SURGICAL NEUROLOGY INTERNATIONAL

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Review Article

Perioperative steroids for lumbar disc surgery: A meta-analysis of randomized controlled trials

Muhammad Waqas, Hussain Shallwani, Muhammad S. Shamim, Khabir Ahmad

Department of Surgery, Section of Neurosurgery, The Aga Khan University Hospital, Karachi, Pakistan

E-mail: Muhammad Waqas - shaiq_waqas@hotmail.com; Hussain Shallwani - hshallwani1@gmail.com; *Muhammad S. Shamim - shahzad.shamim@aku.edu; Khabir Ahmad - khabir.ahmad@aku.edu

*Corresponding author

Received: 12 December 16 Accepted: 20 January 17 Published: 05 April 17

Abstract

Background: Our review question was "Does perioperative steroids administration, in comparison with other treatments or placebo, improve either postoperative pain control, length of hospital stay, or return to work in patients undergoing lumbar disc surgery?"

Methods: We searched PubMed, CINAHL PLUS, and Cochrane databases for randomized control trials (RCTs) studying the role of steroids for lumbar disc surgery. Studies that compared perioperative steroids with other treatments or placebo were included. Study outcomes included postoperative back pain, leg pain, length of hospital stay, and return to work. Data was extracted through a proforma. Means and mean differences were calculated for continuous data, whereas odds ratios were calculated for dichotomous data. Data were analyzed with the help of Rev Man 5.

Results: Twenty RCTs were included in the review. Quantitative analysis could be performed on 19 RCTs. Intraoperative steroids improve control of back pain at 24–48 hours. Although there was some benefit of steroid administration in controlling postoperative leg pain, it disappeared at 1 year and in the overall pooled analysis. The length of hospital stay was much shorter in the steroid group. The frequency of adverse events and complications also favored steroid administration.

Conclusion: Intraoperative epidural steroid administration offers some benefit in pain control with a significant reduction in the length of hospital stay. However, there is insufficient evidence to support the routine use of oral and intravenous steroids in the perioperative period.

Key Words: Lumbar surgery, lumbar surgery outcomes, microdiscectomy, perioperative steroids, randomized control trials



INTRODUCTION

The incidence of lumbosacral radiculopathy is estimated to be approximately 3–5%, and therefore, lumbar disc surgery is one of the most common procedures performed by spine surgeons in United States^[17,18] Because radicular pain may be partially attributed to inflammatory mediators, some surgeons have utilized This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

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How to cite this article: Waqas M, Shallwani H, Shamim MS, Ahmad K. Perioperative steroids for lumbar disc surgery: A meta-analysis of randomized controlled trials. Surg Neurol Int 2017;8:42.

http://surgicalneurologyint.com/Perioperative-steroids-for-lumbar-disc-surgery:-A-meta-analysis-of-randomized-controlled-trials/

perioperative steroids^[8] (e.g., strong anti-inflammatory effect, modulation of pain receptors).^[8] Here, we reviewed the current randomized controlled trial (RCT) literature regarding the use of perioperative steroids in lumbar disc surgery.

MATERIALS AND METHODS

The study included an analysis of RCT studies for adult patients undergoing surgery for lumbar disc herniation who received preoperative, intraoperative, or postoperative steroids, administered through any route, i.e., oral, intravenous, or epidural. We searched PubMed, CINAHL PLUS, and Cochrane databases for randomized control trials (RCTs) studying the role of steroids for lumbar disc surgery. A detailed search strategy is given in Appendix 1. We identified the differences in the mean pain scores [e.g., visual analog scale (VAS) at 24 hours, 48 hours, 72 hours, 1 week, 1 month, and 1 year], mean length of hospital stay (LOS), mean number of days to return to work, and the percentage of adverse events (AE) in patients receiving perioperative steroids vs. control patients (who received no steroids).

Data extraction

Two reviewers separately and independently extracted the data, which was then recorded in Microsoft Excel. In cases where desired data was not reported by authors, the corresponding authors were contacted for more details or missing data.

http://www.surgicalneurologyint.com/content/8/1/42

Risk of bias assessment

Risk of bias was assessed for each of the selected RCT on six quality parameters, i.e., comparability of treatment groups, standardization of care protocol, blinding of care, adequacy of outcomes, blinding of outcomes, and completeness of follow-up. Each parameter was given a score of 1-point if it was adequately described in the article. No score was given for absence of quality parameter or inadequate description of the same. Study quality level was obtained by adding the scores of each parameter to grade the studies from a total of 6 points.

RESULTS

Twenty RCTs were included in this systematic review, and quantitative analysis was performed on 19 studies [Table 1]. The process of study selection is shown in Figure 1.

Two RCTs by Ludin *et al.*^[12] and Hurlbert *et al.*^[10] had maximum quality level of 6, whereas RCT by Debi *et al.*^[5] showed the lowest quality score of 1. Most studies had quality level of 3 or 4. Summary of study characteristics is presented in Table 2.

