# A Prospective Crossover Comparison Study of the Single-Needle and Multiple-Needle Techniques for Facet-Joint Medial Branch Block

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**Background and Objectives:** Medial branch blocks have been widely described in the literature as a diagnostic tool for facet joint pain. Recently, a new "single-needle' technique was described that is purported to be equally accurate, and in some respects, superior to the standard multiple-needle technique. To date, no studies have been performed that compared these 2 techniques.

**Methods:** In a multicenter setting, 24 subjects underwent 2 separate diagnostic medial-branch blocks in a randomized, single-blind crossover comparison of the single-needle and multiple-needle techniques. Multiple variables were compared between the 2 techniques, including procedure-related discomfort, postprocedure pain relief, volume of local anesthetic required, accuracy as determined by final needle position and contrast-media spread, and time needed to perform the procedure.

**Results:** In this pilot study, the single-needle technique resulted in less procedure-related pain ($P$ = .0003), required less superficial local anesthesia ($P$ =.0006), and took less time to complete ($P$ < .0001) than did the multiple-needle approach. With regard to final needle position, contrast spread, and postprocedure pain relief ($P$ = .8), no differences were noted between the 2 techniques.

**Conclusions:** Our results indicate that the single-needle technique takes less time to perform and causes less patient discomfort than does the standard technique but provides the same degree of accuracy. More studies with larger sample sizes are needed to corroborate these results and explore the effect the single-needle approach has on the rate of false-positive medial branch blocks. *Reg Anesth Pain Med 2005;30:484-490.*

**Key Words:** Facet joint, Zygapophyseal joint, Low back pain, Diagnostic block.

Zygapophyseal arthropathy, better known as facet-joint pain, is a common cause of low-back pain; the estimated prevalence is between 15% and 40%.[1,2] Although degenerative facet-joint changes are frequently seen with various imaging techniques, the link between radiologic findings and symptoms is unreliable.[3] Similarly, both historic and physical examination findings have been shown to be nonspecific in the diagnosis of lumbar facet pain.[4]

Presently, the only way to definitively identify the facet joints as pain generators is by diagnostic blocks, of either the medial branches that innervate the zygapophyseal joints (z-joints) or the facet joints themselves. Patients who experience good (>50%) pain relief with 2 separate blocks are considered to have facet joints as their primary pain generator. These patients may then proceed to other treatment options, such as radiofrequency denervation (RF) of the medial branches, which has been demonstrated in several studies to be an effective treatment for facet-joint pain.[5-7]

The most commonly used technique for medial branch blocks (MBBs) involves multiple needle placements, one for each nerve anesthetized.[7] Recently, a new single-needle approach for MBB has been described.[8] What distinguished the single-needle technique from the conventional multiple-needle approach is that, whereas the former utilizes a single skin entry point under 1 anteroposterior (AP) fluoroscopic view to anesthetize several medial branches, the latter requires numerous fluoroscopic images and needle entry sites. Although the new single-needle method has been purported to offer

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several advantages over the conventional method, no studies validate these observations or compare the 2 techniques. The purpose of this study is to compare the single-needle and multiple-needle techniques on the following parameters: procedure-related discomfort, postprocedure pain relief, volume of local anesthetic required, accuracy of needle placement, and time needed to perform the procedure.

## Methods

The study was conducted at 2 academic pain-treatment centers. Approval to conduct this prospective, crossover study was granted by the institutional review boards at both institutions, and the 34 subjects consented for participation. Inclusion criteria were age 18 years or older and axial low-back pain of 6 months or more in duration. Exclusion criteria included evidence of radiculopathy, as determined by history, physical examination, and radiologic studies; previous back surgery; and severe psychiatric illness. Study patients were randomly assigned to MBBs by use of either the single-needle or multiple-needle approach. All subjects who reported better than 50% pain relief after the first block proceeded to receive a second MBB by a technique not used during the first procedure. Only subjects who underwent 2 separate MBBs were included for data analysis.

Data collected for analysis included

- preprocedure low-back pain recorded on a 0 to 10 visual analog scale (VAS);
- VAS recorded 10 minutes after the procedure;
- procedure-related pain as determined by VAS recorded immediately after MBBs;
- time required to complete each procedure (skin-to-skin time); and
- volume of local anesthetic required for superficial and deep anesthesia.

Each subject was given 1 mL of 1% lidocaine for skin and deep-tissue anesthesia injected by a 25-gauge needle. Subjects were then asked to report procedure-related pain; additional lidocaine was administered in up to 1 mL increments for pain described as moderate to severe. Conscious sedation was not used on any subjects.

