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RANDOMIZED TRIAL

Comparison of Intra-articular Thoracic Facet Joint Steroid Injection and Thoracic Medial Branch Block for the Management of Thoracic Facet Joint Pain

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Study Design. A prospective observational study.

Objective. The aim of this study was to show the effect of intra-articular (IA) thoracic facet joint (TFJ) steroid injection for the management of TFJ pain, and to compare it with the effect of therapeutic thoracic medial branch block (MBB) with a local anesthetic and steroid.

Summary of Background Data. Several studies have shown the effects of thoracic MBB with local anesthetics with or without steroids and radiofrequency neurotomy in managing TFJ pain, but thus far, the effectiveness of IA TFJ steroid injection has not been studied.

Methods. Forty patients with TFJ pain were recruited and randomly assigned to one of two groups, the IA steroid injection and the MBB group, each with 20 patients. For IA TFJ steroid injection and therapeutic MBB, we injected 0.5 mL of 0.5% bupivacaine, mixed with 10 mg (0.25 mL) of dexamethasone. We assessed the severity of TFJ pain using a numeric rating scale (NRS) before treatment and at 1, 3, and 6 months after treatment.

Results. Compared to the pretreatment NRS scores, the NRS scores at 1, 3, and 6 months after each treatment showed a significant decrease in patients in both the groups. Intergroup changes in the NRS scores were not significantly different over time. Six months after the treatment, 65% of the patients in the IA steroid injection group reported successful pain relief (pain relief $\geq$50%), and 40% of the patients in the MBB group showed successful pain relief.

Conclusion. In the present study, both IA TFJ steroid injection and therapeutic MBB significantly relieved TFJ pain. Their effects persisted for at least 6 months after the procedure. Thus, we think that both IA TFJ steroid injection and therapeutic thoracic MBB are useful treatment options for managing TFJ pain.

Key words: bupivacaine, chronic pain, intra-articular steroid injection, lidocaine, local anesthetic, medial branch block, mid back pain, steroid, thoracic facet joint pain, upper back pain.

Level of Evidence: 2

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Upper or mid back pain secondary to thoracic disorder is relatively less prevalent than low back pain, whose lifetime prevalence is approximately 15%.[1] Among patients with upper or mid back pain, 34% to 48% are estimated to have thoracic facet joint (TFJ)-origin pain.[2–4] For the management of TFJ pain, especially pain that is unresponsive to analgesics, thoracic medial branch block (MBB) with local anesthetics with or without steroids,[3,5–7] radiofrequency neurotomy of the thoracic medial branch nerves,[8–10] and intra-articular (IA) TFJ steroid injection are being used.

Several studies have shown the effects of thoracic MBB with local anesthetics with or without steroids and radiofrequency neurotomy in managing TFJ pain. The thoracic medial branches supply the sensory innervation of the TFJs. Thoracic MBB or radiofrequency neurotomy inhibits the transmission of pain signals from the facet joints.[5–7] Moreover, considering that the inflammation of

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TABLE 1. Demographic Characteristics of Patients in the Intra-articular Steroid Injection and Medial Branch Block Groups

	ISI Group	MBB Group	*P*
Number (n)	20	20	
Age (yr)	56.2 ± 17.3	55.1 ± 12.7	0.314
Male: female	13:7	8:12	0.113
NRS (pretreatment)	5.3 ± 1.3	5.4 ± 1.4	0.862
Pain duration (mo)	11.9 ± 7.5	15.0 ± 11.7	0.862

Values are presented as numbers or means ± standard deviations.

ISI indicates intra-articular steroid injection; MBB, medial branch block; NRS, numeric rating scale.

the synovium is responsible for the development of facet joint-origin pain,[11] we can suppose that direct injection of steroids into the TFJ would effectively manage TFJ pain. Thus far, the effectiveness of IA TFJ steroid injection has, however, not been studied.[3,5–10]

In the present study, we evaluated the effect of IA TFJ steroid injection in patients with TFJ-origin chronic upper and mid back pain. Moreover, we compared its effect with that of thoracic MBB.

