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Efficacy and safety of lateral lumbar interbody fusion for lumbar degenerative diseases with or without auxiliary posterior fixation: a meta-analysis and systematic review

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Abstract

Background There is no conclusive evidence from evidence-based medicine that clarifies whether the efficacy and safety of lateral lumbar interbody fusion (LLIF) differ significantly with or without auxiliary posterior fixation. This study embarks on a comprehensive comparative meta-analysis, delving into both domestic and international research landscapes, to scrutinize the efficacy of stand-alone LLIF versus LLIF coupled with auxiliary posterior fixation in the treatment of degenerative lumbar diseases.

Methods In this meta-analysis, we searched Pubmed, Embase, and Cochrane databases from inception to December 2023. This study includes research comparing LLIF combined with auxiliary posterior fixation versus stand-alone LLIF in the treatment of lumbar degenerative disease. and we excluded studies without full-text or for which data extraction was not possible; studies using animal studies; reviews and systematic reviews. Review manager 5.3 software was used to analyze the data.

Results Twelve literatures are included in this study, all of which are cohort studies. The sample sizes varied between 30 and 132, totaling 781 patients, of which 440 belonged to the group with posterior fixation, and 224 to the stand-alone group. Findings revealed a significantly higher fusion rate when LLIF was combined with auxiliary posterior fixation compared to stand-alone LLIF. Additionally, postoperative disc height and restoration in segmental lordosis of LLIF combined with auxiliary posterior fixation were all significantly higher than that of stand-alone LLIF. However, postoperative VAS score for LLIF combined with auxiliary posterior fixation is significantly higher than that for stand-alone LLIF. There were no significant differences in the restoration of lumbar lordosis, the ODI and incidence of adverse events.

Conclusions In summary, compared to standalone LLIF, the combination of LLIF with auxiliary posterior fixation exhibits a higher postoperative fusion rate. Additionally, both postoperative disc height and restoration of segmental lordosis are significantly greater. Although the occurrence of adverse reactions is consistent between the two surgical approaches, the LLIF combined with auxiliary posterior fixation approach demonstrates a lower reoperation rate.

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Keywords Lumbar degenerative diseases, LLIF, Auxiliary posterior fixation, Efficacy and safety, Meta-analysis and systematic review

Introduction

Degenerative conditions affecting the lumbar spine stand out as some of the most prevalent issues in spinal health. These conditions give rise to symptoms including persistent lower back pain, radiating discomfort down the legs, and constraints on mobility. The repercussions extend beyond mere physical discomfort, significantly influencing the overall quality of life for those affected [1]. Lumbar interbody fusion techniques represent widely employed surgical methods for addressing degenerative conditions of the lumbar spine [2]. Lateral lumbar interbody fusion (LLIF) is an evolving surgical technique designed to access the lumbar spine from the side. This approach involves navigating through or avoiding the extensive muscles of the lower back, and it is employed for the treatment of degenerative lumbar spine conditions. LLIF includes a variety of variations, such as extreme lateral interbody fusion (XLIF), oblique lateral interbody fusion (OLIF), crenel lateral interbody fusion (CLIF), direct lateral interbody fusion (DLIF), and lateral-anterior lumbar interbody fusion (LaLIF), among other methods [3–5]. In contrast to traditional surgical approaches, LLIF not only facilitates the placement of more substantial interbody fusion devices but also serves to safeguard the integrity of back muscles, ligaments, and surrounding structures. This innovative technique significantly diminishes the risk of major vascular injuries. Consequently, LLIF is rapidly gaining prominence as a preferred method for addressing degenerative lumbar diseases, owing to its enhanced safety profile and superior protection of anatomical structures [3, 6]. LLIF is frequently complemented by the addition of lateral instrumentation applied through the same transpsoas approach or posterior percutaneous pedicle screw fixation administered through a distinct posterior approach. The incorporation of supplementary instrumentation of either type is commonly undertaken with the aim of mitigating the risks associated with graft subsidence, pseudarthrosis, and the need for reoperation [7]. However, to date, there is no conclusive evidence from evidence-based medicine that clarifies whether the efficacy and safety of LLIF differ significantly with or without auxiliary posterior fixation. This study embarks on a comprehensive comparative meta-analysis, delving into both domestic and international research landscapes, to scrutinize the efficacy and safety of stand-alone LLIF versus LLIF coupled with auxiliary posterior fixation in the treatment of degenerative lumbar diseases. The overarching objective is to distill invaluable insights that can significantly shape and guide clinical decision-making, offering a nuanced perspective to navigate the complexities of treating degenerative lumbar conditions.

Materials and methods

Inclusion and exclusion criteria

Inclusion criteria

1) Subjects: Patients diagnosed with lumbar degenerative disease.
2) Intervention measure: LLIF combined with auxiliary posterior fixation.
3) Control: Stand-alone LLIF.
4) Outcome indicators: Fusion rate, postoperative disc height, restoration of segmental lordosis, restoration of lumbar lordosis, postoperative VAS score, postoperative Oswestry Disability Index (ODI), reoperation rate and incidence of adverse events.
5) Study design: Randomized controlled trial (RCT) and cohort study.

