Comparison of Radiofrequency and Corticosteroid Injection for Treatment of Lumbar Facet Joint Pain: A Meta-Analysis

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Background: Lumbar facet joint (LFJ) pain was reported to occur in 27%–40% of patients with chronic low back pain (LBP). Several therapeutic procedures such as corticosteroid injection (CI) and radiofrequency (RF) ablation have been used. However, there is no clear consensus that one is superior to the other. This study aimed to perform a meta-analysis to compare the effectiveness of CI and RF ablation for LFJ pain.

Methods: This study was conducted by searching for all randomized controlled trials comparing the effect of CI and RF ablation on LFJ pain in Cochrane Central Register of Controlled Trials and PubMed database. We performed inverse-variance weighted meta-analysis of outcomes including pain intensity and functional disability at 3, 6, and 12-month measurement by using RevMan 5.3 (Cochrane, London, England).

Results: CI was associated with a higher pain intensity score when compared to RF ablation at 3 months (3 trials; standardized mean difference [SMD], 1.09; 95% CI, 0.79 to 1.38; \( P < 0.00001; I^2 = 96\% \)), at 6 months (7 trials; SMD, 2.10; 95% CI, 0.98 to 3.22; \( P = 0.00002; I^2 = 96\% \)), and at 12 months (3 trials; SMD, 2.15; 95% CI, –0.26 to 4.56; \( P = 0.08; I^2 = 98\% \)). The estimated effect of CI on functional disability score at 6 months when CI was compared to RF ablation showed a significant increase (3 trials; MD, 18.78; 95% CI, 16.20 to 21.36; \( P < 0.00001; I^2 = 98\% \)).

Conclusions: Pooled analysis from limited trials showed a benefit of RF to the improvement of pain intensity and functional disability when we compared RF with CI for the treatment of LFJ pain.

Keywords: corticosteroid injection, denervation, facet joint, low back pain, radiofrequency

Introduction

More than a quarter of patients with chronic lower back pain (LBP) have been reported to have pain originated from lumbar facet joints (LFJs).¹ Meanwhile, LFJ pain is mostly caused by degenerative osteoarthritis.² Some therapeutic procedures have been used for the management of LBP originated from LFJ. Due to its anti-inflammatory effect, LFJ injection with corticosteroid is a beneficial option for treating LBP caused by facet joint osteoarthritis.³ On the other hand, the application of radiofrequency (RF) ablation in patients with LFJ pain has been reported to effectively reduce the pain score and improve the quality of life.⁴ A few studies have explored the effectiveness of facet interventions for chronic lumbar pain, but there has been no clear consensus of which procedures are more superior. This study aimed to perform a meta-analysis to compare the effectiveness of corticostereo-
roid injection (CI) and RF ablation for the treatment of LFJ pain.

Methods

This study followed Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. All randomized controlled trials (RCTs) comparing the pain intensity of CI with RF ablation for the treatment of LFJ pain were eligible for inclusion. The procedure of RF ablation could be either continuous or pulse RF. All studies investigating issues other than patients with LFJ pain were excluded.

Ethical clearance was obtained before a systematic search of the literature. The searched terms “radiofrequency or denervation,” “steroid or corticosteroid,” “facet joint,” and “trial” were subjected to PubMed and Cochrane Library database on September 10, 2020, and evaluated for their presence in the title, abstract, and medical subject heading. The reference list of each study that we found was also evaluated and screened to identify any other relevant studies.

Screening of titles and abstracts was conducted independently by two authors before obtaining full papers for final inclusion. Data extraction included author, the year of publication, the age of population, the number of patients, intervention, pain intensity score, functional disability score, and adverse events. Any relevant data reported in graphical form using ImageJ (ImageJ v1.52k January 2019: http://wsr.imagej.net/distros/win/ij152-win-java8.zip) were extracted if there was no further information from corresponding authors.

