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REVIEW ARTICLE

Multiple injections for low back pain: What's the future?

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Abstract

Aims To examine the strength of evidence available for multiple facet joint injections (FJIs) and medial branch blocks (MBBs), and to report on the variations in the NHS England framework using the getting it right first time (GIRFT) data.

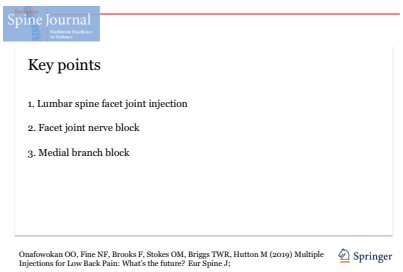
Methods Systematic review using patient, intervention, comparison, outcome and study strategy. The literature search using Cochrane, MEDLINE and EMBASE databases using MeSH terms: lumbar spine, spinal injection and facet joint ("Appendix A").

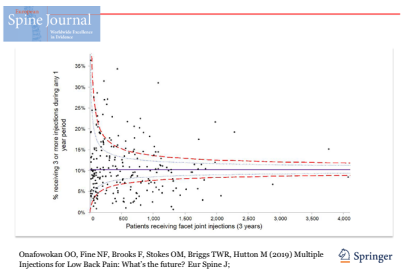
Results Three studies were identified that investigated the efficacy of multiple FJIs or MBBs. None of these studies reported sustained positive outcomes at long-term follow-up.

Conclusion There is a paucity of levels I and II evidence available for the efficacy of multiple FJIs and MBBs in treating low back pain. GIRFT data show a high degree of variation in the use of multiple FJIs, which would not be supported by the literature.

Graphic abstract

These slides can be retrieved under Electronic Supplementary Material.





Keywords Lumbar spine · Facet joint · Zygapophyseal joint · Spinal injection · Facet joint injection · Medial branch block · Facet joint nerve block

Introduction

Lumbar spine pathology is common, affecting 40% of the UK adult population annually [1]. Its economic burden is significant, costing the National Health Service > £1 billion per year [1], and resulting in the annual loss of 3.2 million UK working days [2].

The aetiology of low back pain is varied including: non-spinal pathology such as abdominal aortic aneurysm, malignant spinal pathology such as metastasis, and non-malignant

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spinal causes such as pain arising from the muscles, discs (discogenic) or facet joints [3].

Following exclusion of sinister causes, initial management involves reassurance, simple analgesia and physiotherapy [4]. Where pain is recalcitrant to conservative therapy, injection therapy has been considered in cases where the pain is thought to emanate from degeneration of the facet joints [5]. Several injection techniques are in use in clinical practice, including facet joint injections (FJIs), medial branch blocks (MBBs) and radiofrequency neurotomy [5].

The getting it right first time (GIRFT) report was initially published in 2012 for orthopaedics [6]. It aims, through developing lean health care models, to improve patient safety, outcomes, experience and cost-effectiveness of practice. The GIRFT project for spinal surgery commenced in 2016. One of the variables evaluated was variation in repeated FJIs between health care providers. GIRFT identified a significant rate of repeat FJIs, with 10.9% of patients who underwent FJI receiving three or more FJIs in any 12-month period (Fig. 1).

In the UK, the latest National Institute of Health and Clinical Excellence (NICE) guidance advocated the use of a single diagnostic medial branch block instead of facet joint injections, and following a positive response, radiofrequency ablation should be offered [7]. This systematic review was designed to search the literature for evidence supporting the practice of multiple FJIs and/or MBBs, and to report on the variations in the NHS England framework using GIRFT data.

Methodology

Inclusion criteria

Eligibility criteria were determined using the population, intervention, comparison, outcome and study (PICOS) strategy. The population included patients who received therapeutic injections for management of lumbar pain. Multiple FJIs/MBBs were the intervention of interest, with the comparison being single FJIs/MBBs. Outcomes were patient reports regarding increased and/or maintained levels of pain relief and restoration of function post-injection. Study designs included were systematic reviews, meta-analyses and randomised control trials (RCTs) [Levels I and II evidence].

Levels of evidence were delineated using Manchikanti et al.'s [8] modified criteria for grading of qualitative evidence for diagnostic accuracy and therapeutic interventions ("Appendix A").

Exclusion criteria

Reviews and studies into single FJIs and/or MBBs were excluded. Studies into diagnostic injections alone were excluded. Non-randomised trials, case–control studies, cohort studies, case series and case reports (levels III–V evidence) were excluded. Studies utilising multiple concurrent injection modalities, platelet-rich plasma, radiofrequency denervation/neurotomy/ablation, and surgical management as interventions were excluded. Non-human studies, cadaveric studies and studies not published in the English language were also excluded.

