A single pain physician board certified in pain intervention and fully experienced with fluoroscopically guided spine intervention for more than 15 years performed all MBB procedures.

The patient was positioned prone with a pillow under the abdomen to lessen lumbar lordosis. After this position, skin preparation was done using 2% chlorhexidine. Local infiltration with 1% lidocaine was performed on the affected side of the lower back.

In both groups we targeted the junction of the transverse process and superior articular process. L2 to L4 medial branches were targeted (Figs. 1A, 1B). To determine the appropriate level of MBB, counting upward from the sacrum was done. The Quincke needle was advanced under intermittent C-arm guidance to the junction of the transverse process and superior articular process. The needle was inserted until targeted bony contact was made. All patients in our study received 3 levels of MBB in either the right or left side.

Outcome Measurement

To determine the presence or absence of inadvertent IV injection, an aspiration test was performed after connecting the extension tubing to the hub of the Quincke needle. If blood was seen in the extension tubing after an aspiration, the clinical assistant recorded this event as positive blood aspiration. In cases with no blood aspiration, 1 mL of iohexol contrast medium was slowly injected under real-time C-arm guidance. Injected contrast medium showing characteristic wavy and serpiginous spread under real-time C-arm guidance was considered to be positive for IV injections. If positive IV injection was determined by either aspiration or injection of contrast medium,

the needle was repositioned until no vascular uptake was observed.

The injection time and radiation dose required to complete the MBB and patient discomfort during the procedure were utilized to evaluate technical ease. Injection time means the time required from the needle insertion into the skin until final contact of the needle tip into the junction of the transverse and superior articular processes. Radiation dose was measured during the period from the needle insertion into the skin until final contact of the needle tip into the targeted bony landmark of the medial branch. Patient discomfort refers to the pain intensity during the MBB procedure. The pain intensity was graded as no pain, mild pain, moderate pain, and severe pain during lumbar MBB.

The patient data collected during the study included age, gender, body mass index, side of the injection, and history of previous spine surgery.

Statistical Analysis

Sample size was determined according to the results of a preliminary study showing a 25% and 10% incidence of IV injection for AP or OB approaches, respectively. Assuming a difference of an IV incidence rate between the AP and OB groups to be 0.15, an α

