

# High-viscosity versus low-viscosity cement for the treatment of vertebral compression fractures A meta-analysis of randomized controlled trials

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#### Abstract

**Background:** High viscosity cement (HVC) and low viscosity cement (LVC) have been used to treat osteoporotic vertebral compression fractures (OVCFs). Our study was to assess the safety and efficacy of HVC and LVC in treating OVCFs.

**Methods:** We searched the electronic database for randomized controlled trials of HVC and LVC to treat OVCFs. Randomeffects model was performed to pool the outcomes about operation time, visual analogue scale (VAS), bone cement injection volume, oswestry disability index (ODI), bone cement leakage and adjacent vertebral fractures.

**Results:** Twelve randomized trials were included in the meta-analysis. The 2 groups had similar changes in terms of bone cement injection volume, ODI and adjacent vertebral fractures. The HVC group showed shorter operation time and better VAS score improvement. The bone cement leakage rate of the HVC group was significantly better than LVC group (P < .00001). According to the location of bone cement leakage, in the leakages of the veins (P < .00001), the intervertebral disc (P < .00001), the paravertebral area (P = .003) and the intraspinal space (P = .03), the HVC group were significantly better than the LVC group.

**Conclusions:** In terms of bone cement injection volume, ODI and adjacent vertebral fractures, the 2 group are equivalent. HVC had a shorter operation time, lower bone cement leakage rate and better VAS score improvement, compared with LVC.

**Abbreviations:** CI = confidence intervals, HVC = high-viscosity cement, LVC = low-viscosity cement, MD = mean differences, ODI = oswestry disability index, OVCFs = osteoporotic vertebral compression fractures, PKP = percutaneous kyphoplasty, PVP = percutaneous vertebroplasty, RR = risk ratio, VAS = visual analogue scale, VCF = vertebral compression fracture.

Keywords: cement leakage, high-viscosity cement, meta-analysis, vertebral compression fractures

# 1. Introduction

Osteoporosis can cause a gradual loss of calcium from bone tissue, resulting in a decrease in bone density and bone strength. In daily work and life, osteoporosis patients are very susceptible to fractures from slight external force, among which the osteoporotic vertebral compression fracture (OVCF) is the most common.<sup>[1,2]</sup> An OVCF can cause persistent back pain, spinal deformities, spinal cord and nerve damage, and even paralysis, seriously affecting the function of multiple systems.<sup>[3-6]</sup> Traditional therapies include physical therapy, long-term bed rest, medication and open surgery. Some complications may occur in patients who are bedridden for a long time, such as bedsores, deep vein thrombosis of the lower extremities, pulmonary infections and urinary tract infections.<sup>[7]</sup> Open surgery is mostly used in patients with symptoms of nerve compression who require the decompression of the spinal canal, and there are complications such as slow postoperative recovery and limited vertebral body movement.<sup>[8]</sup>

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In recent years, with the development of minimally invasive techniques for the spine, more and more scholars have applied percutaneous vertebroplasty (PVP) and percutaneous kyphoplasty (PKP) to treating fresh compression fractures of the spine. Compared with open surgery, these 2 minimally invasive surgical methods cause less trauma, effectively strengthen the vertebral body, relieve pain, stabilize the vertebral body, and prevent kyphotic deformities caused by further compression of the vertebral body. In addition, they can enable the patient to get out of bed early and thus avoid related complications caused by longterm bed rest, which can improve the patient's quality of life.<sup>[9,10]</sup> However, minimally invasive surgery may involve bone cement leakage, the refracture of the responsible vertebral body and adjacent vertebral body, pulmonary embolism, and toxic reac-tions to bone cement, etc.<sup>[11]</sup> The most common complication is bone cement leakage, and studies have shown that the incidence of this leakage is 25% to 40%.<sup>[12]</sup> Bone cement leakage into the intervertebral disc or paravertebral soft tissue generally does not produce clinical symptoms. If it penetrates into the blood

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vessel or spinal canal, it can cause pulmonary embolism and spinal cord compression, and severe cases can cause paralysis and death.<sup>[13]</sup> Therefore, reducing the leakage of bone cement has become a hot spot for scholars. As the primary parameter of bone cement performance, viscosity is currently considered as the key factor that affects bone cement leakage after surgery.<sup>[14]</sup> Tang et al<sup>[15]</sup> retrospectively analyzed the efficacy of high-viscosity cement (HVC) and low-viscosity cement (LVC) to treating OVCF, and they found that HVC can significantly reduce the leakage rate of bone cement and improve the safety of the surgery. A prospective randomized controlled study conducted by Fang et al also showed that HVC had a lower leakage rate of bone cement.<sup>[16]</sup> However, some scholars believe that bone cement leakage between HVC and LVC are equivalent.[17-19] In addition, the conclusions of researches on the location of bone cement leakage are also different. A prospective study by Guo<sup>[20]</sup>et al showed that HVC was significantly lower than LVC in terms of the rates of disc leakage and venous leakage, but there was no significant difference between the 2 bone cements in intraspinal and paravertebral leakage. Huang<sup>[21]</sup> et al found that HVC and LVC displayed significant differences in the rate of venous leakage, but no difference in disc leakage.