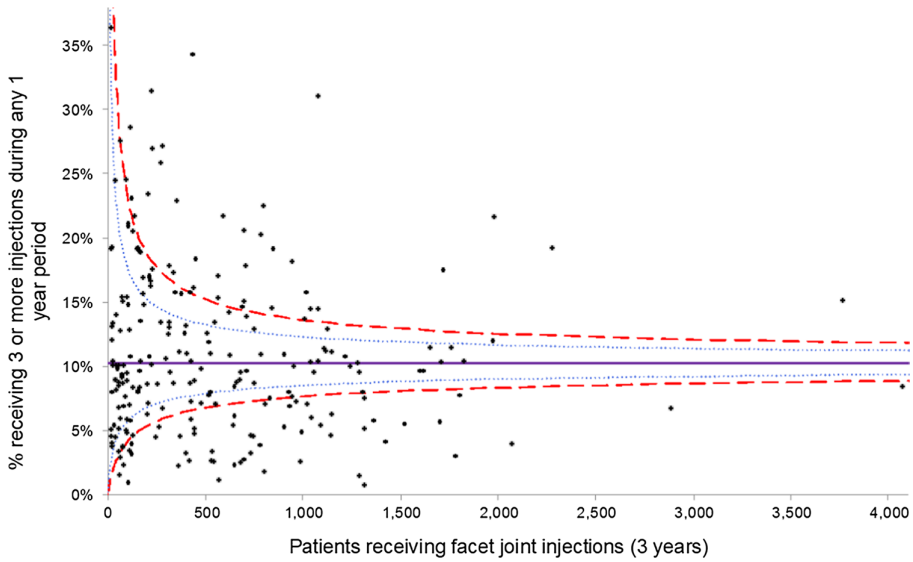


Fig. 1 GIRFT data summary. The position on the funnel plot is determined by the volume of patients having facet joint injections, and the percentage of those that had three or more in 12 months. The mean was 10%. The dotted line represents 2 standard deviations from the mean and the dashed line 3 standard deviations

Search strategy

A literature search using Cochrane, MEDLINE and EMBASE databases was conducted independently by one reviewer (OO) using MeSH terms: lumbar spine, spinal injection and facet joint ("Appendix A"). There was no restriction on publication dates. Bibliographies of relevant studies were searched for additional papers which met the inclusion criteria.

Results

The search strategy provided a total of 2821 results, which were critically reviewed for eligibility of inclusion ("Appendix B"). A total of 3 papers met the study criteria. All other relevant but excluded studies are summarised in "Appendix C".

Randomised control trials

Manchikanti et al.'s [9] study ($n = 73$ patients; no. of MBBs = up to 10) compared therapeutic medial branch blocks (MBBs) of a local anaesthetic and Sarapin® (High Chemical, Levittown, PA) mixture [group I] with a mixture of local anaesthetic, Sarapin® and methylprednisolone [group II]. Participants received MBBs unilaterally or bilaterally (dependent on if pain was unilateral or bilateral/midline). Study participants underwent a varying number of MBBs, with 60% undergoing 7 MBBs, 29% undergoing 9 and 21% undergoing 10 MBBs. There was no easily decipherable pattern to follow-up which occurred up to 2.5 years. They reported cumulative significant (> 50%) pain relief with one to three injections in 100% of participants at 1–3 months, 84% at 4–6 months, 21% at 7–12 months and 10% after 12 months, indicating a decline in length of pain relief with increasing MBBs. Reports between both groups were comparable.

A further study by Manchikanti et al. [10] ($n = 120$ patients, no. of MBBs = up to 9) compared therapeutic MBBs utilising the same materials and grouping as with the previous study described above [9]. Two joints were injected in 70% or participants, 3 joints in 30% and bilateral injections in 79%. Participants only received repeat MBBs when reported pain levels decreased to < 50%, after initially reporting pan relief of ≥ 50% after the previous MBB. Different participants underwent different total number of MBBs. The authors reported improvements in overall pain intensity and function. Follow-up was up to 24 months. The length of pain relief (in weeks) per procedure gradually declined with increasing number of MBBs. Results between both groups were comparable.

Fuchs et al.'s [11] study ($n = 60$ patients, no. of FJIs = 6) compared therapeutic facet joint injections (FJIs) of sodium hyaluronate (SH) with FJIs of glucocorticoids (triamcinolone acetonide; TA), with each participant receiving bilateral FJIs into three levels (L3/4, L4/5 and L5/S1) at weekly intervals. Follow-up was up to 6 months. Participants experienced overall improvements in pain intensity and functional status, with the most significant improvements between the 1st and 5th visits (4-week follow-up; after the 4th FJI). Results between SH and TA groups were comparable.

Getting it right first time (GIRFT)

The GIRFT project retrospectively analysed the data from the hospital episode statistics (HES) database, between April 2012 and March 2015, to compare the variance of practice in spinal care in the UK. One of the matrices chosen to compare health care providers on was the proportion of patients having three or more facet joint injections within a 12-month period. To be included in the comparison, each health care provider needed to have treated at least 20 patients with three or more facet joint injections in any 12-month period. Procedures performed in clinic rooms were excluded.

Two hundred and thirty-six health care providers treated at least 20 patients with three or more facet joint injections in any 12-month period and were therefore included in this comparison of practice of repeated facet joint injections.

The mean number of patients having facet joint injections in a health care provider was 575 (20–4075) in a 12-month period, and the mean percentage per provider of those having three or more facet joint injections was 10.9% (0.8–36.4%) (Fig. 1).The mean time between injections was 20 weeks (8–39 weeks) (Fig. 2).

Discussion

This is a best evidence synthesis of the literature available for different injections used to treat lumbar facet pain and a report on the variations in the NHS England framework using GIRFT data. This is the first time that the GIRFT data for spinal surgery have been reported in comparison to the available high quality literature on intraarticular lumbar facet joint injections (FJIs) and medial branch blocks (MBBs). The use of a structured approach ensured review of only literature meeting the article's inclusion criteria. As a result, a potential limitation was the limited quantity of literature reviewed.