MATERIALS AND METHODS

Patients

We prospectively evaluated consecutive patients who presented with spontaneous onset of TFJ-origin upper or mid back pain. After applying the inclusion criteria, 40 patients were included in the present study (Table 1). The following inclusion criteria were used: (1) ≥6-month history of nonspecific upper or mid back pain with local or paramedian tenderness over the area of the facet joints and reproduction of the pain with deep pressure; (2) age between 20 and 79 years; (3) ≥80% temporary pain relief following a diagnostic thoracic MBB with 0.5 mL of 1% lidocaine; and (4) failure to respond to physical therapy and medication (upper or mid back pain of at least four on the numeric rating scale [NRS]). Each patient underwent thoracic spine magnetic resonance imaging. The exclusion criteria were as follows: (1) disc herniation, stenosis, myelopathy, thoracic fracture, and suspected radiculitis, or intercostal neuritis; (2) previous history of spinal surgery; (3) infection of the spine; (4) coagulation disorder; (5) allergy to iodinated contrast materials; (6) rheumatic disorders; and (7) uncontrolled medical or psychiatric condition. The institutional review board of our hospital approved the study, and all patients provided a signed informed consent form. Based on the findings of previous studies,[12,13] we calculated a sample size. The difference in NRS reduction after treatment (IA facet steroid injection and MBB) was 0.95 ± 1.01 (mean ± standard deviation). When we adopted a type I error of 0.05, power of 80%, and a two-sided test, 18 subjects per group were found necessary for our study. Considering a 10% dropout rate, we needed to recruit 20 subjects in each group. Forty patients with TFJ pain were randomly assigned to one of two groups. In the IA steroid injection group (ISI group), 20 patients received ISI. In the MBB group, 20 patients received thoracic MBB with a local anesthetic and steroid. Randomization was performed *via* a simple method employing a random numbers table. Treatment was carried out only one time for each patient.

Procedures

A putatively painful TFJ was selected on the basis of the pain pattern and reproduction of usual thoracic pain with deep pressure. IA TFJ steroid injection and thoracic MBB were performed *via* a posterior approach with the patient in a prone position for C-arm fluoroscopy (Siemens) (Figure 1). We used a 26-gauge, 90-mm spinal needle for both procedures. In the ISI group (Figure 1A), the initial puncture point was over the lower half of the vertebral body below the targeted TFJ. A spinal needle was introduced ventrally and was angled cephalad (approximately 45°–60°). Once the needle was placed on the dorsum of the lamina, just caudal to the target joint, we targeted the TFJ space on a contralateral oblique view and pierced the joint capsule. After confirming IA access by injecting 0.3 mL of contrast material into the TFJ space, we injected 10 mg (0.25 mL) of dexamethasone, mixed with 0.5 mL of 0.25% bupivacaine. IA injection was successful in all 20 patients in the ISI group. In the MBB group (Figure 1B), after positioning the needle tip on the bony areas where the thoracic medial branch nerves are supposed to pass, we injected 0.5 mL of 0.25% bupivacaine, mixed with 10 mg (0.25 mL) of

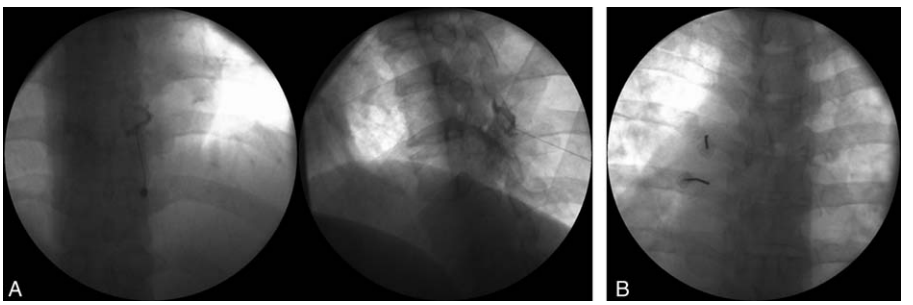

Figure 1. Fluoroscopy-guided (**A**) intra-articular contrast injection into the right T9–10 facet joints (left: anteroposterior view; right: contralateral oblique view) and (**B**) medial branch block on the left T4 and 5 branches.