Exclusion criteria

Duplicate publications; Studies with unavailable full texts or where data extraction was not feasible; Animal studies; Reviews and systematic reviews.

Search strategy

For this meta-analysis, we conducted searches in PubMed, Embase and the Cochrane Library databases from their inception until December 2023. The search terms used were: "lateral lumbar interbody fusion" "extreme lateral interbody fusion" "direct lateral interbody fusion" "oblique lateral interbody fusion" "crenel lateral interbody fusion" "lateral-anterior lumbar interbody fusion" AND "stand-alone" AND "fixation" "instrumentation".

Literature screening and data extraction

Two researchers were responsible for information retrieval, screening, and data extraction. Any questions or discrepancies were resolved through consultation with a third researcher. The collected information included the following: author, year of publication, study type, sample size, number of levels treated, age, sex, BMI, follow-up duration, and outcome indicators.

Literature quality assessment

Two researchers independently conducted literature quality evaluations using the Newcastle-Ottawa Scale (NOS) for cohort study [8]. The Newcastle-Ottawa Scale

(NOS) includes four items (4 points) for "Research Subject Selection" one item (2 points) for "Comparability between Groups," and three items (3 points) for "Outcome Measurement" resulting in a total score of 9 points. A score of ≥7 is considered high-quality literature, while a score of <7 is classified as lower-quality literature. In cases of disagreement, a consensus is reached through discussion or consultation with a third party. The meta-analysis was conducted in accordance with the relevant items of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [9].

Data synthesis and statistical analysis

Data were analyzed using Review Manager 5.3. The I^2 statistic was employed to assess heterogeneity among studies. If the heterogeneity test yielded $P \geq 0.1$ and $I^2 \leq 50\%$, homogeneity was indicated, and the studies were analyzed together using a fixed-effects model. Conversely, if $P < 0.1$ and $I^2 > 50\%$, significant heterogeneity was indicated; in such cases, sensitivity analysis was conducted to identify the source of the difference. A random-effects model was used for effect pooling in this meta-analysis. Publication bias was assessed using funnel plots.

Results

Literature search results

A total of 126 articles were collected for this study. After excluding duplicate studies, 65 studies were included in this study. A total of 48 articles were identified after reading their titles and abstracts. Finally, 12 studies were included in the meta-analysis (Fig. 1).

Baseline characteristics and quality assessment of the included studies

Twelve literatures are included in this study, all of which are cohort studies. Four of the patients were from the USA, three from Australia, and the rest from China. The sample sizes varied between 30 and 132, totaling 781 patients, of which 440 belonged to the group with posterior fixation, and 224 to the stand-alone group. The age of patients in the with posterior fixation group ranged from 50.2 to 67.2, while in the stand-alone group, it ranged from 51.8 to 67.0. The follow-up duration ranged from 11.5 to 24 months. The NOS scores used for quality assessment were all >7 and met the requirements (Tables 1 and 2).

Meta-analysis results

Efficacy

Fusion rate Seven articles investigated the fusion rates between LLIF combined with auxiliary posterior fixation and stand-alone LLIF. Due to the presence of significant heterogeneity (I^2=46.0%, $P = 0.08$), a random-effects model was utilized for the meta-analysis. The findings revealed a significantly higher fusion rate in cases where LLIF was combined with auxiliary posterior fixation compared to stand-alone LLIF (OR = 2.41, 95% CI: 1.06 to 7.99, $P = 0.04$) (Fig. 2; Table 3). The evidence levels for the results are shown in Table 4.

Postoperative disc height Five articles investigated the postoperative disc height between LLIF combined with auxiliary posterior fixation and stand-alone LLIF. As no significant heterogeneity was observed (I^2=43.0%, $P = 0.13$), a fixed-effect model was employed for the meta-analysis. The pooled results show that the postoperative disc height of LLIF combined with auxiliary posterior fixation is significantly higher than that of standalone LLIF (MD = 1.02, 95%CI: 0.71 to 1.32, $P < 0.00001$) (Fig. 3; Table 3). The evidence levels for the results are shown in Table 4.

Restoration of segmental lordosis Five articles examined the restoration in segmental lordosis from preoperative to the last follow-up. Due to significant heterogeneity (I^2=58.0%, $P = 0.05$), a random-effects model was utilized for the meta-analysis. The pooled results demonstrated a statistically significant higher improvement in segmental lordosis in cases where LLIF was combined with auxiliary posterior fixation compared to stand-alone LLIF (MD = 2.14, 95% CI: 0.53 to 3.75, $P = 0.009$) (Fig. 4; Table 3). The evidence levels for the results are shown in Table 4.