Postoperative back pain

Six studies assessed postoperative back pain at 24 hours. The analysis favored the use of steroids, with a mean difference of -0.16 [95% confidence interval (CI) = -0.26, -0.05]. This difference was

Table 1: Quality assessment of included studies

| Study author and year | Comparable | Standardization of care protocol | Blinding of care | Adequate outcomes | Blinding of outcome | Completeness of Follow up | Study quality level |
|--|------------|-------------------------------------|---------------------|----------------------|------------------------|------------------------------|------------------------|
| Abrishamkar <i>et al</i> . (2011) | Y | Y | Can't tell | Ν | Y | Y | 4 |
| Aljabi <i>et al</i> . (2015) | Y | Y | Ν | Ν | Y | Can't tell | 3 |
| Aminmansour <i>et al</i> . (2006) | Y | Y | Y | Ν | Y | Can't tell | 4 |
| Bahari <i>et al.</i> (2010) | Y | Y | Y | Ν | Can't tell | Can't tell | 3 |
| Debi <i>et al</i> . (2002) | Can't tell | Y | Ν | Ν | Can't tell | Ν | 1 |
| Diaz <i>et al</i> . (2012) | Y | Y | Y | Y | Y | Y | 6 |
| Dikmen <i>et al</i> . (2005) | Y | Y | Can't tell | Ν | Can't tell | Y | 3 |
| Glasser <i>et al</i> . (1993) | Y | Y | Ν | Ν | Y | Ν | 3 |
| Hurlbert <i>et al</i> . (1999) | Y | Y | Y | Y | Y | Y | 6 |
| Jirarattanaphochai <i>et al</i> . (2007) | Y | Y | Y | Ν | Y | Ν | 4 |
| Langmayr <i>et al</i> . (1995) | Y | Y | Y | Ν | Y | Ν | 4 |
| Lotfinia <i>et al.</i> (2007) | Y | Y | Y | Ν | Y | Y | 5 |
| Lundin <i>et al</i> . (2003) | Y | Y | Y | Y | Y | Y | 6 |
| Manniche <i>et al</i> . (1994) | Y | Y | Y | Ν | Y | Ν | 4 |
| McNeill <i>et al</i> . (2005) | Can't tell | Y | Ν | Ν | Y | Y | 3 |
| Mirzai <i>et al</i> . (2002) | Y | Y | Ν | Ν | Y | Y | 4 |
| Modi <i>et al</i> . (2009) | Y | Y | Y | Ν | Ν | Ν | 3 |
| Pobereskin <i>et al</i> . (1999) | Y | Y | Y | Ν | Y | Can't tell | 4 |
| Rasmussen <i>et al</i> . (2008) | Y | Y | Ν | Y | Y | Y | 5 |
| Watters <i>et al</i> . (1989) | Y | Ν | Y | Ν | Y | Y | 4 |

Table 2: Summary of methods and clinical characteristic of studies include in the review

| Author and year | Location | Follow-up | No. of patients | Age in years (Mean±std or median/range) | Males (%) | Operative procedure | Steroid formulation | Route of administration |
|---|-------------------------|-----------|--------------------|---|-----------|------------------------|--|-------------------------|
| Abrishamkar <i>et al</i> . (2011) | Iran | 2 weeks | 66 | 45.4±10.33 | 47 | MD | 40 mg MP acetate | EPI |
| Aljabi <i>et al</i> . (2014) | United Arab Emirates | 1 month | 150 | 45.1±13.7 | 49.33 | MD | 80 mg MP Acetate | EPI |
| Aminmansour <i>et al</i> . (2006) | Iran | 2 months | 61 | 38.5±10.39 | 57.4 | MD | DMZ 40 mg in 20 cc syringe | IV |
| Bahari <i>et al</i> . (2010) | Ireland | 8 weeks | 100 | 39.3 (group 1); 42.7 (group 2); 41.8 (Group 3); 39.2 (Group 4) | 0.40 | MD | 10 mg of TAC acetonide or 10 mg of TAC acetonide | EPI |
| Debi <i>et al</i> . (2002) | Israel | 1 year | 61 | 40.9±12.14) | 70.5 | MD, LM | MP 80 mg acetate in 2 ml | EPI |
| Diaz <i>et al</i> . (2012) | Canada | 3 years | 201 | 51 | 59.70 | MD, LM | MP 80 mg acetate in 2 ml | EPI |
| Dikmen <i>et al</i> . (2005) | Turkey | NR | 31 | 42.5 | 52 | MD, LM | DMZ 8 mg | EPI |
| Glasser <i>et al.</i> (1993) | | 1 month | 32 | 46.1±4.2 | NR | MD, LM | 250 mg IV MP + 160 mg IM MP + 30 ml of 0.25% bupivacaine with 1:200,000,80 mg MP | IV, IM, EPI |
| Hurlbert <i>et al</i> . (1999) | USA | 3 months | 60 | 51 ± 3.3 | 61.67 | MD, LM | MP 80 mg, 1 mg morphine | EPI |
| Jirarattanaphochai <i>et al</i> . (2007) | Thailand | 3 months | 103 | 52.0±11.6 | 46.60 | MD, LM, PSF | MP 80 mg, 0.375% bupivacaine infiltrated | EPI |
| Langmayr <i>et al</i> . (1995) | Austria | 6 months | 26 | 43 | 76.92 | MD | Betamethasone 2 ml of IT | IT |
| Lotfinia <i>et al</i> . (2007) | Iran | 96 hours | 150 | 38.09 ± 0.86 | 44.67 | MD | MP 40 mg | EPI |
| Lundin <i>et al</i> . (2003) | Sweden | 2 years | 80 | 41.15 | 55 | MD | MP 160 mg IM and 250 mg IV MP sodium succinate + 80 mg MP | IV, IM, EPI |
| Manniche <i>et al</i> . (1994) | Denmark | 156 weeks | 93 | 40.47 | 68.82 | MD | PD 50 mg daily for fourteen days of surgery, then 25 mg daily for the following fourteen days | PO |
| McNeill <i>et al</i> . (2005) | USA | 48 hours | 166 | NR | 60.20 | MD, LM | MP 40 mg or 40 mg MP acetate + 5 mg morphine | EPI |
| Mirzai <i>et al</i> . (2002) | Turkey | 12 hours | 44 | 39.3 ± 8.26 | 56.81 | MD | 40 mg of MP | EPI |
| Modi <i>et al.</i> (2009) | Korea | Variable | 57 | 29.82±7.16 intervention); 30.14±8.15 (control) | 80.70 | MD | 40 mg of MP | EPI |
| Pobereskin <i>et al.</i> (2000) | United Kingdom | 24 hours | 93 | 44.5 (Control); 44.8 (Group 1); 46.3 (Group 2) | 50.53 | MD | TAC 40 mg/ml or 20 mg/ml OR 40 mg MP acetate + 5 mg Morphine | EPI |
| Rasmussen <i>et al</i> . (2008) | Denmark | 2 years | 200 | 42.5±7.02 | 61 | MD | 40 mg MP acetate | EPI |
| Watters <i>et al.</i> (1989) | USA | 1d | 20 | NR | 80 | MD | 6 mg of DMZ IV just before surgery and every 6 hours postop for four doses, followed by 4 mg orally every 6 hours for four doses, and finally 2 mg orally every 6 hours for four doses | IV, PO |