Two independent authors performed methodological quality evaluation using the Cochrane Collaboration Risk of Bias Tool and the Grades of Recommendation Assessment, Development and Evaluation (GRADE) approach. Pain intensity was assessed by either visual analogue scale or numerical rating scale and was pooled as a primary outcome. Pain intensity measurement was categorized into three periods (3, 6, and 12 months). The secondary outcome was the functional disability measured via Oswestry Disability Index. The analysis was conducted by using standardized mean difference (SMD) for pain intensity, whereas mean difference (MD) was used for functional disability. Fixed-effects method was implemented by using Review Manager (RevMan v5.3 2014; Cochrane, London, England). When the heterogeneity was greater than 50%, the I^2 statistic, random-effects model analysis was applied. Sensitivity analysis was performed by not only removing data that were retrieved using ImageJ but also removing high risk of bias study.

Results

Systematic search of literature revealed 58 records in PubMed, 27 in the Cochrane Library database, and 1 from other sources, among which 20 were duplicates (Figure 1). Ten studies were then retrieved for full text review. However, 3 studies were excluded because two of them did not use steroid or RF in one arm, and the other one was unavailable in full text. In total, 7 studies were finally included in our analysis. The characteristics of the 7 included studies are presented in Table 1. All studies used a combination of corticosteroid and local anesthetic agents for CI groups. The corticosteroid agents were methylprednisolone in 4 trials, betamethasone in 2 trials, and dexamethasone in 1 trial. Pulsed RF was performed in 4 trials, whereas continuous RF was performed in 3 trials. Three trials did not identify adverse event. In one study, two subjects experienced an increase of LBP in the follow-up period.

The risk of bias across the domains is presented in Figure 2. The method of randomizations, adherence to interventions, missing outcome data, measurement, and reporting were considered adequate in 5 studies. Two studies were considered high risk of bias because they did not mention randomization and blinding-to-assessor process. The quality of evidence for each outcome is presented in Table 2. We downgraded two levels from the risk of bias and inconsistency for all outcomes but pain intensity at 6-month period because of the serious risk of bias and substantial heterogeneity. Publication bias was detected in all outcomes as shown in Figure 3.

Seven studies involving 552 patients reported pain intensity score (Figure 4). Treatment with CI was associated with higher pain intensity score than RF ablation (3 trials; SMD, 1.09; 95% CI, 0.79 to 1.38; P < 0.00001), with substantial heterogeneity (I^2 = 96%) at 3 months. Pain intensity score at 6 months were significantly higher in patients treated with CI.
than RF ablation (7 trials; SMD, 2.10; 95% CI, 0.98 to 3.22; \(P = 0.0002\)), with substantial heterogeneity (\(I^2 = 96\%\)). The estimated effect of CI on pain intensity score at 12 months when CI was compared to RF ablation showed a statistically insignificant increase (3 trials; SMD = 2.15; 95% CI, -0.26 to 4.56; \(P = 0.08\)), with substantial heterogeneity (\(I^2 = 98\%\)).

Sensitivity analysis by removing data\(^10\) that were retrieved by using ImageJ showed a similar result of pain intensity at 3 months (SMD, 0.60; 95% CI, 0.28 to 0.92; \(P < 0.01\); \(I^2 = 56\%\)). A similar result was also obtained for pain intensity measurement at 6 months after removing data\(^10,12\) retrieved by using ImageJ (SMD, 1.64; 95% CI, 0.38 to 2.90; \(P = 0.01\); \(I^2 = 96\%\)). Sensitivity analysis by removing high risk of bias studies\(^13,14\) demonstrated a similar result at 3 months (SMD, 1.38; 95% CI, 0.97 to 1.80; \(P < 0.01\); \(I^2 = 98\%\)) and at 6 months (SMD, 2.09; 95% CI, 0.63 to 3.56; \(P < 0.01\); \(I^2 = 97\%\)).