TABLE 2. The Treated Facet Joint Level of Each Patient

Patient No	ISI Group	MBB Group
1	Both T9–10, 11–12	Both T11, 12
2	Both T6–7, 7–8	Rt. T4, 5, 6
3	Both T3–4, 4–5	Lt. T11, 12
4	Both T2–3	Both T6, 7, 8
5	Both T4–5, 5–6	Rt. T7, 8, 9
6	Both T8–9	Lt.T9, 10, 11
7	Both T2–3	Both T3, 4, 5
8	Rt. T9–10	Lt. T9, 10, 11
9	Rt. T11–12	Both T3, 4, 5
10	Both T11–12	Both T10, 11, 12
11	Rt. T1–2	Rt. T4, 5, 6
12	Rt. T11–12	Lt. T4, 5
13	Lt. T2–3, 3–4	Both T3, 4, 5
14	Lt. T1–2	Both T11, 12
15	Both T9–10	Lt. T9, 10, 11
16	Both T11–12	Lt. T5, 6, 7
17	Lt. T4–5, 5–6	Both T10, 11, 12
18	Rt. T1–2, 6–7	Both T6, 7, 8
19	Both T8–9	Both T 7, 8, 9
20	Both T10–11, 11–12	Both T3, 4

ISI indicates intra-articular steroid injection; MBB, medial branch block.

dexamethasone. MBBs on branches T1-T4, T9, and T10 were performed by placing the needle on the superolateral corners of the thoracic transverse processes. For MBBs on branches T5 to T8, the needle made contact with the rib lying at the same depth as the back of the transverse process. For MBBs on branches T11 and T12, the target point was the junction of the superior articular process and transverse process, which was crossed by the target nerve.[5] The MBBs were performed on at least two medial branches to treat a single joint and on three nerves on two consecutive joints (*e.g.*, for the management of the T3/4 facet joint, the T2 and T3 medial branches were targeted; for the management of the T3/4 and T4/5 facet joints, the T2, T3, and T4 medial branches were targeted). Treatment was performed once for each patient.

We preformed either IA TFJ steroid injection or thoracic MBB in the thoracic medial branch (ISI group: 45 levels; MBB group: 85 levels; Table 2). We performed IA TFJ steroid injection and thoracic MBB bilaterally in 12 and 9 patients, respectively.

Outcome Measures

The same investigator performed all pretreatment and follow-up assessments. This investigator was blinded to the grouping of the patients, and did not participate in administering any treatment. Pain intensity was assessed using an NRS, with values between 0 and 10 (0 represented "no pain" and 10 represented "the most intense pain imaginable"). The NRS scores were measured before treatment, and at 1, 3, and 6 months after treatment. Successful treatment was defined as a more than 50% reduction in the NRS score at 6 months, when compared to the pretreatment NRS score. To validate the change in pain reduction, the NRS scores were evaluated by assessing the difference between the pretreatment NRS scores and the scores after 6 months (change in NRS [%] = [pretreatment score − score at 6 months after treatment]/pretreatment score × 100).

TABLE 3. Global Perceived Effect According to a Likert Scale

Score	% Change	Description
7	≥75 Improvement	Very good
6	50–74 Improvement	Good
5	25–49 Improvement	Fairly good
4	0–24 Improvement or worse	Same as before
3	25–49 Worse	Fairly bad
2	50–74 Worse	Bad
1	≥75 Worse	Very bad

After 6 months, the patient global perceived effect was assessed using a 7-point Likert scale (Table 3).[14,15] Patients reporting very good (score = 7) or good results (score = 6) were considered to be satisfied with the procedure.

Statistical Analysis

Data were analyzed using IBM Statistical Package for Social Sciences Statistics for Windows/Macintosh (Version 22.0, IBM Corp., Armonk, NY). Demographic data and the rates of successful pain relief and patient satisfaction were compared between the two groups by using the Mann-Whitney *U* test and chi-square test. The changes in the NRS scores in each ISI and MBB group were evaluated using repeated-measures one-factor analysis. Repeated-measures two-factor analysis was used to compare changes between groups over time. Multiple comparisons were conducted by Bonferroni correction. The level of statistical significance was set at $P < 0.05$.