There is significant paucity in the high quality evidence available for repeating therapeutic facet joint injections (FJIs). This review identified only one paper of level I and/or level II evidence which investigated multiple injections [11]. This study indicated increasing improvements in

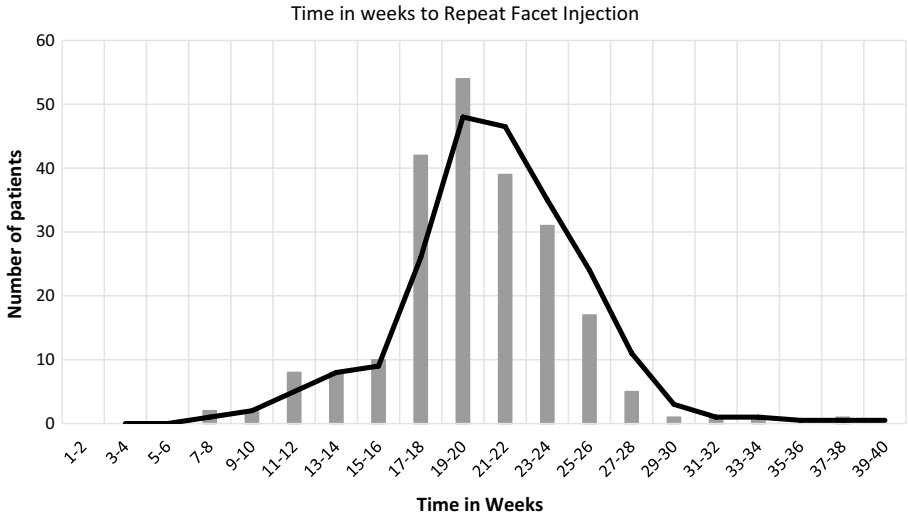


Fig. 2 Distribution of time (in weeks) to repeat injection. The mean time between repeat injections was 20 weeks (8–39)

patient outcomes up to 6 months, with the most significant improvements seen in the first 4 weeks after intervention commenced.

The literature available on repeated FJIs is weak and predominantly of levels III and IV evidence. Overall, these have reported remarkable immediate pain relief following each FJI, but with significant decline in outcomes when used up to and longer than 6 months [12–25]. A narrative review by Bogduk [26] included 24 lumbar intraarticular FJI studies [14, 15, 17–21, 27–43]. Only two of these [36, 37] were of level I or II evidence, and both researched single-injection interventions. Considering the 22 studies of levels III and IV evidence, the results indicate significantly positive immediate responses to intraarticular FJIs, but with rapid decline in outcomes between 3 and 6 months.

For single-intervention FJIs, reports indicate mostly favourable immediate outcomes, but rarely for longer than 3 months after which efficacy significantly decreases [35–37, 44–55].

Unfortunately, the spinal GIRFT report did not include patient-reported outcome measures, and it is therefore not possible to use the report to further comment on the effectiveness of repeated FJIs in relieving patients' symptoms. However, given the weakness of the supporting data and the competing health care needs of society, it is difficult to justify repeat FJIs, with the frequency that GIRFT has identified, given this level of evidence to support this practice.

The levels I and II evidence for medial branch blocks (MBBs) is also significantly limited in availability but of higher quality, with two randomised control trials by Manchikanti et al. [9, 10] ($n = 204$ patients) reporting 100% pain relief at 3 months with 1–3 MBBs, and an average length of relief being 19 weeks per episode of treatment. At 2-year follow-up (average 8–10 injections), significant improvement ($\geq 50\%$ on Numerical rating scale and $\geq 40\%$ on Oswestry disability index) was still reported in 85–90% of patients ($p < 0.05$). These findings suggest that the literature appears to offer some support for the use of MBBs in treating lumbar facet joint pain, rather than FJIs. Recent NICE guidance suggests using MBBs instead of FJIs [7]. This review supports that guidance. No level I or II evidence of relevance for single MBBs was discovered by this review.

The spinal GIRFT report identified a variation in the UK practice between health care providers regarding the use of repeated FJIs to treat patients with back pain. In some centres, over 30% of patients receive 3 or more repeat injections in 1 year. The results of this systematic review do not support such practice, due to a lack of identified evidence in support of it. The cost-effectiveness of repeated FJIs/MBBs is also questionable, as many patients are having multiple

hospital events each year with limited length of symptom relief. Also, the facet joints are still considered a controversial common source of lumbar pain [56], with frequent difficulty in distinguishing lumbar facet joint pain from pain referred from surrounding structures [57].

By standardising care and treating patients with evidence-based medicine, we can aim to streamline management, increase efficiency and hopefully improve patient satisfaction. The Virginia Mason Medical Centre has been well recognised for adapting the Toyota Production System to cut costs and improve patient satisfaction [58]. By eradicating the variability that we are seeing across hospitals in the UK and increasing transparency of treatments through GIRFT, we can aim to become more efficient and provide an effective service to patients, given the finite resources and competing health care needs of the population.

Conclusion

As evidenced by the GIRFT data, intraarticular FJIs are still being widely used despite the lack of support by UK and US guidelines, and a lack of evidence supporting their use [59–61]. There is low quality evidence supporting the use of medial branch blocks for the long-term management of low back pain and poor evidence supporting the use of repeat injections (MBB and FJI). Despite this, the GIRFT data show a high degree of variation in the use of multiple injections which would not appear to be supported by the literature.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Appendix A

Manchikanti et al.'s [8] modified grading of qualitative evidence with best evidence synthesis for diagnostic accuracy and therapeutic interventions.