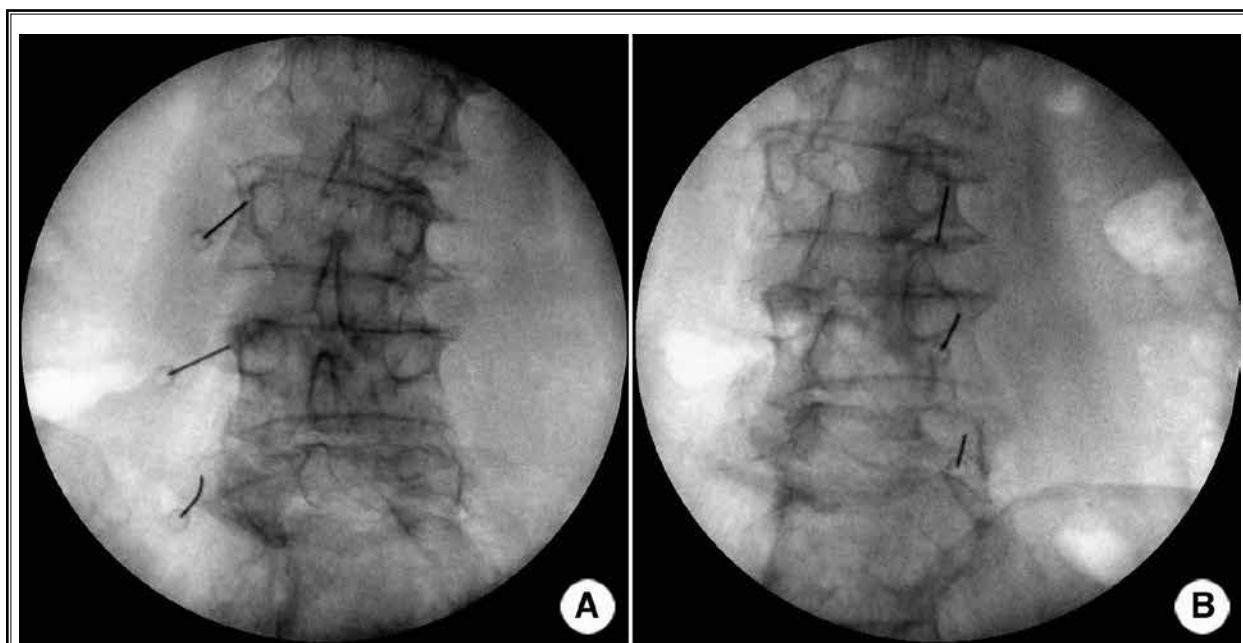


Fig. 1. Fluoroscopic image showing needle tip location during medial branch block from L2 to L4 in anteroposterior (A) and oblique (B) groups.

error level of 0.05, and a β error level of 0.02, a 2-sided χ^2 test revealed that at least 99 MBB injections were required in each group to achieve a power of 80%.

The clinical characteristics of the demographic data were compared using the independent t test, χ^2 test, or Fisher's exact test, as appropriate. The incidences of IV injection, injection time, radiation dose required to complete MBB, and patient discomfort were compared using the independent t test and the χ^2 test. Multivariable logistic regression analysis was used to evaluate the risk factors associated with a longer total procedure time and higher radiation dose. The median value for total procedure time (49.5 seconds) and dose of radiation (29.15 cGy/cm²), a binary outcome variable, was used as the cutoff value. A *P* value of < 0.05 was considered statistically significant. Calculations were made using IBM SPSS Statistics, Version 20 (IBM Corporation).

RESULTS

A total of 71 patients who received 213 C-arm-guided lumbar MBBs were assessed for eligibility. Three patients declined to be included in our study. Ultimately, 68 patients who received 204 MBBs were enrolled in our study. A total of 34 patients who

received 102 MBBs were in each of the AP and OB groups (Fig. 2).

The OB group included a significantly higher number of women. Pain duration was significantly longer in the OB group. Left side injection was performed more frequently in the OB group than in the AP group (Table 1).

The overall incidence of IV injection was analyzed when each approach was used. The incidence of IV injection was 22.5% (23/102) in the AP group and 17.6% (18/102) in the OB group. A significant difference was not found in the incidence of IV injection between the 2 groups (*P* = 0.382, Table 2). Significantly, a longer injection time and a higher dose of radiation were required to complete 3 levels of MBB in the OB group than in the AP group (45.9 seconds vs 61.9 seconds, *P* = 0.001; 27.4 cGy/cm² vs 42.2 cGy/cm², *P* = 0.004, Table 2). When patient discomfort was evaluated, most patients in both groups felt a mild degree of pain during the lumbar MBB procedure (*P* = 0.695, Table 2).

Risk factors resulting in a longer total procedure time and greater radiation dose than each median value were evaluated. The OB approach and left side injection were the risk factors associated with a longer total procedure (odds ratio [OR] = 6.64, 95% CI, 1.99-22.17, *P* = 0.002; OR = 0.20, 95% CI, 0.06-0.67, *P* = 0.009, respectively). Also, the OB approach was the risk factor associated with a higher radiation dose (OR = 5.76, 95% CI, 2.03-16.35, *P* = 0.00). Other variables such as the patient's gender, age, body mass index, and pain duration were not associated with a longer total procedure time and greater radiation dose (Table 3).

DISCUSSION

Our study investigated whether an OB approach has any advantages in reducing IV injections and whether it has an enhanced technical ease compared to an AP approach in MBB. The OB approach did not reduce the incidence of IV injection: both approaches