RESULTS

All patients completed the study. No adverse events were observed in both groups. No significant intergroup differences were observed in the demographic data ($P > 0.05$; Table 1).

In the ISI group, the mean NRS score decreased after treatment. The pretreatment NRS score was 5.3 ± 1.3. The mean NRS score was 2.7 ± 1.3 at 1 month, 2.8 ± 1.5 at 3 months, and 2.9 ± 1.5 at 6 months (Figure 2). In the MBB group, the mean NRS score decreased from 5.4 ± 1.4 before treatment, to 2.9 ± 1.7 at 1 month, 3.2 ± 1.9 at 3 months, and 3.4 ± 1.9 at 6 months.

The NRS scores for each group were significantly different over time ($P < 0.001$). In both groups, the NRS scores at 1, 3, and 6 months were significantly lower than the pretreatment scores ($P < 0.001$). Changes in the NRS scores over time were not significantly different between groups

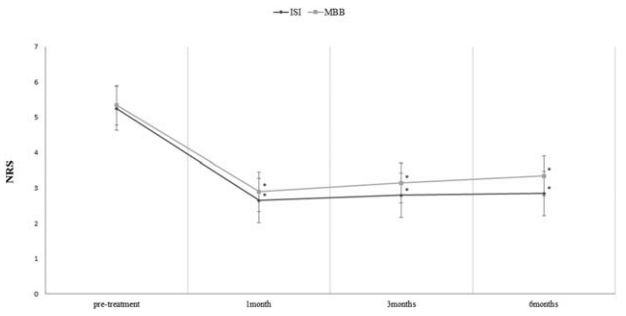

Figure 2. Change in the NRS scores. Both groups showed a significant decrease in scores at 1, 3, and 6 months after each treatment than before treatment. The intergroup changes over time were not significantly different. $^{*}P < 0.05$: intragroup comparison before and after treatment (1, 3, and 6 mo) (repeated-measures one-factor analysis). ISI indicates intra-articular steroid injection; MBB, medial branch block; NRS, numeric rating scale.

($P = 0.727$). The decrease in NRS scores from before treatment to each evaluation time point was not significantly different between the two groups (1 mo: $P = 0.807$; 3 mo: $P = 0.714$; 6 mo: $P = 0.570$). Six months after treatment, 13 patients (65%) in the ISI group reported successful pain relief (pain relief $\geq$50%), and 8 patients (40%) in the MBB group reported successful pain relief. No significant difference was observed in the rates of successful pain relief at 6 months after the procedures ($P = 0.113$).

On the seven-point Likert scale, very good results (score = 7) were seen in four patients (20%) in the ISI group. Good (score = 6) and fairly good results (score = 5) were observed in eight (40%) and two patients (10%), respectively. No change in results (score = 4) was, however, observed in six patients (30%). Accordingly, 12 patients (60% of the patients in the ISI group) were satisfied with the results 6 months after the IA TFJ steroid injection. Fairly bad (score = 3), bad (score = 2), and very bad (score = 1) results were not reported after the ISI. In the MBB group, very good and good results were observed in five (25%) and three patients (15%), respectively. Fairly good and no change in results were observed in four (20%) and seven patients (35%), respectively. One patient (5%) reported fairly bad results, but bad or very bad results were not reported after the MBB procedure. Therefore, eight patients (40% of the patients in the MBB group) were satisfied with the results 6 months after the MBB procedure. The rates of patient satisfaction between the two groups were not significantly different ($P = 0.206$).

DISCUSSION

In the present study, we evaluated the effect of IA TFJ steroid injection, and compared it with that of therapeutic thoracic MBB in patients with TFJ origin upper or mid back pain. Our results showed that the severity of pain, which was evaluated using an NRS, was significantly reduced after each procedure, and their effects persisted for at least 6 months. During the 6 months after the procedures, the degrees of pain reduction were not significantly different between the two groups. Moreover, the rates of patient satisfaction were not significantly different between the two groups. Although statistical significance was, however, not observed, the rate of successful pain relief (>50% pain relief at 6 mo after the procedures) tended to be higher in the ISI group (60%) than in the MBB group (35%).