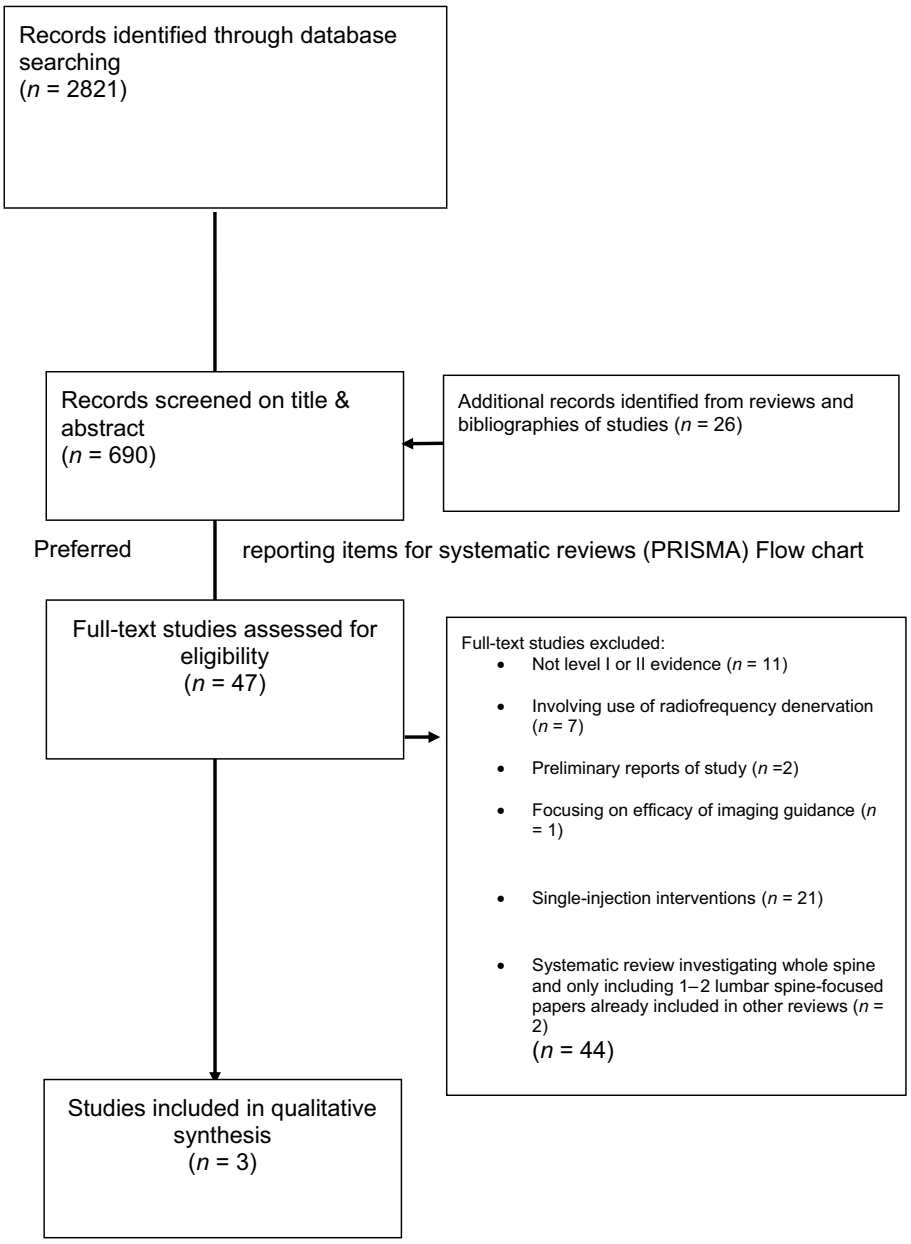
Level I	Evidence obtained from multiple relevant high quality randomised controlled trials Or Evidence obtained from multiple high quality diagnostic accuracy studies
Level II	Evidence obtained from at least one relevant high quality randomised controlled trial or multiple relevant moderate or low quality randomised controlled trials Or Evidence obtained from at least one high quality diagnostic accuracy study or multiple moderate or low quality diagnostic accuracy studies
Level III	Evidence obtained from at least one relevant moderate or low quality randomised controlled trial study Or Evidence obtained from at least one relevant high quality non-randomised trial or observational study with multiple moderate or low quality observational studies Or Evidence obtained from at least one moderate quality diagnostic accuracy study in addition to low quality studies
Level IV	Evidence obtained from multiple moderate or low quality relevant observational studies Or Evidence obtained from multiple relevant low quality diagnostic accuracy studies
Level V	Opinion or consensus of large group of clinicians and/or scientists

Search strategy

1. "Lumbar spine" [MeSH]
2. "Spinal injection" [MeSH]
3. 1 AND 2
4. "Facet joint" [MeSH] OR "zygapophyseal joint"
5. 4 AND "intervention"
6. 4 AND "spinal injection"
7. 3 AND "medial branch facet block"
8. 4 AND "medial branch facet block"
9. 3 AND "medial branch nerve block"
10. 4 AND "medial branch nerve block".

Appendix B

Preferred reporting items for systematic reviews (PRISMA) flow chart.