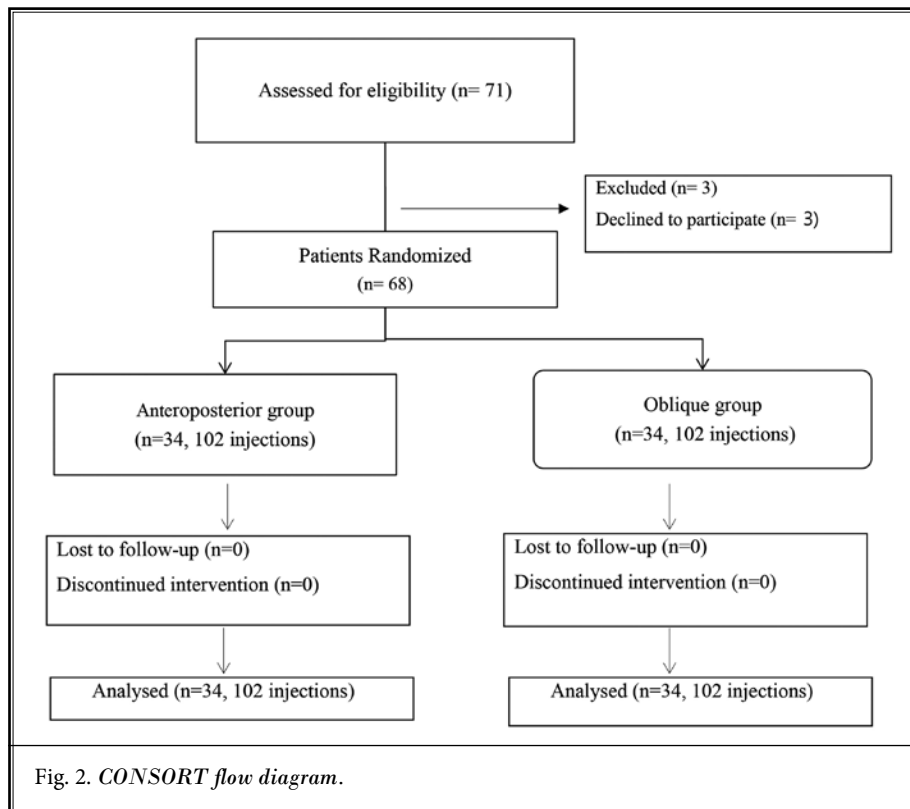


Fig. 2. CONSORT flow diagram.

Table 1. Demographic data.

	Anteroposterior Group (n = 34)	Oblique Group (n = 34)	P
Age, mean (SD)	71.6 ± 9.3	74.2 ± 8.6	0.250
Men, n (%)	14 (41.2%)	5 (14.7%)	0.029
Women, n (%)	20 (58.8%)	29 (85.3%)	
History of previous spine surgery	3 (8.8%)	1 (2.9%)	0.614
Body mass index (kg/m ²)	23.8 ± 4.8	22.6 ± 3.5	0.229
Numerical Rating	5.1 ± 0.7	5.4 ± 0.7	0.053
Pain duration (mo)	5.1 ± 10.8	13.1 ± 18.7	0.035
Side of injection			
Right	20 (58.8%)	11 (32.4%)	0.028
Left	14 (41.2%)	23 (67.6%)	

Values are mean ± SD or number of patients.

demonstrated similar IV injection incidences. Moreover, the OB approach required a significantly longer injection time and higher radiation dose to complete 3 levels of MBB than the AP approach. In contrast to the result of our study, the use of an OB fluoroscopic view during an S1 transforaminal injection demonstrated greater technical ease with fewer IV injections (11-13).

The similar rate of IV injection incidences between the AP and OB groups could be attributed to several factors. The final injection point of the lumbar MBB is the junction between the transverse and superior articular processes, which is a bony surface. According to the previous study (14), the incidence of IV injection increased when the needle contacted the bony surface of the sacral bone. Although the needle approach method was different in our study between the 2 groups, both groups could not avoid contacting the bony surface. In addition, it is possible that the needle contact with the bony surface might generate a significant impact, resulting in vessel injury irrespective of a fluoroscopic view. It is likely that different fluoroscopic views cannot ameliorate the effect on the vessel which leads to subsequent IV injections.

There have been several studies comparing IV injection incidences of MBB between different needle types or different fluoroscopy technologies, such as static vs digital subtraction angiography (3,4,6). However, there has been no study comparing IV injection incidences and technical ease of MBB between the AP and OB views.

The OB view is the classic view used for MBB or cervical and lumbar transforaminal epidural injections.

Table 2. Comparison of intravascular injection rates, injection time, radiation dose, and patient discomfort.