Regarding the efficacy of IA TFJ steroid injection, the aim of ISI is to introduce steroids into the degenerated TFJ based on the belief that there is inflammation. The inflammation of the synovium excites the synovial-lining nociceptive nerve fibers, which are responsible for the TFJ pain.[16] The anti-inflammatory properties of steroids inhibit the production and release of inflammation-related cytokines, consequently inhibiting the processes leading to inflammation.[17] These actions of the injected steroid in our patients could reduce the IA TFJ inflammation, which in turn is thought to have helped manage the TFJ pain. As for the efficacy of the therapeutic thoracic MBB, the suppression of neural transmission is a key mechanism.[5–7,18] Local anesthetics, such as lidocaine and bupivacaine, suppress nociceptive discharge and block the axonal transport and sympathetic reflex arc.[19–23] Steroids inhibit neural transmission within the nociceptive C-fibers, in addition to having an anti-inflammatory effect.[16,24–26] In our patients, these blockage effects of bupivacaine and steroid influence the medial branches providing sensory innervation of the TFJs, which seems to be associated with the reduction of TFJ pain. In addition, in the ISI group, the steroid was directly injected into the TFJ that was the source of the back pain, whereas in the MBB group, TFJ pain was indirectly managed by blocking the transmission of pain signals in the thoracic medial branches. This difference in characteristics between the two procedures might have contributed to the tendency of the higher successful pain relief rate in the ISI group than in the MBB group.

To the best of our knowledge, only four previous studies have evaluated the effect of therapeutic thoracic MBB for managing TFJ pain.[3,5–7] All the previous studies on therapeutic thoracic MBB were performed by Manchikanti *et al*. In 2006, they performed therapeutic thoracic MBB with bupivacaine mixed with prednisolone in 55 patients with chronic TFJ pain.[5] After the MBB, approximately 70% of the included patients showed significant pain relief ($\geq$50%), and the effect persisted for at least 3 years. In 2008, 48 patients with upper or mid back pain secondary to TFJ disorder were recruited, and were divided into the local anesthetic (MBB with bupivacaine) and steroid groups (MBB with bupivacaine and betamethasone).[6] In both groups, approximately 80% of the patients showed a $\geq$50% pain relief at 1 year after the procedures. In 2010, the authors observed significant functional improvement (decrease in Oswestry Disability Index), not only significant pain reduction, in 90% of the 100 included patients at 1 year after therapeutic MBBs with bupivacaine with or without betamethasone.[3] In 2012, they showed the 2-year positive effect of thoracic MBB on pain relief and functional improvement.[7] Thus far, no study has, however, been

conducted on the effect of IA TFJ injection on controlling TFJ-origin pain. Therefore, we believe this is the first study to evaluate the efficacy of IA TFJ steroid injection for the management of upper or mid back pain due to TFJ pathology.

In conclusion, we found that both IA TFJ steroid injection and therapeutic thoracic MBB with a local anesthetic mixed with a steroid significantly relieved TFJ pain, and their effects were sustained for at least 6 months after the procedures. In addition, although statistical significance was not observed, successful pain relief at 6 months tended to be higher in patients who received the ISI. We think that IA TFJ steroid injection is a useful treatment option for managing TFJ pain, together with thoracic MBB. As a future study, it would be interesting to evaluate the effect of combined therapy with IA TFJ steroid injection and therapeutic thoracic MBB. A limitation of our study was its small sample size; thus, further studies involving larger number of subjects are warranted to confirm our findings and elucidate the effects of these treatments.

➢ Key Points

- ❑ We evaluated the effect of IA TFJ steroid injection for the management of TFJ pain, and compared it with the effect of therapeutic thoracic MBB.
- ❑ After each treatment, TFJ pain was significantly decreased in patients in both the groups. Intergroup changes in the NRS scores were not significantly different over time.
- ❑ We think that IA TFJ steroid injection is a useful treatment option for managing TFJ pain.

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