Restoration of lumbar lordosis Five articles examined the restoration in lumbar lordosis from preoperative to the last follow-up. As no significant heterogeneity was observed (I^2=37.0%, $P = 0.18$), a fixed-effects model was employed for the meta-analysis. The combined results indicated no statistically significant difference in the restoration of lumbar lordosis between cases where LLIF was combined with auxiliary posterior fixation and stand-alone LLIF (MD = 1.61, 95% CI: -0.12 to 3.33, $P = 0.07$) (Fig. 5; Table 3). The evidence levels for the results are shown in Table 4.

Postoperative ODI Four articles investigated the postoperative ODI between LLIF combined with auxiliary posterior fixation and stand-alone LLIF. Due to significant heterogeneity (I^2=67.0%, $P = 0.03$), a random-effects model was employed for the meta-analysis. The results showed that there was no significant difference between LLIF combined with auxiliary posterior fixation and stand-alone LLIF in postoperative ODI (SMD=-0.12, 95%CI: -0.62 to 0.37, $P = 0.62$) (Fig. 6; Table 3). The evidence levels for the results are shown in Table 4.

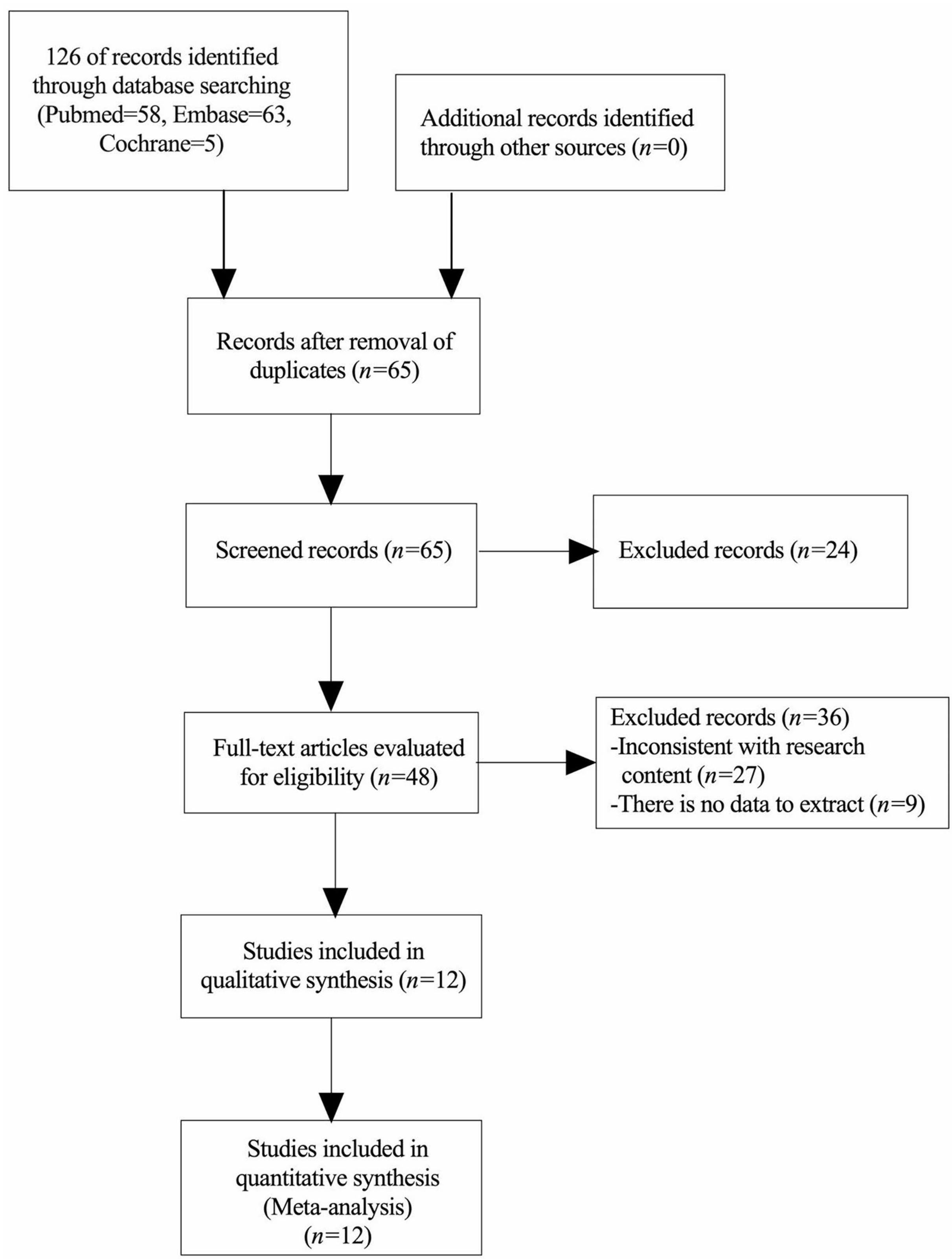

Fig. 1 Flow diagram for selection of studies

Table 1 Baseline characteristics of the included studies

Author	Year	Country	Study type	Sample size		Number of levels		Age		Sex (Male/female)		BMI		Follow-up (month)
				With posterior fixation	Stand-alone	With posterior fixation	Stand-alone	With posterior fixation	Stand-alone	With posterior fixation	Stand-alone	With posterior fixation	Stand-alone	
Sharma et al. [10]	2011	USA	Cohort study	33	10	71	16	63.9 ± 10.2		16/27		26.0 (18.1–39.9)		12
Malham et al. [11]	2012	Australia	Cohort study	15	15	13	13	62.7 ± 10.5		10/20		26.7 ± 5.4		11.5 (9.0–12.0)