Abbreviations: MD, Microdiscectomy; PSF, pedicle screw fixation; EPI, epidural, IV, Intravenous; IT, Intrathecal; IM, intramuscular; PO, oral; MP, methylprednisolone; DMZ, Dexamethasone; Trimacinolone, TAC; prednisolone, PD; N/M, not mentioned; USA, United States of America

statistically significant with a P value of 0.003 [Figure 2]. Analysis showed similar trend at 1 month and for overall analysis.

Postoperative leg pain The overall analysis favored the use of epidural steroids for reduction of leg pain. The analysis

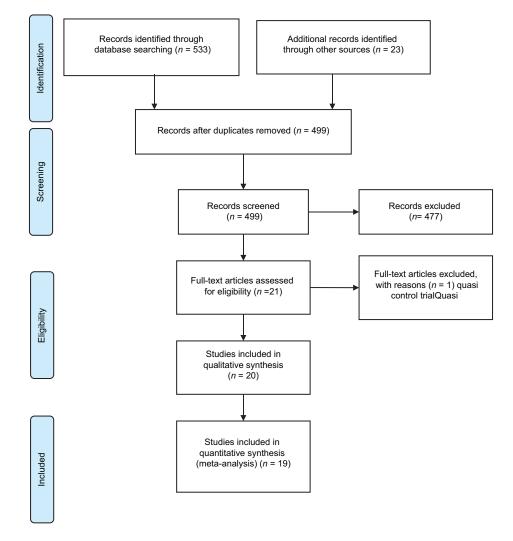


Figure 1: Prisma flow chart - study selection

showed significant pain reduction with epidural steroids at 1 week and 1 year. The overall effect favored steroid group with mean difference of -0.18 (-0.29, -0.07). Test for effect Z was 3.32 (*P* value = 0.001).

Length of hospital stay

The overall mean difference on LOS favored steroid group with a value of -0.93 (-1.31, -0.55), with a *P* value of 0.00001.

Return to work

The mean number of days for return to work favored the steroid group with a mean difference of -2.90 (95% CI - 3.94, -1.86).

Adverse events

Fifteen RCTs reported AEs and an odds ratio of 0.71 (95% CI: 0.41, 1.26) favored steroid group [Figure 3].

DISCUSSION

Perioperative steroids better control back and leg pain. The administration of perioperative steroids resulted in improved postoperative back pain and postoperative leg pain. The overall mean difference in postoperative back pain between the two groups was small and not statistically significant, i.e., -0.11 (CI - 0.25, 0.02), with a P value of 0.1. RCTs by Pobereskin et al.^[14] Bahari et al.,[4] and Aminmansour et al.[3] had two intervention groups assessing different regimens of steroids in comparison to controls. Each of the regimens by these three trials were analyzed separately [Figure 2]. Only one study by Lutfina et al.[11] assessed postoperative back pain at 48 and 72 hours, with a mean difference of +0.06 and +0.19favoring control groups. One RCT by Glasser et al. assessed postoperative back pain at one week with a mean difference of -0.43 (CI = -3.03, 2.17).