Appendix C

Levels I and II studies reporting multiple facet joint injections and medial branch blocks.

Author and references	Trial type	Interventions	Participants	Assessment tool	Outcome
Medial branch blocks					
Manchikanti [9]	RCT	I (lidocaine/bupivacaine LA + Sarapin) versus II (LA + Sarapin + methylprednisolone)	73 (32 in I, 41 in II)	Verbal pain scale	Cumulative significant pain relief with 1–3 injections was 100% up to 1–3 months, 82% for 4–6 months, 21% for 7–12 months and 10% after 12 months, with a mean relief of ~ 6.6 months. Significant improvement also noted in overall health status and quality of life
		Mean number of procedures/interventions was ~ 8.4 in 13–32 months			No significant differences between both groups
Manchikanti [10]	Double-blind, RCT	IA (control group-lumbar facet joint nerve block using bupivacaine) versus IB (facet block using bupivacaine and Sarapin) versus IIA (facet block using bupivacaine + steroids) versus IIB (facet block using bupivacaine + steroids + Sarapin)	120 (30 per group)	Numeric rating scale (NRS) + Oswestry Disability Index (ODI), opioid intake, and work status; at baseline, 3, 6, 12, 18 and 24 months	Significant pain relief and functional improvement seen in 85% in Group I and 90% of Group II at 2-year follow-up. Pain relief experienced for 82–84 of 104 weeks, requiring 5–6 injections (mean relief—19 weeks per injection)
Facet joint injections					
Fuchs [11]	Single-blind (observer) RCT	10 mg sodium hyaluronate (SH) versus 10 mg triamcinolone acetonide (TA). Both into bilateral facet joints at levels S1–L5, L5–L4 and L4–L3. Done once a week for study duration	60 (30 to SH, 30 to TA)	VAS, Rowland–Morris Questionnaire, ODI, low back outcomes score, short form-36	Both showed long-lasting pain reduction, improved function and improved quality of life (at 6 months). SH-group showed better benefits, particularly in pain reduction

Levels I and II studies reporting single facet joint injections and medial branch blocks.

Author and references	Trial type	Interventions	Participants	Assessment tool	Outcome
Facet joint injections					
Lilius [35]	RCT	I (6 mL [30 mg] bupivacaine hydrochloride + 2 mL [80 mg] methylprednisolone acetate] bilaterally into L3–L4 and L4–L5 versus II (same mixture as above into facet joint pericapsular space of same joint) versus III (8 mL saline into same joints as above)	109 (28 to I, 39 to II, 42 to III)	VAS	Mean probability for p value differences in pain between groups (combined cortisone vs. saline) = 0.3375 (mean and SD) pain score on a scale of 0–100 mm for all 109 patients: Before injection = 49.2 (22.3). 1 h = 30.9 (25.6). 2 weeks = 35.8 (25.9). 6 weeks = 40.7 (25.7). 3 months = 43.3 (26.6). $p < 0.0001$ Mean probability for p value differences in disability between groups (combined cortisone vs. saline) = 0.1206 (mean and SD) Disability score ranging from 6 to 18 constructed from 6 variables scoring from 1 to 3: (standing, walking, sitting, sitting with legs extended, climbing onto examination table and dressing) Before injection = 10.3 (1.7). 1 h = 8.9 (2.3). 2 weeks = 9.1 (2.1). 6 weeks = 9.1 (1.9). $p < 0.0001$ No significant between-group differences in pain intensity at each follow-up Mean pain intensity differences from baseline across all groups were: − 18.7 at 1 h post-injection, − 13.4 at 2 week follow-up, − 8.5 at 6 weeks, and − 5.9 (all $p \leq 0.0001$)
Carette [36]	Double-blind RCT	20 mg methylprednisolone acetate (1 mL + 1 mL of isotonic saline) versus 2 mL isotonic saline Bilateral L4–L5 and L5–S1 facet injection	97 (49 to steroid, 48 to saline)	Pain visual analogue scale (VAS) + McGill Pain Intensity Questionnaire + modified Sickness Impact Profile	Mean present pain intensity, intervention, baseline = 2.7 Mean present pain intensity, control, baseline = 2.8 Mean present pain intensity, intervention, 1 month = 2.3, control = 2.6 Mean present pain intensity, intervention, 6 months = 2.1, control = 2.9 Baseline mean VAS, intervention, 6.3, control, 6.2 1 month mean VAS intervention, 4.5, control 4.7 Difference (95% CI) = − 0.2 (− 1.1 to 0.8) 6 month mean VAS (0–10 cm scale) = 4.0 (methyl) = 5.0 (placebo) Difference (95% CI) = − 1.0 (− 2.0 to − 0.1) Mean sickness impact profile, intervention, baseline, 11.4, control 13.4 Mean sickness impact profile intervention, 1 month 9.3 control 9.8 Difference (95% CI) = − 0.5 (− 2.8 to 1.7) Mean sickness impact profile, intervention, 6 month, 7.8 control 10.8 Difference (95% CI) = − 3.0 (− 6.2 to 0.2) After 1 month, 42% of steroid group and 33% of saline group reported improvement in VAS and pain intensity which was marked or better from baseline pain levels (95% CI for difference, − 11 to 28; $p = 0.53$) Similar results at 3 months At 6 months, 22% of steroid group and 10% of saline group had sustained improvement from 1st to 6th month (95% CI for difference, − 2 to 26; $p = 0.19$) When concurrent interventions (physical therapy, antidepressant medication, peridural injections) taken into account, 31% of steroid group and 17% of saline group had sustained improvement at 6th month (95% CI for difference, − 3 to 31; $p = 0.17$)