Alimi et al. [12]	2014	USA	Cohort study	81	9	110	22	64.4 ± 10.2		/	/	27.6 ± 4.9		12.6 (3.1–50.4)
Aichmair et al. [13]	2017	USA	Cohort study	21	31	21	31	60.9 ± 10.6	62.5 ± 12.1	35/17		29.3 ± 5.4		16.1 ± 9.8
Malham et al. [14]	2017	Australia	Cohort study	19	21	30	24	61.8 ± 10.3	65.2 ± 12.1	5/14	7/14	26.2 ± 5.3	27.5 ± 5.1	12
Parker et al. [15]	2017	Australia	Cohort study	78	54	78	54	/	/	/	/	27.9 ± 5.1		24
Chen et al. [16]	2019	China	Cohort study	49	27	60	34	61.7 ± 8.2	60.2 ± 11.3	18/42	19/15	23.8 ± 2.2	24.3 ± 2.2	24
He et al. [17]	2020	China	Cohort study	41	32	41	32	61.0 ± 9.3	59.8 ± 13.7	11/30	10/22	/	/	24
Li et al. [18]	2021	China	Cohort study	41	54	41	54	57.9 ± 8.2	60.3 ± 6.2	20/21	19/35	22.4 ± 3.9	23.1 ± 5.0	16.3 ± 4.0/16.3 ± 4.0
Cheng et al. [19]	2021	China	Cohort study	15	48	27	86	67.0 ± 10.0		/	/	25.9 ± 3.6		23.2 ± 11.5
Nuss et al. [20]	2022	USA	Cohort study	30	17	49	25	67.2 ± 9.2	65.6 ± 9.6	/	/	33.1 ± 5.8	30.9 ± 6.9	17.6 ± 8.0/17.4 ± 8.0
Wang et al. [21]	2022	China	Cohort study	17	23	17	25	50.2 ± 9.3	51.8 ± 13.6	6/11	6/17	26.7 ± 3.1	25.4 ± 2.8	≥ 12.0

Table 2 Quality assessment of the included studies

Author	Year	Research Subject Selection (4 points)	Comparability between Groups (2 points)	Outcome Measurement (3 points)	Total NOS Score
Sharma et al. [10]	2011	3	2	2	7
Malham et al. [11]	2012	4	2	2	8
Alimi et al. [12]	2014	4	2	2	8
Aichmair et al. [13]	2017	3	2	2	7
Malham et al. [14]	2017	4	2	2	8
Parker et al. [15]	2017	3	1	3	7
Chen et al. [16]	2019	4	2	3	9
He et al. [17]	2020	4	2	2	8
Li et al. [18]	2021	3	2	2	7
Cheng et al. [19]	2021	4	2	2	8
Nuss et al. [20]	2022	4	2	3	9
Wang et al. [21]	2022	3	2	2	8

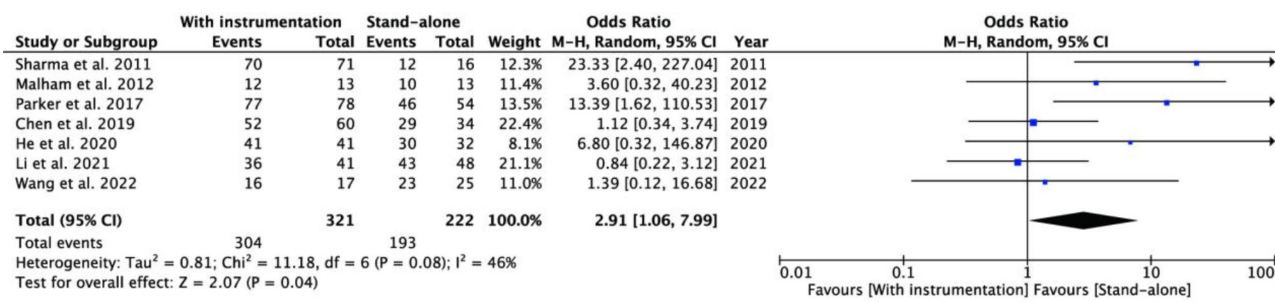

Fig. 2 Compare the fusion rates between LLIF combined with auxiliary posterior fixation and stand-alone LLIF