Three studies including 232 patients reported

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**Figure 1. PRISMA Flow Diagram**

Abbreviation: PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.
<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Inclusion criteria</th>
<th>Procedure</th>
<th>Adverse event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do et al.⁹</td>
<td>2017</td>
<td>≥ 6 months history of LBP; NRS ≥ 4 after conservative therapy; ≥ 50% pain relief after diagnostic block of 0.5 mL of 1% lidocaine</td>
<td>IA 0.5 mL mixture of dexamethasone 10 mg + 0.25 mL of bupivacaine 0.125%</td>
<td>One subject had hyperglycaemia</td>
</tr>
<tr>
<td>Civelek et al.⁸</td>
<td>2012</td>
<td>Failure to respond 6 weeks after therapy including conservative and additional steroid injection for RF group; not mentioning specific history of LBP and diagnostic block performed</td>
<td>MBB mixture of methylprednisolone 40 mg + 2 mL of bupivacaine 0.25%–0.50%</td>
<td>None</td>
</tr>
<tr>
<td>Düger et al.¹⁴</td>
<td>2012</td>
<td>≥ 6 months history of LBP; single-sided LFJ pain</td>
<td>IA 5 mL mixture of methylprednisolone 20 mg + 5 mg bupivacaine</td>
<td>No report</td>
</tr>
<tr>
<td>Hashemi et al.¹⁰</td>
<td>2014</td>
<td>≥ 6 months history of LBP; NRS ≥ 4 after conservative therapy; positive diagnostic block using lidocaine</td>
<td>MBB using methylprednisolone 40 mg + 0.5 mL bupivacaine 0.5%</td>
<td>No report</td>
</tr>
<tr>
<td>Lakemeier et al.¹¹</td>
<td>2013</td>
<td>≥ 24 months history of non-specific LBP; ≥ 50% pain relief after diagnostic block of 0.5 mL of 0.5% bupivacaine</td>
<td>IA mixture of 1 mL of betamethasone 3 mg + 0.5 mL of bupivacaine 0.5%</td>
<td>None</td>
</tr>
<tr>
<td>Yasar et al.¹³</td>
<td>2018</td>
<td>≥ 3 months history of LBP; failure to respond after conservative therapy; positive diagnostic block</td>
<td>2.5 mL mixture of methylprednisolone 40 mg + bupivacaine 0.25%</td>
<td>No report</td>
</tr>
<tr>
<td>Zhou et al.¹²</td>
<td>2016</td>
<td>≥ 6 months history of LBP; ≥ 80% pain relief after diagnostic block of 0.3 mL of 2% lidocaine</td>
<td>MBB and IA injection using 5 mL mixture of betamethasone 6 mg + lidocaine 20 mg</td>
<td>None</td>
</tr>
</tbody>
</table>

Abbreviations: CI, corticosteroid injection; CRF, continuous radiofrequency; IA, intraarticular; LBP, low back pain; LFJ, lumbar facet joint; MBB, medial branch block; NRS, numeric rating scale; PRF, pulsed radiofrequency; RF, radiofrequency.
functional disability score at 6 months. According to the meta-analysis as shown in Figure 4D, the CI group had a higher functional disability score than RF ablation (3 trials; MD, 18.78; 95% CI, 16.20 to 21.36; \( P < 0.00001 \)), with substantial heterogeneity (\( I^2 = 98\% \)). Sensitivity analysis by removing data retrieved by using ImageJ showed improvement in heterogeneity with similar effect estimate (MD, 9.44; 95% CI, 6.33 to 12.56; \( P < 0.01 \); \( I^2 = 0\% \)).

Discussion

This meta-analysis showed that RF ablation was associated with lower pain intensity score and lower functional disability score when compared to CI. An earlier Cochrane systematic review including fewer studies reported that RF ablation was more effective than CI with very low-quality of evidence for pain relief at 3–6-month follow-up period.\(^{15}\) Recent pooled analysis done by Chen et al.\(^{16}\) involving patients with not only chronic lumbar but also sacroiliac joint pain also reported similar results.