Author and references	Trial type	Interventions	Participants	Assessment tool	Outcome
Marks [37]	Double-blind RCT	0.5 mL Depomedrone (20 mg methylprednisolone acetate) + 1.5 mL lignocaine (1%) at L5–S1 versus 0.5 mL Depomedrone + 1.5 mL lignocaine facet nerve blocks of the L1–L5 medial articular branches of the posterior primary rami	83 (41 to joint injection, 42 to nerve block)	Level of pain relief + ROM (range of motion) provocative test	At 2 weeks, 43% and 45% of patients reported good or excellent pain severity improvements in joint injection and nerve block groups, respectively At 1 month, this was 36% and 20.5% At 3 months, this was 22% and 14% All reported changes were statistically significant ($p < 0.05$)
Ribeiro [44]	Double-blind RCT	Bilateral facet joint injections of 1 mL (20 mg) triamcinolone hexacetonide into L3–L4, L4–L5 and L5–S1 joints (6 injections, 120 mg total) + 1 mL lidocaine [EG] versus bilateral intramuscular injections of 1 mL (20 mg) of triamcinolone acetonide + 1 mL lidocaine on 6 surface points of lumbar paravertebral musculature (120 mg total) [CG]	60 (31 to EG, 29 to CG)	Pain VAS + pain VAS during extension of the spine + Likert scale + improvement percentage scale + Roland-Morris + 36-Item Short Form Health Survey + accountability of medications taken	At 1 week, 90% of EG and 86% of CG reported "better" or "much better" pain improvements in a Likert scale. The difference between groups was statistically significant ($p = 0.029$) No statistically significant differences in pain improvement and disability between groups at 4, 12 and 24 weeks
Kawu [45]	RCT	Intraarticular 0.5 mL of 0.25% bupivacaine + 0.5 mL (20 mg) of methylprednisolone acetate versus Physiotherapy (McKenzie regimen)	18 (10 to injection, 8 to physiotherapy)	VAS, ODI	At 6 months, mean visual analogue scale scores lower in injection group (4), compared with physio group (5) [$p = 0.032$] FJI group fared consistently better with a low mean ODI score against the mean score of the physiotherapy group. No direct information specifically reported for the ODI except graph showing ODI against time
Mayer [46]	Single-blind RCT	A [(Multi-level (3) bilateral facet injections of 1 mL 2% lidocaine + 1 mL 0.5% bupivacaine + 1 mL steroid) + home stretching exercise programme versus B [exercise programme only—twice a week in facility and concurrent home stretching programme]	70 (36 to A, 34 to B)	VAS	At 5–7 week follow-up, mean pain intensity decreased in A (mean change 0.9, $p \leq 0.003$) and in B (mean change 0.8, $p \leq 0.004$) No difference between groups at follow-up ($p = 0.27$)
Ackerman [47]	Double-blind RCT	Lumbar FJ SPECT-positive I (Intraarticular) versus II (Medial branch nerve blocks) of triamcinolone and lidocaine	46 (23 to each)	Numeric Pain Intensity (NPS) score, ODI	Pain relief and improved disability were observed in 61% and 53% of patients in group I, and in 26% and 31% of group II. This difference was statistically significant ($p < 0.05$)

Author and references	Trial type	Interventions	Participants	Assessment tool	Outcome
Schütz [48]	Single-blind, triple crossover RCT	3 bilateral facet joint injections: verum (1.5 mL 1% Mepivacaine), placebo (1.5 mL 0.9% isotonic sodium chloride solution), sham (extraarticular positioning of needle without volume application) Participants randomised to 6 parallel groups based on sequence of injections received	60 (10 to each)	VAS	Study was into diagnostic value of facet joint injections. It concluded that there were no significant differences between the three different injection types and that a single intraarticular block with local anaesthetic was not useful in diagnosing facet joint pain
Annaswamy [49]	Double-blind RCT	Bilateral L3–S1 FJIs Triamcinolone versus Synvisc-One		VAS and Pain disability questionnaire (PDQ)	
Yun [50]	RCT	Intraarticular FJI of 10 mg triamcinolone + 2 mL of 1% lidocaine; bilateral or unilateral; into L4–L5 and/or L5–S1 Fluoroscopy-guided (FL) versus ultrasound-guided (US)	57 (32 to FL, 25 to US)	VAS, physician's and patient's global assessment (PhyGA, PaGA), modified Oswestry Disability Index (ODI)	Significant decrease in VAS at 1 week (mean change − 3.31), 1 month (mean difference − 3.40) and at 3 months (mean difference − 2.87) [$p = < 0.001$ for all changes] Similarly, significant decreases at each follow-up in PaGA, PhyGA and modified ODI No significant differences between groups at each follow-up
Al-Tawil [51]	Single-blind RCT	Intraarticular FJI using oblique versus antero-posterior (AP) x-ray guidance	29 (17 to AP, 12 to oblique)	Numerical 11 point pain rating scale questionnaire	Statistically significant difference in pain scores between pre- and post-op in both groups No significant differences between groups
Sae-Jung [52]	RCT	100 mg/day oral diclofenac for? how long (D) versus 80 mg intraarticular methylprednisolone into each symptomatic facet joint (IA) versus both (B)	99 (33 to D, 32 to IA, 34 to B)	VAS and ODI	Initial ODI (mean ± SD) was 45.1 ± 9.3, 42.9 ± 15.6, 42.2 ± 11.5 for D, IA and B groups, respectively. Respective 4-week ODI was 30.1 ± 8.1, 20.2 ± 8.0 and 15.1 ± 5.5. The 12-week ODI was 42.4 ± 9.0, 32.2 ± 15.6 and 26.2 ± 11.7 Initial VAS was 7.1 ± 1.2, 7.6 ± 1.1 and 7.3 ± 1.0. The 4 week VAS was 5.3 ± 1.4, 3.6 ± 0.7 and 3.3 ± 1.1. The 12-week VAS was 6.1 ± 1.1, 5.8 ± 1.4 and 5.1 ± 0.9 Combined treatment was more effective than either treatment alone. IA also had better ODI scores than D