Table 3 Summary of meta-analysis results with effect size interpretation

Outcome	Effect Size (OR/MD)	95% Confidence Interval	*P*-value	Interpretation
Fusion Rate	OR = 2.41	1.06 to 7.99	0.04	LLIF with posterior fixation significantly increases fusion rate compared to stand-alone LLIF.
Postoperative Disc Height	MD = 1.02	0.71 to 1.32	< 0.00001	LLIF with posterior fixation results in a significantly higher postoperative disc height compared to stand-alone LLIF.
Restoration of Segmental Lordosis	MD = 2.14	0.53 to 3.75	0.009	LLIF with posterior fixation significantly improves segmental lordosis restoration compared to stand-alone LLIF.
Restoration of Lumbar Lordosis	MD = 1.61	-0.12 to 3.33	0.07	No statistically significant difference in lumbar lordosis restoration between the two groups.
Postoperative ODI	SMD=-0.12	-0.62 to 0.37	0.62	No significant difference in postoperative Oswestry Disability Index between LLIF with posterior fixation and stand-alone LLIF.
Postoperative VAS Score	MD = 0.80	0.58 to 1.02	< 0.00001	LLIF with posterior fixation significantly increases postoperative VAS score compared to stand-alone LLIF, indicating more pain.
Reoperation Rate	OR = 0.33	0.15 to 0.75	0.008	LLIF with posterior fixation significantly reduces the reoperation rate compared to stand-alone LLIF.
Incidence of Adverse Events	OR = 0.74	0.47 to 1.15	0.18	No significant difference in the incidence of adverse events between LLIF with posterior fixation and stand-alone LLIF.

Postoperative VAS score Seven articles investigated the postoperative VAS score between LLIF combined with auxiliary posterior fixation and stand-alone LLIF. As no significant heterogeneity was observed (I^2=40.0%, $P = 0.14$), a fixed-effects model was employed for the meta-analysis. The comprehensive results indicate that the postoperative VAS score for LLIF combined with auxiliary posterior fixation is significantly higher than that for stand-alone LLIF (MD = 0.80, 95%CI: 0.58 to 1.02, $P < 0.00001$) (Fig. 7; Table 3). The evidence levels for the results are shown in Table 4.

Reoperation rate Six articles reported reoperation rate between LLIF combined with auxiliary posterior fixa-

Table 4 GRADE assessment of the summary results

Outcome	Study Design	Risk of Bias	Consistency	Precision	Indirectness	Publication Bias	Overall Quality
Fusion Rate (I^2=46%, $P=0.08$)	Cohort Studies	Low	Moderate	High	Low	No Bias	Moderate
Postoperative Disc Height (I^2=43%, $P=0.13$)	Cohort Studies	Low	High	High	Low	No Bias	High
Restoration of Segmental Lordosis (I^2=58%, $P=0.05$)	Cohort Studies	Low	Moderate	Moderate	Low	No Bias	Moderate
Restoration of Lumbar Lordosis (I^2=37%, $P=0.18$)	Cohort Studies	Low	High	Moderate	Low	No Bias	Moderate
Postoperative ODI (I^2=67%, $P=0.03$)	Cohort Studies	Low	Moderate	Moderate	Low	No Bias	Moderate
Postoperative VAS Score (I^2=40%, $P=0.14$)	Cohort Studies	Low	High	High	Low	No Bias	High
Reoperation Rate (I^2=23%, $P=0.26$)	Cohort Studies	Low	High	High	Low	No Bias	High
Incidence of Adverse Events (I^2=0%, $P=0.60$)	Cohort Studies	Low	High	High	Low	No Bias	High

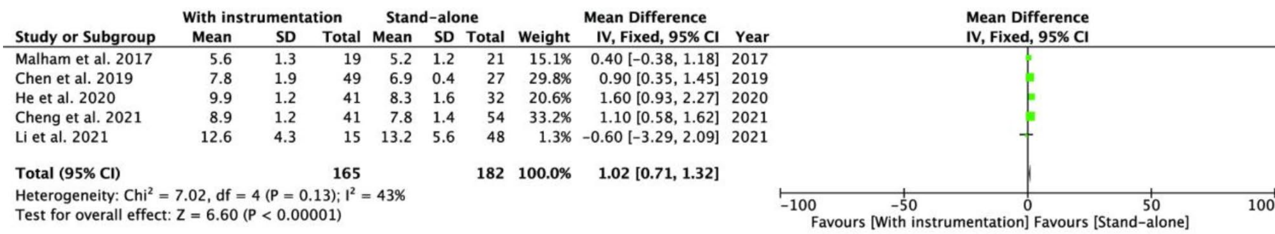

Fig. 3 Compare the postoperative disc height between LLIF combined with auxiliary posterior fixation and stand-alone LLIF