Multiple needle blocks were performed with fluoroscopic guidance in an oblique "tunneled" view, as described by Bogduk.[9] The final needle position was confirmed by use of AP imaging. Single-needle blocks were performed in accordance with our previously described technique,[8] in which only 1 skin entry point was used at the most lateral margin of the L5 transverse process for 3-level blocks (L3, L4, and L5), and midway between the lateral margins of the L4 and L5 transverse processes for 4-level blocks (L2, L3, L4, and L5) (Fig 1). Once the needles were satisfactorily positioned, 0.3 mL of contrast media (Isovue 300; Bracco DXS, Princeton, NJ) was administered at each level. In the event of intravascular or unsatisfactory spread, needles were repositioned until adequate spread was achieved. The L3 and L4 medial branches and L5 dorsal ramus were blocked in all patients. In 7 patients, the L2 medial branch was also anesthetized. AP and oblique fluoroscopic images were saved after final positioning of the needles at each level and again after contrast-media administration to determine the accuracy of needle placement and for analysis of contrast spread. Before the needles were removed, 0.3 mL of a 1:1 mixture of lidocaine 1% and bupivacaine 0.5% was administered at each level.

All procedures were performed by one of two board-certified pain specialists with extensive experience in both techniques (MPS, SPC). Procedures were performed by use of 25-gauge, 3.5-inch spinal needles bent at a 20° angle one-half inch from their distal shaft, except when 4-level blocks were done, in which case 6-inch, 22-gauge spinal needles were used for the single-needle technique.

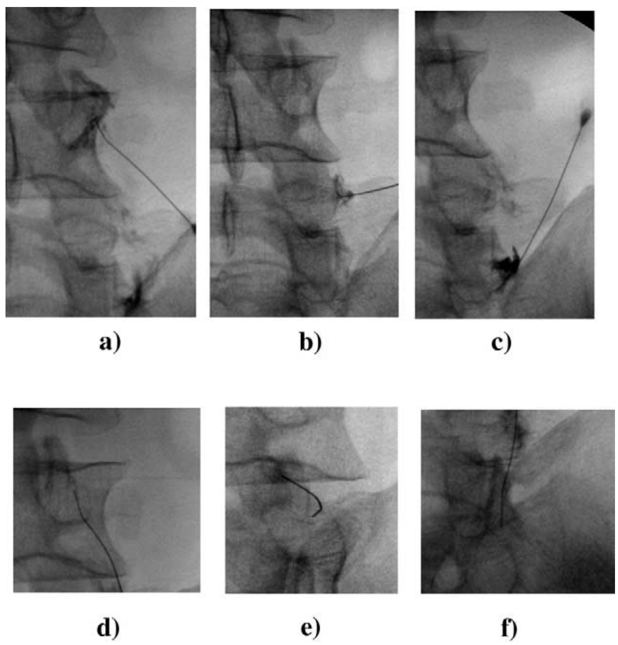


**Fig 1.** Spread of the 0.3 mL of Isovue 300 contrast media. (a) L3, (b) L4, (c) L5 medial branch in AP view of use of single-needle technique for MBB. The same technique showing needle tip before contrast media injection in oblique views at (d) L3, (e) L4, and (f) L5 levels.

### Statistical Analysis

A paired *t* test was used to analyze the differences between the single-needle and multiple-needle techniques for

- preprocedure low-back pain;
- postprocedural pain;
- procedure-related discomfort;
- time required to complete each procedure; and
- volume of local anesthetic used for skin and deep tissue anesthesia.

Saved images for both techniques were analyzed by 2 independent reviewers who were well versed in reading fluoroscopic images and performing MBBs. For each block, images were analyzed for (1) accuracy of needle placement and (2) analysis of contrast spread.

## Results

Of the 34 subjects who signed informed consent forms, 10 subjects failed to obtain significant (≥50%) pain relief with the first MBBs and were not included in data analysis (of these 10 dropouts, 6 subjects had multiple-needle technique MBBs and 4 had single-needle technique MBBs). The remaining 24 subjects completed the study. These patients included 17 males and 7 females, with the average age of 46.7 years (SD ± 16.6 years). A two-tailed post hoc, power analysis that estimated a 20% difference with 24 patients undergoing both procedures determined a 92% chance of detecting a difference at $P < .05$ (power = .92).