Author and references	Trial type	Interventions	Participants	Assessment tool	Outcome
Celik [53]	RCT	Bilateral L4/5 and L5/S1 facet joints block with prilocaine (skin preparation) 10 mg bupivacaine and 5 mg methylprednisolone versus diclofenac sodium 100 mg/day thiocolchicoside 8 mg/day for 5 days and recommended bed rest for 4 days	80 (40 to each)	ODI, VAS	Intervention group: VAS pre-treatment = 8. Immediately after = 2. 1st month = 1. 3rd month = 5. 6th month = 2 Control group: VAS pre-treatment = 7. Immediately after = 3. 1st month = 2. 3rd month = 4. 6th month = 5 Decrease in VAS scores in post-treatment at 1st, 3rd and 6th month was not statistically significant ($p > 0.005$) Intervention group: ODI pre-treatment = 23. Immediately after = 5. 1st month = 5. 3rd month = 11. 6 months = 3 Control group: ODI pre-treatment = 21. Immediately after = 9. 1st month = 4. 3rd month = 7. 6th month = 11 Reduction in ODQ scores in intervention group was greater than in control group ($p < 0.005$) Between-group differences were not reported
Kennedy [55]	Double-blind, RCT	Triamcinolone 20 mg versus saline	28 (14 to each group)	ODI, Numeric Pain Rating (NPR) scale	No statistical difference in the subsequent need for radiofrequency neurotomy
North [62]	RCT	3 mL of 0.5% bupivacaine 3 different nerve blocks [paraspinal lumbosacral root block, medial branch posterior ramus block (at or proximal to the pathology and sciatic nerve blocks (distal or collateral to the pathology)] versus control lumbar subcutaneous injection of identical volume	33	Standardised 0–10 rating pain scale	False positive results were common For sciatic nerve block specificity was 24%–36% For root blocks sensitivity was 9%–42% All the different nerve blocks produced temporary pain relief in majority of patients Statistical analysis of clinical and technical prognostic factors revealed that the only association with pain relief by any block was the effects of other blocks. The strongest association was between relief by sciatic nerve block and relief by medial branch posterior primary ramus (facet) block (P = 0.001, odds ratio 16.0).
Medial branch blocks					
Kaplan [54]	Single-blind RCT	Two saline injections versus two 2% lidocaine medial branch injection	14 (9 to medial branch block, 5 to control)	Repeat capsular distension (30 min after) in order to elicit pain	All 5 control individuals who received saline medial branch injections felt pain on repeat capsular distention Of the 9 individuals who received 2% lidocaine medial branch blocks, 8 felt no pain and 1 felt pain on repeat capsular distention
Stojanovic [63]	Cross-over-comparison RCT	2 separate diagnostic medial branch blocks (single-needle versus multiple-needle technique) Multiple variables compared	24	VAS	Single-needle technique resulted in less procedure-related pain ($p = .0003$), required less superficial local anaesthesia ($p = .0006$) and took less time to complete ($p < .0001$) than the multiple-needle approach Single-needle technique also provided same degree of accuracy

Levels III–V studies reporting single and multiple FJIs.