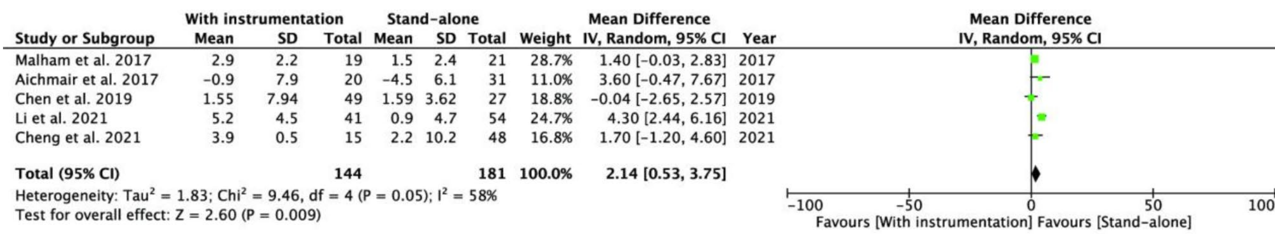

Fig. 4 Compare the restoration of segmental lordosis between LLIF combined with auxiliary posterior fixation and stand-alone LLIF

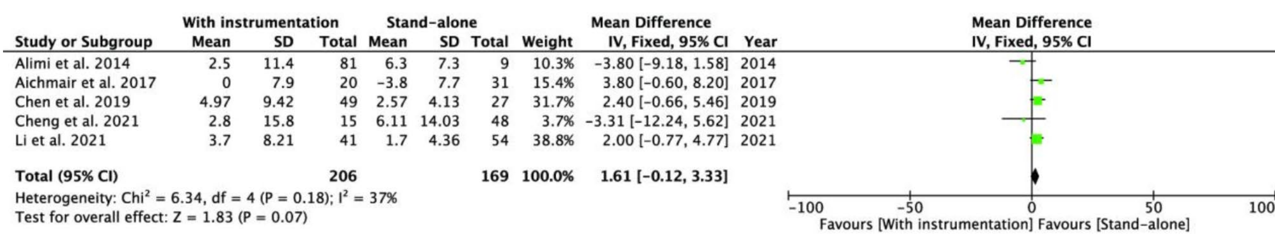

Fig. 5 Compare the restoration of lumbar lordosis between LLIF combined with auxiliary posterior fixation and stand-alone LLIF

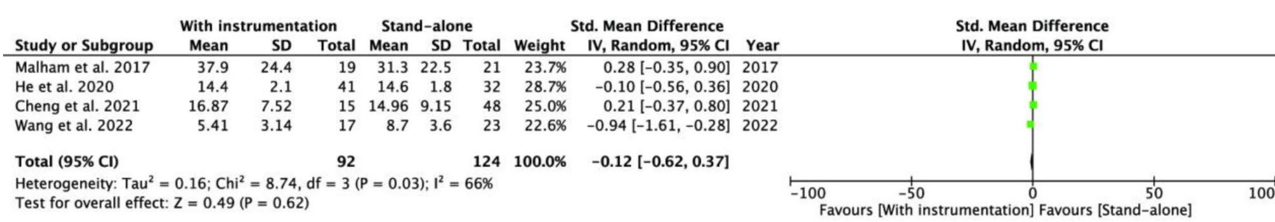

Fig. 6 Compare the postoperative ODI between LLIF combined with auxiliary posterior fixation and stand-alone LLIF

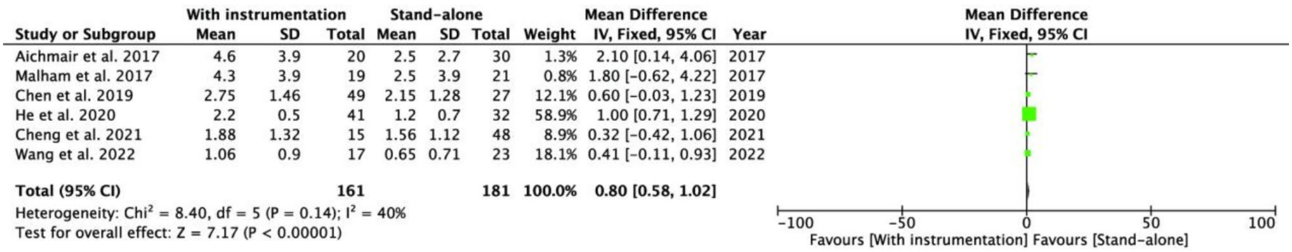

Fig. 7 Compare the postoperative VAS score between LLIF combined with auxiliary posterior fixation and stand-alone LLIF