| 1.14 | | | - | | Control | 1 | | Mean Difference | | Mean Difference |
|---|-----------|----------|---------------------|----------|---------|-------------------|--|---|------|--|
| udy or Subgroup | Меап | \$D | Total | Mean | \$D | Total | Weight | IV, Random, 95% CI | Year | IV, Random, 95% CI |
| L1 24-hour post-op | | | ÷ | | | ÷ | ÷ | · · | | |
| lasser et al | 3.33 | | 9 | 6.07 | | 14 | | -2.74 [-5.50, 0.02] | | |
| obereskin et al (40mg Trimacinolone) | | 0.0525 | 31 | | 0.0975 | 31 | | -0.21 [-0.25, -0.17] | | |
| obereskin et al (20mg Trimacinolone) | 0.15 | 0.07 | 31 | | 0.0975 | 31 | 12.1% | -0.18 [-0.22, -0.14] | 2000 | |
| minmansour et al (80mg) | 2.85 | 1.76 | 20 | 2.73 | 2.35 | 22 | 1.1% | 0.12 [-1.13, 1.37] | 2006 | |
| minmansour et al (40mg) | 2.32 | 1.64 | 19 | 2.73 | 2.35 | 22 | 1.1% | -0.41 [-1.64, 0.82] | 2006 | allow a set |
| otfinia et al | 4.64 | 0.22 | 50 | 4.63 | 0.34 | 100 | 11.6% | 0.01 [-0.08, 0.10] | 2007 | |
| ahari et al (Triamcinolone + Bupivacaine) | 0.68 | 0.98 | 25 | 1.56 | 1.5 | 25 | 2.8% | -0.88 [-1.58, -0.18] | 2010 | |
| hari et al (Triamcinolone only) | 2.04 | 1.69 | 25 | 3.24 | 1.73 | 25 | 1.7% | -1.20 [-2.15, -0.25] | 2010 | |
| rishamkar et al btotal (95% CI) | 1.31 | 1.35 | 22 232 | 1.13 | 1 | 44 314 | | 0.18 [-0.46, 0.82] | 2011 | |
| erogeneity: Tau ² = 0.01; Chi ² = 32.41, | df = 8 (| P < 0.00 | 01): I ² | - 75% | | | A | | J | |
| for overall effect: $Z = 2.99$ (P = 0.003 | | | -,, . | | | | | | | 167 |
| .2 48-hour post-op | | | | | | | | | - | |
| inia et al Itotal (95% CI) | 3.84 | 0.17 | 50 50 | 3.78 | 0.37 | 100 100 | | 0.06 [-0.03, 0.15] 0.06 [-0.03, 0.15] | 2007 | |
| erogeneity. Not applicable | | | - | 1 | | - | A | Anna | - | |
| for overall effect: $Z = 1.36 (P = 0.17)$ | | | | | | | | | | S. 11 11 11 |
| .3 72-hour post-op | | | | | | | | | | |
| inia et al Itotal (95% CI) | 3.22 | 0.17 | 50 50 | 3.03 | 0.17 | 100 100 | 11.9% 11.9% | 0.19 [0.13, 0.25] 0.19 [0.13, 0.25] | 2007 | |
| erogeneity. Not applicable | | | | | | | | | | And the second second |
| for overall effect: $Z = 6.45$ (P < 0.000 | 01) | | | | | | | | | Contraction of the second seco |
| A 1-week post-op | - | ~~~~ | ~ | - | 1- | × | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ | | -1 | |
| sser et al Itotal (95% CI) | 2.78 | 2.64 | 9 9 | 3.21 | 3.72 | 14 14 | 0.3% 0.3% | | 1993 | |
| terogeneity: Not applicable st for overall effect: Z = 0.32 (P = 0.75) | | | | | | | ~ | | | |
| 1.5 1-month post-op | | | | | | | | | | |
| asser et al | 2.22 | | 9 | 1.79 | | 14 | 0.3% | 0.43 [-1.96, 2.82] | | |
| di et al | 2.54 | 0.2 | 29 | 3.03 | 0.17 | 28 | | -0.49 [-0.59, -0.39] | 2009 | |
| total (95% CI) erogeneity: Tau ² = 0.00; Chi ² = 0.57, d | f = 1 (P | = 0.45); | | 6 | | 42 | 11.8% | -0.49 [-0.58, -0.39] | | |
| t for overall effect: Z = 9.96 (P < 0.000 | 01) | | | | | | | | | 200 |
| .6 1-year post-op | | | | | | | | | - | |
| mussen et al | 4.67 | 1.22 | 100 | 4.67 | 1.28 | 100 | 6.8% | 0.00 [-0.35, 0.35] | 2008 | + |
| | 3.37 | 0.16 | 29 129 | 3.3 | | | 11.5% 18.3% | 0.07 [-0.02, 0.16] 0.07 [-0.03, 0.16] | | |
| di et al | | | | | | 140 | 10.37 | 0.07 [-0.03, 0.16] | 1000 | |
| di et al Itotal (95% CI) | r _ 1 m | | - = 02 | • | | - | | | | |
| di et al btotal (95% CI) terogeneity: Tau ² = 0.00; Chi ² = 0.15, d | lf = 1 (P | = 0.70); | - | | | | | and the second se | | |
| odi et al Jototal (95% CI) eterogeneity: Tau ² = 0.00; Chi ² = 0.15, d est for overall effect: Z = 1.41 (P = 0.16) otal (95% CI) | lf = 1 (P | = 0.70); | 508 | ٢., | - | 698 | 100.0% | -0.11 [-0.25, 0.02] |) (ش | |
| odi et al I btotal (95% CI) eterogeneity: Tau ² = 0.00; Chi ² = 0.15, d Ist for overall effect: Z = 1.41 (P = 0.16) | E | | | ; ² = ≤ | 4% | 698 | 100.0% | -0.11 [-0.25, 0.02] |)â | -4 -5 0 -5 |

Figure 2: Forest plot - meta-analysis of postoperative back pain

The overall effect Z was 0.32 (*P* value = 0.75). Two RCTs by Glasser *et al.*^[7] and Modi *et al.*^[13] assessed postoperative back pain at 1 month, with a mean difference of -0.49 (CI = -0.58, -0.39) favoring steroid group. Two RCTs by Rasmussen *et al.*^[16] and Modi *et al.*^[13] assessed postoperative back pain at 1 year, with a mean difference 0.07 (CI = -0.03, 0.16).

Analysis favored the steroid group for better postoperative leg pain control at 1 week and 1 year postoperatively [Figure 4].