Some studies\(^{15,19}\) reported that CI combined with a local anesthetic agent might be beneficial to the treatment of chronic LFJ pain. However, recent trial comparing intraarticular (IA) injection with corticosteroid and saline reported that steroid injection has no benefit of prolonging the time to the requirement of further treatments for facet joint pain.\(^{20}\) A study suggested that although the long-term efficacy for facet blocks lack, it might provide prognostic value before RF ablation.\(^{21}\) However, the dose of steroid used in their study was lower than the equipotent doses.

For CI groups, there were two approaches of CI among the studies: IA and medial branch block (MBB). IA blocks are difficult to perform, more painful than MBB, which had lower technical failure rate.\(^{22}\) The needle is positioned at the junction of the superior articular and transverse processes for MBB, whereas the needle for IA is positioned to be within the joint. Lumbar MBB should be performed with a volume < 0.5 mL in order to prevent the spread to adjacent structures, and IA injections should be done with a volume < 1.5 mL in order to prevent aberrant spread and capsular rupture.\(^{23}\)

IA injections would be more accurate than MBB because 10%–15% of joints receive aberrant innervations from nerves other than the medial branches.\(^{24}\) Ackerman and Ahmad\(^{25}\) found that 61% of those who

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Table 2. Grade Assessment

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Risk of bias</th>
<th>Inconsistency</th>
<th>Indirectness</th>
<th>Imprecision</th>
<th>Publication of bias</th>
<th>GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain intensity at 3 months</td>
<td>Serious</td>
<td>Severe</td>
<td>No at all</td>
<td>Some</td>
<td>Presence</td>
<td>Very low</td>
</tr>
<tr>
<td>Pain intensity at 6 months</td>
<td>Not serious</td>
<td>Severe</td>
<td>No at all</td>
<td>None</td>
<td>Presence</td>
<td>Low</td>
</tr>
<tr>
<td>Pain intensity at 12 months</td>
<td>Very serious</td>
<td>Severe</td>
<td>No at all</td>
<td>Some</td>
<td>Presence</td>
<td>Very low</td>
</tr>
<tr>
<td>Functional disability score at 6 months</td>
<td>Serious</td>
<td>Severe</td>
<td>No at all</td>
<td>Some</td>
<td>Presence</td>
<td>Very low</td>
</tr>
</tbody>
</table>

Abbreviation: GRADE, Grading of Recommendations, Assessment, Development, and Evaluation.
received IA blocks achieved a sustained relief of 12 weeks post-procedure compared with 26% of those who received MBB. IA injections may be considered an option of treatment for some individuals (e.g., young people with inflammatory pain, people at risk of RF ablation complications).²³

For RF groups, there were two methods performed in the included studies: pulsed and continuous RF. A meta-analysis showed that continuous RF ablation significantly decreased pain score compared with control treatments at the 6 and 12-month follow-up periods.²⁶ However, it would increase the risk of nerve injury. An included trial²⁸ reported burns and neuropathy as adverse events related to continuous RF ablation.

There were several limitations in this study. First, most of the included studies involved small sample sizes. Secondly, there was substantial heterogeneity among the studies. The sensitivity analysis also showed no improvement in heterogeneity, which might be attributed to the variation in procedures and agents among trials.

Conclusions

Pooled analysis from limited trials showed that RF can be beneficial to the improvement of pain intensity and functional disability when compared to CI for the treatment of LFJ pain. More RCTs with proper homogeneous data are required to improve the quality of evidence.
Figure 4. Forest Plot of Comparing the Outcome of Corticosteroid Injection and the Outcome of Radiofrequency Ablation
(A) Pain intensity at 3 months. (B) Pain intensity at 6 months. (C) Pain intensity at 12 months. (D) Functional disability at 3 months.
Abbreviations: CI, confidence interval; IV, intravenous; SD, standard deviation.

References
Wardhana et al.

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