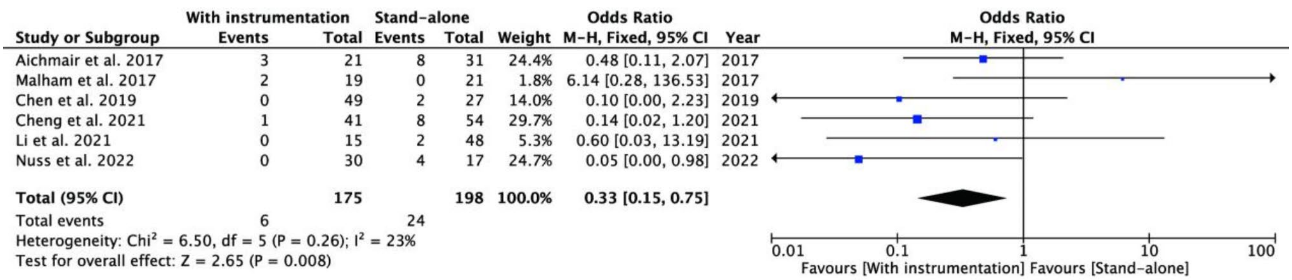

Fig. 8 Compare the reoperation rate between LLIF combined with auxiliary posterior fixation and stand-alone LLIF

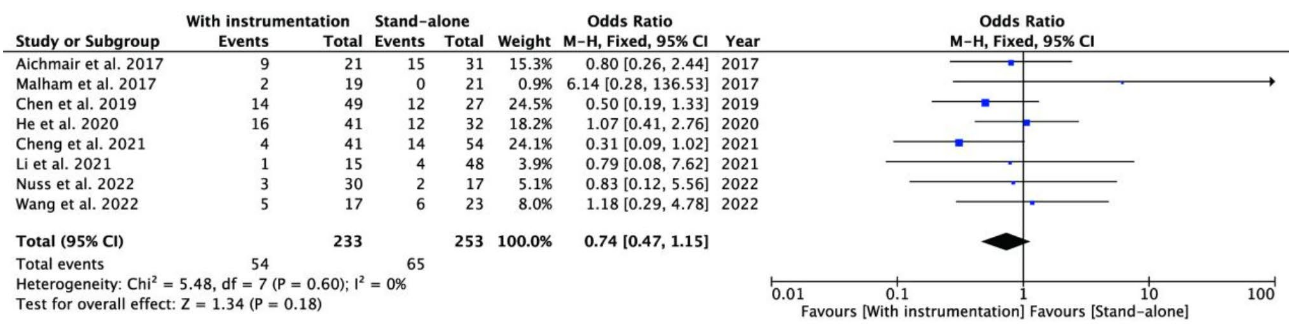

Fig. 9 Compare the incidence of adverse events between LLIF combined with auxiliary posterior fixation and stand-alone LLIF

tion and stand-alone LLIF. As no significant heterogeneity was observed (I^2=23.0%, $P=0.26$), a fixed-effects model was employed for the meta-analysis. The pooleded results show that the reoperation rate of LLIF combined with auxiliary posterior fixation is significantly lower than that of stand-alone LLIF (OR = 0.33, 95%CI: 0.15 to 0.75, $P=0.008$) (Fig. 8; Table 3). The evidence levels for the results are shown in Table 4.

Safety: incidence of adverse events

Eight articles reported the incidence of adverse events between LLIF combined with auxiliary posterior fixation and stand-alone LLIF. As no significant heterogeneity was observed (I^2=0.0%, $P=0.60$), a fixed-effects model was employed for the meta-analysis. The pooled results showed The results showed that there was no significant difference between LLIF combined with auxiliary posterior fixation and stand-alone LLIF in incidence of adverse events (OR = 0.74, 95% CI: 0.47 to 1.15, $P=0.18$) (Fig. 9; Table 3). The evidence levels for the results are shown in Table 4.

Sensitivity analysis

We performed a sensitivity analysis to exclude each trial individually, and then performed a combined analysis of the remaining trials. It was found that no study had a great influence on the results, suggesting that the results of this study are reliable and stable.

Publication bias

The funnel plots generated in this study were presented in the supplementary material. The plots demonstrated a generally symmetrical shape, indicating that there was no significant publication bias in this study (Figures S1-8).

Discussion

Due to its minimal disruption to paraspinal muscles, LLIF has garnered escalating attention and application in the management of diverse degenerative lumbar conditions [22]. This surgical approach, characterized by its reduced impact on surrounding musculature, has witnessed a growing adoption as a preferred intervention for addressing an array of degenerative issues affecting the lumbar spine [23–25]. As of now, evidence-based medicine has not provided definitive conclusions on whether the efficacy and safety of LLIF exhibit significant differences with or without the incorporation of auxiliary posterior fixation. This study encompasses a total of 12 pertinent literature sources, involving 781 patients, and scrutinizes the efficacy and safety of stand-alone LLIF in comparison to LLIF complemented with auxiliary posterior fixation for the treatment of degenerative lumbar diseases. The objective is to offer guiding insights for clinical treatment strategies.

Firstly, the study's consolidated findings revealed a significantly higher fusion rate when LLIF was combined with auxiliary posterior fixation compared to stand-alone LLIF. Some studies suggest that additional posterior fixation can effectively restrict the movement of the surgical segment, thereby ensuring a higher fusion rate [26]. This underscores the potential benefits of incorporating auxiliary posterior fixation in the surgical approach for degenerative lumbar diseases. The significance lies in providing clinicians with valuable guidance to make informed decisions, maximizing the success of vertebral fusion. Looking ahead, future research may delve into larger-scale clinical studies to further validate the fusion efficacy of LLIF with auxiliary posterior fixation. Additionally, exploring long-term postoperative outcomes, patient quality of life, and comprehensive indicators will contribute to a more nuanced assessment of the benefits of these surgical approaches. Personalized treatment strategies for specific patient groups also present an intriguing avenue for future exploration.