RCT by Aminmansour *et al.*^[3] studied two steroid regimens, which we analyzed separately. Mean difference was -0.19 (CI = -0.42, 0.04). Overall effect Z was 1.59 (*P* value = 0.11). Three RCTs assessed postoperative leg pain at 48 hours. Mean difference between steroid and control group was 0.07 (CI = -0.30, 0.45). The effect Z was 0.39 (*P* value = 0.70). Three RCTs assessed postoperative leg pain at 1 week, with a mean

difference of -0.05 (-0.07, -0.03). Test for overall effect Z was 4.25 with a significant *P* value of <0.001. Mean differences for postoperative leg pain at 72 hours and 1 month were not statistically significant between the groups. Rasmussen *et al.* assessed postoperative leg pain at 1 year, with a mean difference of -2.33 (CI = -2.58, -2.08).

Perioperative steroids reduce length of stay

Patients receiving perioperative steroids exhibited shorter LOS. Eight of the nine RCTs included in analysis showed shorter hospital stay in steroid group with mean difference of -0.93 (-1.31, -0.55) [Figure 5].

Perioperative steroids reduced time to return to work

Only one RCT by Aljabi *et al.*^[2] evaluated time for return to activity and favored steroid group [Figure 6]. Fifteen RCTs did not show an increase in adverse