The breakdown of subjects who had better than 50% pain relief with the first block but failed to obtain a similar outcome with the second block was as follows. Two of the 12 (17%) subjects who underwent their second diagnostic injection by use of the single-needle technique failed to get similar pain relief after a positive block with the multiple-needle technique. Among the 12 subjects who had the multiple-needle technique used for their second block, 1 subject (8%) failed to get adequate pain relief.

Among the 24 subjects who completed the study, 17 had unilateral MBBs and 7 had bilateral MBBs. In the unilateral group, 13 subjects had 3-level MBBs (L3, L4, and L5) and 4 subjects had 4-level MBBs (L2, L3, L4, and L5). In the bilateral group, 4 subjects had 3-level MBBs and 3 subjects had 4-level MBBs. In the 48 blocks performed, no reported complications occurred.

Statistically significant differences that favored the single-needle approach were found for procedure-related pain ($P$ = .0003), time required to perform the procedure ($P < .0001$), and the amount of local anesthetic required ($P$ = .0006). No significant differences were seen in preprocedure pain levels and postprocedure pain relief between the 2 techniques (Fig 2 and Table 1). For the subgroup who underwent unilateral 3-level blocks (n =13), the differences in outcome variables were more pronounced than in the total sample (Fig 3 and Table 2).

A total of 103 images were compared for final needle position and contrast spread between the 2 techniques. In all but 2 cases, needle position and contrast spread were deemed to be adequate by two independent reviewers. In one discrepancy, both reviewers found the needle position for an L4 MBB that used the single-needle technique was adequate but that the contrast failed to engulf the target nerve. The second instance involved an L5 dorsal ramus block that used the multiple-needle technique. Although both reviewers found the needle to be appropriately positioned, one thought the contrast spread was inadequate.

An intention-to-treat analysis was performed that essentially corroborated the crossover findings. Although no statistically significant difference was seen between the 2 techniques with regard to the average time to perform each separate nerve block (2.3 minutes for the single-needle *v* 2.6 with the multiple-needle approach; $P$ = .23), differences that favored the single-needle technique were confirmed for procedure-related pain (4.1 *v* 6.4; $P$ =

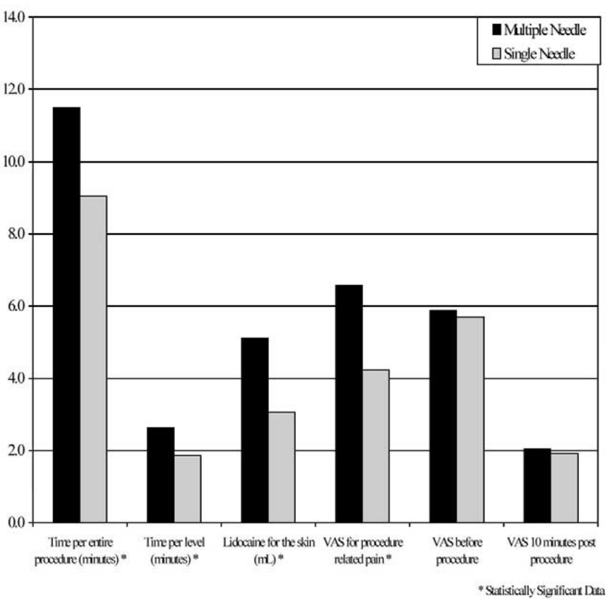


**Fig 2.** Comparison of multiple variables between single-needle and multiple-needle technique for medial branch blocks (compiled data include unilateral, bilateral, 3-level, and 4-level medial branch blocks).

**Table 1.** Data for Multiple Variables in Comparison of Single-Needle and Multiple-Needle Technique for Medial Branch Blocks

| | Multiple-Needle Technique | | | Single-Needle Technique | | |
|---|---|---|---|---|---|---|
| | Value | SD | Range | Value | SD | Range |
| Procedure-related pain (VAS)* | 6.6 | 2.2 | 3-10 | 4.2 | 1.8 | 2-7 |
| Local anesthetic (mL)* | 5.1 | 1.3 | 3-7 | 3.0 | 1.6 | 1-5.5 |
| Time per level (min)* | 2.6 | 0.5 | 2-3.7 | 1.9 | 0.5 | 1-3 |
| Preprocedure pain (VAS) | 5.7 | 2.1 | 5-10 | 5.6 | 1.7 | 4-10 |
| Postprocedure pain (VAS) | 2.0 | 1.6 | 0-6 | 1.9 | 1.9 | 0-5 |

NOTE. Compiled data including unilateral, bilateral, 3-level, and 4-level medial branch blocks.
*Statistically significant data; $P < .0006$.