In addition, the results of present study found that postoperative disc height and restoration in segmental lordosis of LLIF combined with auxiliary posterior fixation were all significantly higher than that of stand-alone LLIF. The observed increase in postoperative disc height suggests that the combined approach contributes to better maintenance and restoration of intervertebral space. This is crucial for spinal stability and may positively impact overall spinal alignment. Improved disc height is often associated with enhanced load-bearing capacity and reduced risk of adjacent segment degeneration. Furthermore, the notable increase in restoration of segmental lordosis in the LLIF combined with auxiliary posterior fixation group indicates a more successful correction of the lumbar spine curvature compared to stand-alone LLIF. Proper lordotic alignment is essential for maintaining biomechanical efficiency and preventing abnormal loading on adjacent structures.

The ODI is a commonly used tool to assess the impact of lumbar spine disorders on patients' daily life functions. Originally designed by a group of orthopedic surgeons in the United Kingdom, this index evaluates the extent of lumbar pain and spinal functional impairments in patients [27]. In the context of this study, the lack of a significant difference in postoperative ODI scores suggests that both LLIF approaches, with and without auxiliary posterior fixation, resulted in comparable functional outcomes. Several factors may contribute to the absence of a significant difference in ODI scores. It's possible that the LLIF technique itself, even when performed as a stand-alone procedure, provides substantial improvements in functionality and quality of life. Additionally, the inclusion of auxiliary posterior fixation may not have had a discernible impact on functional outcomes as measured by the ODI in the postoperative period. While the ODI is a valuable indicator of functional status, it is crucial to consider that other factors, such as pain levels, radiographic parameters, and patient-reported outcomes, contribute to the overall assessment of surgical success [28]. The absence of a significant difference in ODI scores does not necessarily imply uniformity in all aspects of postoperative recovery.

Importantly, the comprehensive results indicate that the postoperative VAS score for LLIF combined with auxiliary posterior fixation is significantly higher than that for stand-alone LLIF, suggesting a potentially greater level of discomfort or pain experienced by patients in this group compared to those who underwent stand-alone LLIF. Several factors may contribute to the observed difference in postoperative VAS scores. The inclusion of auxiliary posterior fixation may result in additional surgical trauma or discomfort for patients. The use of posterior fixation involves the placement of screws or other hardware, which could contribute to increased pain levels in the postoperative period. Additionally, the biomechanical changes introduced by the combination of LLIF and posterior fixation might affect the overall load distribution and stress on adjacent structures, potentially influencing pain perception.

Furthermore, The pooled results indicate a noteworthy finding, demonstrating a significantly lower reoperation rate associated with the combination of LLIF and auxiliary posterior fixation compared to stand-alone LLIF. This observation suggests potential advantages in terms of long-term surgical success and the need for subsequent interventions. A lower reoperation rate is a crucial metric in evaluating the overall effectiveness and durability of a surgical approach. In the context of lumbar interbody fusion, a reduced reoperation rate signifies a more sustainable and successful outcome. This could be attributed to the additional stability provided by auxiliary posterior fixation, which may contribute to improved fusion and decreased risk of complications requiring further surgical intervention.

This study has encountered several limitations: (1) The scarcity of research addressing the impact of additional posterior fixation on the efficacy of LLIF for degenerative lumbar diseases resulted in a limited pool of articles, especially those concentrating on specific LLIF techniques. (2) The absence of comprehensive information on pre-existing patient comorbidities across most studies introduces a potential confounding factor that might affect the precision of our study outcomes. (3) The constrained number of available studies posed challenges in conducting subgroup analyses stratified by distinct types of patient diseases. (4) The lack of protocol registration for this study may reduce its credibility and transparency.

Conclusion

In summary, compared to standalone LLIF, the combination of LLIF with auxiliary posterior fixation exhibits a higher postoperative fusion rate. Additionally, both postoperative disc height and restoration of segmental lordosis are significantly greater. Although the occurrence of adverse reactions is consistent between the two surgical approaches, the LLIF combined with auxiliary posterior fixation approach demonstrates a lower reoperation rate.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12891-024-08094-6.

Supplementary Material 1

Supplementary Material 2

Acknowledgements

Not applicable.

Author contributions

Nannan Kou wrote the manuscript and created the figures. Runyao Zhang and Feifei Liu participated in literature screening, Hongliang Zhou and Lirong Ren participated in data extraction. Jing Luo conceived the final approval of the version to be submitted and provided the funding. All authors read and approved the final manuscript.

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Data availability

Data available on request from the authors.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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