	Anteroposterior Group (n = 34)	Oblique Group (n = 34)	P
Intravascular injection (%)	23 (22.5%)	18 (17.6%)	0.382
Injection time (s)	45.9 ± 13.8	61.9 ± 21.1	0.001
Radiation dose (cGy/cm ²)	27.4 ± 011.1	42.2 ± 26.8	0.004
Patient discomfort during medial branch block			0.695
No pain	1	2	
Mild pain	26	27	
Moderate pain	6	3	
Severe pain	1	2	

Values are mean ± SD or number of patients. cGy, centigray.

Table 3. Logistic regression analysis of risk factors associated with longer total procedure time and greater radiation dose than each median value.

	Total Procedure Time (≥ 49.5 s*)		Radiation Amount (≥ 29.15 cGy/cm²*)	
	OR (95% CI)	P value	OR (95% CI)	P value
OB approach (AP+)	6.64 (1.99-22.17)	0.002	5.76 (2.03-16.35)	0.001
Sex (Female+)	0.26 (0.07-1.04)	0.057	0.48 (0.14-1.67)	0.248
Age	0.92 (0.86-0.98)	0.013	0.99 (0.94-1.06)	0.844
BMI(kg/m ²)	1.06 (0.92-1.21)	0.418	1.08 (0.95-1.24)	0.234
Pain duration	1.00 (0.96-1.04)	0.682	1.07 (0.97-1.05)	0.76
Right side (left side+)	0.20 (0.06-0.67)	0.009	1.30 (0.39-4.30)	0.666

All relevant variables underwent univariate and multivariate analysis. AP, anteroposterior; BMI, body mass index; OB, oblique; OR, odds ratio; cGy, centigray. * median value + reference

If the OB approach is used, the "Scottie dog" appearance of the lumbar spine becomes clearer and easier to identify. A pain physician should be very familiar with this approach when performing a fluoroscopy-guided injection, such as a transforaminal epidural injection or MBB. However, when the OB approach is used, the needle injection point for MBB is located farther laterally compared to the AP approach. Therefore, the OB approach requires the needle to course from a lateral

to a central direction over a longer distance. The AP approach has a shorter passage route, with the needle injecting directly into the junction between the superior articular and transverse processes.

The differences between the 2 fluoroscopic views might not be significant for an experienced pain physician. The use of the AP or OB view depends on the physician's preference. However, the increased injection time and radiation dose in the OB view might contraindicate that approach for beginners of fluoroscopy-guided injection.

In our study, the only risk factor associated with a longer total procedure time and radiation dose was the approach method. The OB approach was associated with a significantly longer total procedure time and higher radiation dose. Previous studies have demonstrated that the OB approach could reduce the total procedure time and foramen passage time during S1 transforaminal injection (12,13). However, when this approach was used during lumbar MBB, it did not provide any technical ease, as shown in our study.

Right-side MBBs required a significantly shorter time than left-side MBBs. For technical ease, it is better for the physician to stand by the contralateral side of injection. However, in our study, the physician performing a 3-level MBB always stood by the patient's left side, irrespective of the injection side. When a physician stands by a patient's left side for a left-side MBB, the

procedure can require a longer time for a right handed physician. If a physician moved to the patient's right side for a left-side MBB, it might result in a shorter procedure time.

Our study did not show any association between body mass index and total procedure time or radiation dose. However, Kang et al (13) demonstrated a significant association between body mass index and total procedure time during S1 transforaminal injections. Although our study could not show any association between body mass index and total procedure time or radiation dose, further study is required to clarify the association because previous studies have demonstrated conflicting results (15-19).

Our study includes several limitations. First, the physician performing the MBBs could recognize the AP or OB fluoroscopic view during the procedure. However, there is no way for the performing physician to be blinded as to the fluoroscopic view. Second, we did not evaluate if there are any differences in clinical outcome between the 2 approaches. Further study is required to clarify if clinical outcomes differ between the 2 approach views.

In conclusion, the overall incidence rate of IV injection during lumbar MBB was nearly 20% for both approach groups. The use of an OB approach and left-side MBBs were associated with a longer total procedure time and a higher radiation dose.

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