.0003) and the volume of local anesthetic required (3.2 mL *v* 4.9 mL; $P = .0004$).

## Discussion

### Procedure-Related Pain

Although minimizing patient discomfort is important with any medical intervention, it is especially important in chronic-pain patients, who may be more sensitive to painful stimuli than are healthy individuals.[10] In addition to provoking unnecessary suffering in patients, intense, procedure-related pain may adversely affect treatment outcomes by interfering with the interpretation of data and, thus, lead to false-negative results.

### Amount of Local Anesthetics Used for Skin and Deep-Tissue Anesthesia

Recent studies have shown that conventional MBBs have a very low specificity, with false-positive rates that range from 25% to 38%.[11,12] Consequently, many authors recommend performing 2 separate procedures with different local anesthetics before proceeding to definitive treatment to reduce the incidence of false-positive blocks. The finding that less local anesthetic is required for the single-needle technique than for the multiple-needle approach can theoretically translate into a lower rate of false-positive MBBs. In a study by Dreyfuss et al.[13] that assessed the specificity of lumbar medial branch and L5 dorsal ramus blocks, whereas the spread of local anesthetic into neural structures other than the targeted nerve (i.e., epidural space and the intervertebral foramina) occurred in 16% of cases, distal spread into the posterior muscles of the back occurred in all cases.[13] In most cases, the leakage of local anesthetic occurred between the multifidus and longissimus muscles. In addition, local anesthetic administered to skin and deep tissues may spread to other potential pain generators, such as muscles not innervated by medial branches,[13] and osteophytes.[14]

The leakage of local anesthetics into muscle can have negative impacts on outcomes. In a large, observational, multicenter study by Long et al.[15] that involved more than 2,000 patients, myofascial pain was found to be the second most common cause of low-back pain; it accounted for almost 20% of cases.[15] In a more recent study by Cohen et al.[16] that examined the causes of false-positive MBBs in military personnel, the authors found that inadvertent spread of injectate into adjacent neural structures was probably not responsible for the high false-positive rate of lumbar MBBs. Instead, the authors postulated that the relief of myofascial pain by the overzealous use of superficial local anesthesia might be a cause.[16] In some practices, patients who fail diagnostic MBBs end up undergoing diagnostic/therapeutic trigger-point injections in a similar fashion to that used for administering local

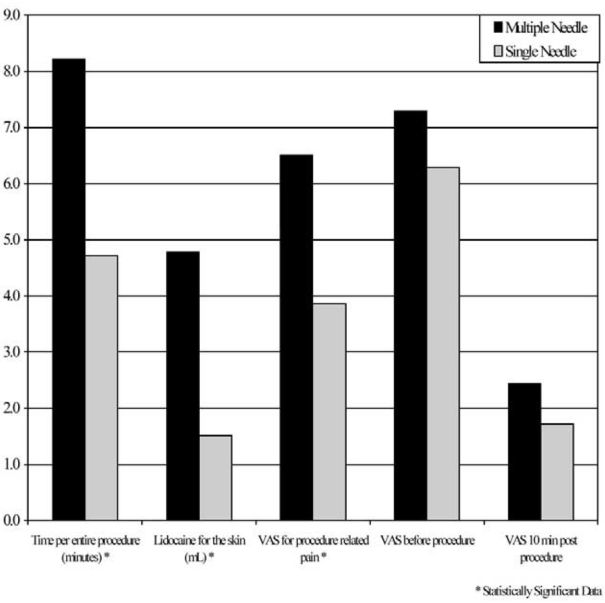


**Fig 3.** Data for unilateral, 3-level medial branch blocks only: comparison of multiple variables between single-needle and multiple-needle technique.

**Table 2.** Data for Unilateral, Three-Level Medial Branch Blocks Only

| | Multiple-Needle Technique | | | Single-Needle Technique | | |
|---|---|---|---|---|---|---|
| | Value | SD | Range | Value | SD | Range |
| Procedure-related pain (VAS)* | 6.5 | 2.3 | 3.5-10 | 3.9 | 2.3 | 2-7 |
| Local anesthetic (mL)* | 4.8 | 0.6 | 3-5.5 | 1.5 | 0.6 | 1-4 |
| Time for entire procedure (min)* | 8.2 | 1.4 | 6-11 | 4.7 | 1.1 | 3-7 |
| Preprocedure pain (VAS) | 7.3 | 1.5 | 5-10 | 6.3 | 1.1 | 4-10 |
| Postprocedure pain (VAS) | 2.4 | 1.9 | 0-6 | 1.7 | 1.7 | 0-5 |