Author and year	Trial type	Interventions	Participants	Assessment tool	Outcome
Bani [12]	Prospective case series	Intraarticular FJI with LA and/or steroid 1st injection: 1 mL bupivacaine 1% 2nd injection (if 1st successful): betamethasone	715 FJIs in 230 patients	Pain relief	18.7% of patients reported lasting pain relief at 10 months 15.2% noticed general pain improvement 11.7% reported relief of low back pain but not leg pain 3.9% suffered no back pain but still leg pain 50.4% experienced no improvement in pain at all In two cases, the procedure had to be interrupted because of severe pain
Beyer [13]	Prospective study	Repeated epidural injections and FJIs and also physiotherapy during 1-week hospitalisation	38	VAS, ODI, Core Outcome Measures Index (COMI), Short-Form 36 Health Survey Questionnaire(SF-36)	Significant improvements in back and leg pain VAS up to 3 months
Carrera [14]	Prospective case series	Fluoroscopically-guided intraarticular FJ blocks of local anaesthetic and steroid	20	Pain relief	13/20 patients had immediate pain relief, confirming diagnosis 6/20 patients pain free for 6 months following single block
Destouet [15]	Prospective case series	1 mL 0.25% bupivacaine and 40 mg depot methylprednisolone	54	Pain relief	54% of patients had initial relief (up to 3 months). 38% had continued pain relief for 3 months or longer 11% of patients were pain free for 6–12 months
Freyhardt [16]	Prospective case series	MR fluoroscopic-guided FJ block of local anaesthetic and steroid	166 facet joints in 45 patients	VAS	38 patients completed study 63% had pain relief immediately 34% had lasting pain relief at 6 months 24% had lasting pain relief at 12 months Mean VAS was reduced from 7.1 ± 1.7 (baseline) to 3.5 ± 2.2, 4.1 ± 3.0, 3.8 ± 2.9 and 4.6 ± 2.9 at 1 week, 3, 6 and 12 months ($p < 0.01$)
Lewinnek [17]	Prospective case series	Intraarticular FJI with local anaesthetic and steroid	21	Pain relief	75% of patients had initial positive response 33% still had positive response at 3 months Repeat injections, when done, always led to temporary relief, but only to lasting relief in 20% (1 in 5) of those who had repeat injections
Lippitt [18]	Retrospective review	Intraarticular injection of 1 mL 1% lidocaine and 80 mg depot methylprednisolone	99	Pain relief	42% of patients had initial relief, which declined to 14% at 6 months
Lynch and Taylor [19]	Case series	Bilateral intraarticular 0.5% lignocaine + 60 mg methylprednisolone mixed	50	Level of pain relief	Intraarticular injection into two joints more effective than one. Both effective but improvements reduce with time. Intraarticular FJI more effective than "failed" extraarticular FJI
Murtagh [21]	Prospective case series	Repeat intraarticular injections of lidocaine and 6 mg betamethasone	100	Pain relief	54% of patients had more than 3 months of pain relief

Author and year	Trial type	Interventions	Participants	Assessment tool	Outcome
Schulte [22]	Case series	Up to 6 intraarticular FJIs of prednisolone acetate, lidocaine 1% and phenol 5%	39	Pain Disability Index, MacNab criteria, VAS	"Excellent" or "good" response seen in 62% of patients after 1 month, 41% after 3 months and 36% after 6 months Positive effect on pain in short term. Effects reduce within 3 months
Shih [23]	Case series	1–3 Intraarticular injections of 0.3–1.5 mL lignocaine with betamethasone dipropionate (Diprosan) + iopamidol (1:1:0.5) Bilateral in 42.2% of patients	277	VAS	73.6% had pain relief for at least 1 week. Effects reduced with time
Shim [24]	Retrospective case series	Patients receiving multiple injections for lumbar canal stenosis Review of which injection (FJI or epidural steroid injection [ESI]) was used as 3rd injection after sequential injections of FJI and ESI	73	Five-point satisfaction scale	50/73 patients had 3rd injection 33 underwent FJI as the 3rd injection Out of 19/73 patients who experienced ineffective first ESI, 13 (68.4%) reported 2nd FJI as effective Out of the 6/13 patients who reported the 2nd FJI as ineffective, 3/6 (50%) reported the 2nd ESI as effective Authors conclude that FJIs can be administered as an alternative to ESIs in cases of lumbar canal stenosis
Han [25]	Retrospective study	Ultrasound versus fluoroscopy-guided MBB	146 (68 to USS, 78 to FL)	VAS, ODI, VNS (verbal numeric scale)	ODI and VNS scores improved at 1, 3 and 6 months after last injections in both groups. No significant differences between both groups
Lau [30]	Retrospective case series	Bilateral intraarticular 1.5 mL bupivacaine hydrochloride (0.5% Marcain) and 20 mg methylprednisolone acetate (Depo-Medrol)	34	Pain relief percentage scale	63% reported relief of greater than 70% for 6 months or longer
Moran [31]	Prospective case series	Intraarticular 1.5 mL bupivacaine	143 facet joints in 54 patients	Pain provocation and pain relief	Diagnosis was confirmed in only 16.7% (nine) of patients
Mooney and Robertson [37]	Case series	3 Intraarticular FJIs of 1 mL of Depo-Medrol and 2–5 mL local anaesthetic	100	Questionnaire	Intraarticular steroid + LA mixture effective but effects reduce by 6 months
Hwang [64]	Retrospective case series	Single-level bilateral FJI with steroid	42	Five-point patient satisfaction scale	59.5% of patients considered the treatment to have been effective 72% of the 25 patients with mild-to-moderate central canal stenosis had symptom relief 7 of the 17 (41.2%) patients with severe central canal stenosis had symptom relief ($p < 0.05$) Other outcome predictors were not statistically significant

Author and year	Trial type	Interventions	Participants	Assessment tool	Outcome
Gorbach [65]	Prospective case series	Single-level or two-level FJ block with 0.5 mL of local anaesthetic and 0.5 mL of steroid	42	VAS	Positive immediate effect was seen in 31 patients (74%) Positive medium-term effect was found in 14 patients (33%) Pain alleviated by motion ($p=0.035$) and the absence of joint-blocking sensation ($p=0.042$) predicted pain relief Extent of facet joint osteoarthritis on MRI and CT was not a significant predictor for outcome ($p=0.57$–0.95)
da Rocha [66]	Prospective case series	Sham blockade (with saline injection) and then controlled medial branch block with 0.5 mL lidocaine 2%	104	VAS	52% of patients demonstrated $d>50\%$ improvements in pain after the blockade False positive results seen in 67% of patients

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