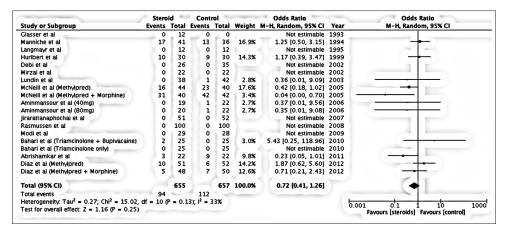


Figure 3: Forest plot - meta-analysis of adverse effects

| Study or Subgroup | S Mean | Steroid SD | Total | | Control SD | Total | Weight | Mean Difference IV, Random, 95% CI | Year | Mean Difference IV, Random, 95% CI |
|---|---|--|--|--------------------------|---|---------------------|--|--|--------------------|--|
| 1.2.1 24-hour post-op | ~ | | · | | | | - | | × | |
| Glasser et al | 1.67 | 3.54 | 9 | 3.21 | 3.72 | 14 | 0.1% | -1 54 [-4 56, 1 48] | 1993 | |
| Langmayr et al | | 0.047 | 13 | | 0.061 | 13 | | -0.24 [-0.28, -0.20] | | and the second s |
| Aminmansour et al (40mg) | 1.16 | 1.24 | 19 | 2.82 | | 22 | | -1.66 [-2.91, -0.41] | | |
| Aminmansour et al (80mg) | 1.15 | 1.14 | 20 | 2.82 | 2.67 | 22 | | -1.67 [-2.89, -0.45] | | the first second s |
| Lotfinia et al | 2.88 | 0.22 | 50 | 2.82 | 0.24 | 100 | 7.8% | | | |
| | | | 50 | | | 52 | | | | |
| Jirarattanaphochal et al | | | | - | 0.5 | | 6.5% | 0.00 [-0.19, 0.19] | | _I |
| Abrishamkar et al | 0.63 | 0.78 | 22 184 | | 1.01 | 44 | 3.5% | | | Ţ |
| Subtotal (95% CI) | | | | | | 267 | 27.3% | -0.19 [-0.42, 0.04] | proved in | |
| Heterogeneity: Tau ² = 0.05 | | | л = б (| ۲ < 0.0 | 0001); | • = 919 | 6 | Contraction of the local division of the loc | | Sec.277 19 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 |
| Test for overall effect: $Z = 1$ | 59 (P = | 0.11) | 1000 | | - | | | | | |
| 1.2.2 48-hour post-op | | | | | | | | | | |
| Langmayr et al | 0.15 | 0.036 | 13 | 0.29 | 0.056 | 13 | 8.0% | -0.14 [-0.18, -0.10] | 1995 | · · · · · · · · · · · · · · · · · · · |
| Lotfinia et al | 2.56 | 0.23 | 50 | | 0.27 | 100 | 7.7% | | | • |
| lirarattanaphochal et al | 1 | 0.5 | 51 | 1 | | 52 | 6.5% | 0.00 [-0.19, 0.19] | | |
| Subtotal (95% CI) | | A | 114 | M., * | A | 165 | 22.2% | 0.07 [-0.30, 0.45] | | |
| Heterogeneity: $Tau^2 = 0.10$ | | 117 84 | | (P < O | 000011 | - | | | 1 | T |
| Test for overall effect: $Z = 0$ | | | ui = 2 | | | , - 90 | 570 | | | |
| 1.2.3 72-hour post-op | | | | | | | - | | - | |
| Langmayr et al | 0.11 | 0.039 | 13 | 0.74 | 0.056 | 13 | 8 0% | -0.13 [-0.17, -0.09] | 1005 | |
| jirarattanaphochal et al | 2 | 0.039 | | 2 | | 52 | 5.7% | 0.00 [-0.25, 0.25] | | 1 |
| | _ | | | _ | | 100 | 5.7% 7.9% | | | Т |
| Lotfinia et al Subtotal (95% CI) | 1.46 | 0.18 | 114 | 1.43 | 0.2 | 100 165 | 21.6% | | 2007 | |
| | Ch12 | 10.70 | | | | | \$1.0X | -0.04 [-0.18, 0.09] | prove and a second | |
| Heterogeneity: Tau ² = 0.01 Test for overall effect: $Z = 0$ | | | JI = 2 () | r < 0.0 | 1001î, h | = 89% | _ | | | |
| 1.2.4 1-week post-op | | | | | | | | | | A statement of the stat |
| Glasser et al | 1.67 | 2.5 | 9 | 2.86 | 3.78 | 14 | 0.2% | -1.19 [-3.76, 1.38] | 1993 | |
| Langmayr et al | | 0.013 | 13 | 0.1 | | 13 | | -0.05 [-0.07, -0.03] | | and the second sec |
| | 1 | | 51 | 1 | | 52 | | 0.00 [-0.15, 0.15] | | + |
| | | 0.20 | | 10. T | 0.5 | 79 | | -0.05 [-0.07, -0.03] | | |
| Jirarattanaphochal et al Subtotal (95% CI) | - | | 15 | | | | | | | |
| Subtotal (95% CI) | | 1 16 4 | 73 | - 0.54 | D: 12 - 0 | 4 | | -0.03 [-0.07, -0.03] | _ | All the second s |
| Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 | ; Chl² = : | | = 2 (P | = 0.56 | 5); I ² = 0 | % | _ | | _ | 100 |
| Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 Test for overall effect: Z = 4 | ; Chl² = : | | = 2 (P | = 0.5¢ | 5); ² = 0 | 66 | | -0.03 [-0.07, -0.03] | | |
| Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 Test for overall effect: Z = 4 1.2.5 1-month post-op | ; Chl² = : 4.25 (P < | 0.0001 | r = 2 (P 1) | | | | | | _ | |
| Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 Test for overall effect: Z = 4 1.2.5 1-month post-op Glasser et al | ; Chl² = : 4.25 (P < 0.56 | 1.67 | r = 2 (P 1) 9 | 1.43 | 3.06 | 14 | 0.3% | -0.87 [-2.81, 1.07] | 1993 | |
| Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 Test for overall effect: Z = 4 1.2.5 1-month post-op Glasser et al Jirarattanaphochal et al | ; Chl² = : 4.25 (P < | 0.0001 | r = 2 (P l) 9 51 | 1.43 | | 14 52 | 0.3% 7.6% | -0.87 [-2.81, 1.07] 0.00 [-0.10, 0.10] | 1993 | |
| Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 Test for overall effect: Z = 4 1.2.5 1-month post-op Glasser et al | ; Chl ² = : 4.25 (P < 0.56 0 | 1.67 0.25 | 9 51 60 | 1.43 0 | 3.06 0.25 | 14 52 66 | 0.3% | -0.87 [-2.81, 1.07] | 1993 | |
| Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 Test for overall effect: Z = 4 1.2.5 1-month post-op Glasser et al Jirarattanaphochal et al Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 | ; Chl ² = : 4.25 (P < 0.56 0 ; Chl ² = 0 | 1.67 0.25 0.77, df | 9 51 60 | 1.43 0 | 3.06 0.25 | 14 52 66 | 0.3% 7.6% | -0.87 [-2.81, 1.07] 0.00 [-0.10, 0.10] | 1993 | |
| Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 Test for overall effect: Z = 4 1.2.5 1-month post-op Glasser et al Jirarattanaphochal et al Subtotal (95% CI) | ; Chl ² = : 4.25 (P < 0.56 0 ; Chl ² = 0 | 1.67 0.25 0.77, df | 9 51 60 | 1.43 0 | 3.06 0.25 | 14 52 66 | 0.3% 7.6% | -0.87 [-2.81, 1.07] 0.00 [-0.10, 0.10] | 1993 | |
| Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 Test for overall effect: Z = 4 12.5 1-month post-op Glasser et al Jirarattanaphochal et al Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 Test for overall effect: Z = 0 1.2.6 1-year post-op | ; Chl ² = : 4.25 (P < 0.56 0 ; Chl ² = (0.04 (P = | 1.67 0.25 0.77, df | 9 51 60 7 = 1 (P | 1.43 0 = 0.38 | 3.06 0.25 3); I ² = 0 | 14 52 66 | 0.3% 7.6% 7.9% | -0.87 [-2.81, 1.07] 0.00 [-0.10, 0.10] -0.00 [-0.10, 0.09] | 1993 2007 | |
| Subtotal (95% CI) Heterogeneity Tau ² = 0.00 Test for overall effect: Z = 4 1.2.5 1-month post-op Glasser et al Jirarattanaphochal et al Subtotal (95% CI) Heterogeneity Tau ² = 0.00 Test for overall effect: Z = C 1.2.6 1-year post-op Rasmussen et al Subtotal (95% CI) | ; Chi ² = ; 4.25 (P < 0.56 0 ; Chi ² = (0.04 (P = 1.67 | 1.67 0.25 0.77, df | 9 51 60 | 1.43 0 = 0.38 | 3.06 0.25 | 14 52 66 | 0.3% 7.6% 7.9% 5.7% | -0.87 [-2.81, 1.07] 0.00 [-0.10, 0.10] | 1993 2007 | |
| Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 Test for overall effect: Z = 4 12.5 1-month post-op Glasser et al Jirarattanaphochal et al Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 Test for overall effect: Z = 0 | ; Chi ² = ; 4.25 (P < 0.56 0 ; Chi ² = (0.04 (P = 1.67 | 1.67 0.25 0.77, df | y = 2 (P y 51 60 y = 1 (P 100 | 1.43 0 = 0.38 | 3.06 0.25 3); I ² = 0 | 14 52 66 | 0.3% 7.6% 7.9% 5.7% | -0.87 [-2.81, 1.07] 0.00 [-0.10, 0.10] -0.00 [-0.10, 0.09] -2.33 [-2.58, -2.08] | 1993 2007 | |
| Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 Test for overall effect: Z = 4 1.2.5 1-month post-op Glasser et al Jirarattanaphochal et al Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 Test for overall effect: Z = C 1.2.6 1-year post-op Rasmussen et al Subtotal (95% CI) | ; Chi ² = ; 4.25 (P < 0.56 0 ; Chi ² = (0.04 (P = 1.67 | 1.67 0.25 0.77, df 0.97) 0.67 | 9 51 60 7 = 1 (P 100 100 | 1.43 0 = 0.38 | 3.06 0.25 3); I ² = 0 | 14 52 66 | 0.3% 7.6% 7.9% 5.7% | -0.87 [-2.81, 1.07] 0.00 [-0.10, 0.10] -0.00 [-0.10, 0.09] -2.33 [-2.58, -2.08] | 1993 2007 | |
| Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 Test for overall effect: Z = 4 1.2.5 1-month post-op Glasser et al Jirarattanaphochal et al Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 Test for overall effect: Z = C 1.2.6 1-year post-op Rasmussen et al Subtotal (95% CI) Heterogeneity: Not applicab | ; Chi ² = ; 4.25 (P < 0.56 0 ; Chi ² = (0.04 (P = 1.67 | 1.67 0.25 0.77, df 0.97) 0.67 | 9 51 60 7 = 1 (P 100 100 | 1.43 0 = 0.38 | 3.06 0.25 3); I ² = 0 | 14 52 66 % | 0.3% 7.6% 7.9% 5.7% 5.7% | -0.87 [-2.81, 1.07] 0.00 [-0.10, 0.10] -0.00 [-0.10, 0.09] -2.33 [-2.58, -2.08] | 1993 2007 | |
| Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 Test for overall effect: Z = 4 1.2.5 1-month post-op Glasser et al Jirarattanaphochal et al Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 Test for overall effect: Z = 0 1.2.6 1-year post-op Rasmussen et al Subtotal (95% CI) Heterogeneity: Not applicab Test for overall effect: Z = 1 Total (95% CI) | (; Chi2 = :4.25 (P < 0.56 0)(; Chi2 = (0.04 (P = 1.67 0))1.67 0)1.67 0) | : 0.0001 1.67 0.25 0.77, df 0.97) 0.67 < 0.000 | <pre>9 = 2 (P 1) 9 51 60 7 = 1 (P 100 100 001) 645</pre> | 1.43 0 = 0.38 4 | 3.06 0.25 3); I ² = 0 1.057 | 14 52 66 % | 0.3% 7.6% 7.9% 5.7% 5.7% | -0.87 [-2.81, 1.07] 0.00 [-0.10, 0.10] -0.00 [-0.10, 0.09] -2.33 [-2.58, -2.08] -2.33 [-2.58, -2.08] | 1993 2007 | |
| Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 Test for overall effect: Z = 4 12.5 1-month post-op Glasser et al Jirarattanaphochal et al Subtotal (95% CI) Heterogeneity: Tau ² = 0.00 Test for overall effect: Z = 0 12.6 1-year post-op Rasmussen et al Subtotal (95% CI) Heterogeneity: Not applicab Test for overall effect: Z = 1 | ; Chi ² = ; 4.25 (P < 0.56 0 ; Chi ² = (0.04 (P = 1.67 1.67 1.67 1.67 ; Chi ² = (| : 0.0001 1.67 0.25 0.77, df 0.97) 0.67 < 0.000 \$60.30, | (= 2 (P) 9 51 60 (= 1 (P 100 100 001) 645 df = 1; | 1.43 0 = 0.38 4 | 3.06 0.25 3); I ² = 0 1.057 | 14 52 66 % | 0.3% 7.6% 7.9% 5.7% 5.7% | -0.87 [-2.81, 1.07] 0.00 [-0.10, 0.10] -0.00 [-0.10, 0.09] -2.33 [-2.58, -2.08] -2.33 [-2.58, -2.08] | 1993 2007 | Favours [steroids] Favours [control] |