NOTE. Comparison of multiple variables between single-needle and multiple-needle technique.
*Statistically significant data; $P < .004$.

anesthesia during MBBs. This practice is supported by a double-blind study by Foster et al.,[17] who found that injections of botulinum toxin type A are an effective treatment in patients with chronic, axial low-back pain. The treatment group in this study received 5 lumbosacral paraspinal injections of 40 units of botulinum toxin diluted in 0.4 mL of saline. The positive results suggest that even small volumes of superficially injected analgesics can effectively relieve low-back pain.

Another possible, but unlikely mechanism for false-positive MBBs may be systemic absorption of local anesthetic. Human studies have found that even small doses of systemic lidocaine can provide symptomatic relief in certain chronic-pain syndromes.[18-20] Although lidocaine blood concentrations were not measured in this study, one must conclude that they would be less after the single-needle blocks than after the multiple-needle blocks.

In our study, 17% of subjects who had their second block done by use of the single-needle technique and 8% of subjects who had their second block done by use of the multiple-needle technique failed to get adequate pain relief with the crossover injection after obtaining good relief with the first block. Although these numbers are consistent with our hypothesis that the rate of false-positive MBBs is higher with the multiple-needle technique, a greater number of study subjects, combined with the results of either confirmatory blocks or RF denervation, would be needed to reach valid conclusions.

### Time Required to Perform the MBBs

Although decreasing the time required to perform the procedure confers many advantages, two of the more important advantages are reduced patient discomfort and minimized procedure-related anxiety. In addition, reductions in pain, anxiety, and procedure time can avert the need for sedation, which is routinely used in some institutions. The use of sedatives such as midazolam during a procedure can confound the interpretation of diagnostic blocks. The reasons for this outcome include limiting of postblock activity levels by sedatives and the well-known ability of benzodiazepines to relieve paraspinal muscle pain,[21] both of which may result in false-positive results.

### Fluoroscopy Use and Radiation Exposure

According to the International Spinal Injection Society (ISIS) guidelines for performing MBBs, although oblique fluoroscopic views are recommended during the actual procedure, the final needle position should always be confirmed by AP imaging.[8] Because the entire single-needle technique is performed by use of an AP fluoroscopic view, confirmation of accurate needle placement without adjusting the fluoroscope is possible, as recommended by Bogduk[9] and Dreyfuss.[13] Although the single-needle approach is possibly associated with less radiation exposure, fluoroscopy time was not measured in this study.

### Use of Single-Needle Technique for Placement of RF Cannulas

If use of the single-needle technique offers advantages, should this approach be used for the placement of RF cannulas? Previous studies have shown that although positioning the needle tip "parallel" to the medial branch during diagnostic procedures may not be important, doing so is advantageous during RF lesioning.[22] The larger lesion size obtained when placing the cannula parallel to the target nerve may reduce the high failure rate associated with RF denervation and possibly prolong pain relief. We, therefore, conclude that the standard, multiple-cannulae approach should continue to be employed for all RF procedures.

### Study Shortcomings

Several shortcomings are inherent to this study. First, only 2 physicians, each with extensive experience in both techniques, performed all the procedures. The only reasonable alternative would have been to have the crossover procedure performed by different practitioners, in which case the variability in clinicians' skill levels might affect the results. Given the unfamiliarity with the single-needle technique in the general pain community, having all procedures performed by these 2 practitioners was a compromise we felt was necessary. For practitioners with less experience in the single-needle approach, the outcomes may vary from our results. Second, some might argue that all diagnostic procedures should be done without anesthetizing the skin and deep tissues. However, in our experience, most practitioners use superficial local anesthetic to perform MBBs, which is an observation supported by the literature.[23] Third, although patients were not told which technique was being used, "true" blinding in a study such as this is very difficult to ensure. Finally, our study did not assess RF outcomes. To determine whether any differences exist between the 2 techniques with regard to RF success rates, prospective, randomized studies are needed.

## Summary

The results of this pilot study provide preliminary evidence that the single-needle technique for MBBs offers several advantages over the conventional multiple-needle approach, while providing comparable postprocedure pain relief. A separate study that uses a larger sample size is needed to confirm these results. The effect that use of the single-needle technique has on other variables of interest, including the rate of false-positive blocks, radiation exposure, and outcomes after denervation, are other areas that invite further investigation.

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