Figure 4: Forest plot - meta-analysis of postoperative leg pain

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| | \$ | teroid | | c | ontrol | | | Mean Difference | | Mean Difference |
|--|----------|----------|--------|----------------------|--------|-------|--------|----------------------|------|---|
| Study or Subgroup | Mean | SD | Total | Mean | SD | Total | Weight | IV, Random, 95% CI | Year | IV, Random, 95% CI |
| Watters et al | 1.9 | 0 | 10 | 2.5 | 0 | 10 | | Not estimable | 1989 | |
| Glasser et al | 1.4 | 0.1 | 12 | 3.25 | 0.94 | 20 | 10.0% | -1.85 [-2.27, -1.43] | 1993 | |
| luribert et al | 1.8 | 1.1 | 30 | 1.7 | 1.1 | 30 | 9.1% | 0.10 [-0.46, 0.66] | 1999 | |
| obereskin et al (20mg Trimacinolone) | 1.22 | 0.42 | 31 | 1.48 | 0.57 | 31 | 10.8% | -0.26 [-0.51, -0.01] | 2000 | |
| bereskin et al (40mg Trimacinolone) | 1.16 | 0.37 | 31 | 1.48 | 0.57 | 31 | 10.8% | -0.32 [-0.56, -0.08] | 2000 | |
| Indin et al | 1.7 | 0 | 38 | 2.3 | 0 | 42 | | Not estimable | 2003 | and the second se |
| asmussen et al | 6 | 1 | 100 | 8 | 1.17 | 100 | 10.6% | -2.00 [-2.30, -1.70] | 2008 | |
| ahari et al (Triamcinolone only) | 2.3 | 1.2 | 25 | 2.8 | 1.4 | 25 | 8.0% | -0.50 [-1.22, 0.22] | 2010 | |
| ahari et al (Triamcinolone + Bupivacaine) | 1.9 | 1 | 25 | 2.3 | 1.6 | 25 | 7.9% | -0.40 [-1.14, 0.34] | 2010 | |
| az et al (Methylpred + Morphine) | 1.7 | 0.25 | 48 | 3 | 0.21 | 50 | 11.3% | -1.30 [-1.39, -1.21] | 2012 | • |
| az et al (Methylpred) | 2.4 | 0.125 | 51 | 3 | 0.25 | 52 | 11.3% | -0.60 [-0.68, -0.52] | 2012 | • |
| jabi et al | 1.3 | 0.9 | 75 | 3.2 | 1.2 | 75 | 10.4% | -1.90 [-2.24, -1.56] | 2014 | |
| otal (95% CI) | | | 476 | | | 491 | 100.0% | -0.93 [-1.31, -0.55] | | ◆ |
| eterogeneity: Tau ² = 0.33; Chi ² = 300.52 | . df = 9 | (P < 0.) | 00001) | : I ² = 9 | 7% | | | | - | |
| est for overall effect: $Z = 4.85$ (P < 0.000 | | | | | | | | | | -2 -1 0 1 2 |
| Test for overall effect: $Z = 4.85$ (P < 0.000 | 01) | | | | | | | | | Favours [steroids] Favours [control] |



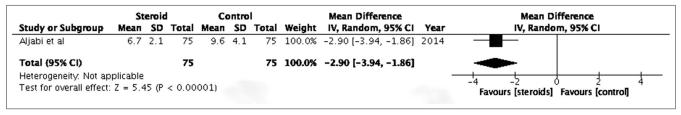


Figure 6: Forest plot - meta-analysis of return to work

events for patients receiving steroid (e.g., indicating the safety of epidural steroids in surgery). However, there were considerable differences in what was defined as an adverse event by different RCTs.

Quality of randomized controlled trials

The quality of RCTs was assessed using a standardized 6-point scale specifically designed for systematic reviews. Only three RCTs conducted by investigators Diaz,^[6] Hurlbert,^[10] and Lundin *et al.*^[12] had the maximum score. Another limitation of the RCTs was heterogeneity of outcomes. Most RCTs focused on short-term control of back and leg pain, and only two RCTs by Rasmussen *et al.*^[16] and Modi *et al.*^[13] assessed pain control at 1 year. Moreover, the method of reporting different variables also varied between different RCTs. For numerical data, some trials reported medians, which required conversion into means for analysis. This statistical problem was solved with the help of Cochrane Collaboration guidelines and article by Hozo.^[9,18]

Previous systematic reviews on the topic had several limitations. The review by Ranguis *et al.* in 2010 missed several key trials^[15] and did not distinguish microdiscectomy from laminectomy, which are two different procedures. It also did not analyze steroids administered intravenously or in oral form. Another review by Akinduro *et al.*^[1] only examined the complications related to steroid use^[1] addressing postoperative pain as a secondary outcome with no meta-analysis.

CONCLUSION

Intraoperative epidural steroid administration offers some benefit in pain control with a significant reduction in LOS. However, there is insufficient evidence to support the routine use of oral and intravenous steroids in the perioperative period.

Financial support and sponsorship Nil.

Conflicts of interest

There are no conflicts of interest.

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APPENDIX I: SEARCH STRATEGY

- NLM PubMed:
- (("lumbar disc surgery"[All Fields] AND (("prednisolone"[MeSH Terms] OR "prednisolone"[All Fields]) OR ("methylprednisolone"[MeSH Terms] OR "methylprednisolone"[All Fields]) OR ("dexamethasone"[MeSH Terms] OR "dexamethasone"[All Fields]))) OR ("lumbar disc surgery"[All Fields] AND (("postoperative period"[MeSH Terms] OR "dexamethasone"[All Fields] AND "period"[All Fields]) OR "postoperative period"[All Fields] OR ("postoperative"[All Fields]) OR "postoperative period"[All Fields] OR ("post"[All Fields]) OR "postoperative period"[All Fields] OR ("postoperative"[All Fields]) OR "postoperative period"[All Fields] OR "postoperative"[All Fields]) OR "postoperative period"[All Fields] OR "postoperative"[All Fields]) OR "postoperative period"[All Fields] OR "postoperative"[All Fields]) OR "postoperative"[All Fields] OR "postoperative"[All Fields]]))) OR ((("lumbosacral region"[MeSH Terms] OR ("lumbosacral"[All Fields] AND "period"[All Fields]) OR "postoperative period"[All Fields] AND "region"[All Fields]] OR "lumbar"[All Fields]) AND disc[All Fields] AND "surgery"[Subheading] OR "surgery"[All Fields] OR "surgical procedures, operative"[MeSH Terms] OR ("surgical"[All Fields] AND "procedures"[All Fields] AND "operative"[All Fields]) OR "operative surgical procedures"[All Fields] OR "surgery"[All Fields] OR "surgery"[All Fields]] OR "general surgery"[All Fields] OR "general surgery"[All Fields]] OR "general surgery"[All Fields]] OR "general surgery"[All Fields]] OR "steroids"[All Fields]] OR "general surgery"[All Fields]] OR "steroids"[All Fields]])) OR ("lumbar disc surgery"[All Fields]]) OR "steroids"[All Fields]])) OR ("lumbar disc surgery"[All Fields]])) OR ("fumbar disc surgery"[All Fields]])) OR ("fumbar disc surgery"[All Fields]]))
- CENTRAL (Cochrane)
 - Lumbar disc surgery AND steroid
 - CINAHL PLUS (EBSCOHOST)
 - Lumbar disc surgery AND steroid