To date, several scholars have studied the efficacy, leakage rate and other complications of HVC and LVC, but the number of cases in a single study is small and the strength of the relevant meta-analysis evidence is low. To this end, we conducted a systematic review and meta-analysis to understand the efficacy and safety of HVC and LVC in treating osteoporotic vertebral compression fractures.

# 2. Materials and methods

# 2.1. Search strategy

Two independent evaluators conducted a relevant literature retrieval on EMBASE, PubMed, Cochrane Library, Web of Science and China National Knowledge Infrastructure. The following key words were entered for the search: (high-viscosity OR high viscosity) AND (vertebral fracture\* OR vertebral compression fracture\* OR vertebral compression fracture [VCF\*] OR osteoporotic vertebral compression fracture\* OR OVCF\*). The last search was performed on December 23, 2021, with no language restrictions. Moreover, the reference list of relevant study was also applied to search. Ethics approval is not required as this study is a meta-analysis based on published studies.

## 2.2. Criteria for selected trials

Studies that met the following criteria were included in the meta-analysis: This study was a randomized controlled trial comparing HVC and LVC; the subjects were diagnosed with a vertebral compression fracture caused by osteoporosis; and the results of the study on the filling and leakage of bone cement and the patient's physical function were reported. The exclusion criteria are as follows: Case reports, reviews, observational studies, basic science experiments; animal or body research; and studies for which data were not available. Repeated published research. Two reviewers independently extracted potentially eligible studies based on the inclusion and exclusion criteria. Differences were resolved through discussion and consultation, and an agreement was reached.

## 2.3. Data extraction

The 2 evaluators independently extracted the relevant information from each eligible study. Any inconsistencies were resolved by discussion and consultation, and if necessary, the opinion of the third examiner was consulted until all participants reached a consensus. The information included the study design, publication year, study location, intervention details, sample size, VCF level, age, gender distribution, follow-up time, and clinical results. The combined outcome parameters included the surgical parameters (operation time and bone cement injection volume) and clinical indicators including visual analogue scale (VAS), bone cement leakage, adjacent vertebral fractures and oswestry disability index (ODI). The sites of bone cement leakage were classified into the paravertebral regions, intraspinal canal, intervertebral disc space, and peripheral veins. The short-term, mid-term and long-term follow-up times were 1 to 3 months, 6 to 12 months and more than 12 months.

#### 2.4. Quality assessment

Two reviewers independently assessed the risk of bias in the included randomized controlled studies based on the Cochrane review criteria. In addition, the Grades of Recommendation, Assessment, Development and Evaluation approach ranked the strength of evidence for all the merged results. According to the evaluation of the study design, bias risk, consistency, directness and accuracy, the quality of the results was divided into 4 categories: extremely low, low, medium and high.<sup>[22]</sup>

#### 2.5. Statistical analysis

Continuous outcomes were pooled into mean differences (MD) with 95% confidence intervals (CI). Dichotomous data were expressed as the risk ratio (RR) and 95% CI. The  $\chi^2$  (P < .1 indicates heterogeneity) and  $I^2$  statistic ( $I^2 > 50\%$  indicates high heterogeneity) were used to evaluate the heterogeneity between studies.<sup>[23,24]</sup>The outcomes were pooled using random effects models. Funnel plots and Egger tests were used to identify the possibility of publication bias. Subgroup analyses were performed based on the locations of cement leakage, the surgical methods and follow-up information. Sensitivity analyses were used to evaluate the source of high heterogeneity. The data analyses were used in Review Manager 5.3. The Egger test was performed using Stata 12.0. *P* values < .05 were considered statistically significant.

# 3. Results

#### 3.1. Search results

The 567 relevant studies were preliminarily retrieved from PubMed (n = 53), EMBASE (n = 159), the Cochrane Library (n = 23), Web of Science (n = 115), and China National Knowledge Infrastructure, (n = 217), and 411 remained after repeats were excluded. After a review of the titles and abstracts, the number of articles was reduced to 104. Lastly, through reading the full text, a total of 12 randomized controlled studies<sup>[16,17,20,21,25-32]</sup> were included in the meta-analysis (Fig. 1). There are 4 articles in English and 8 in Chinese. The characteristics of all the studies are summarized in Table 1.

#### 3.2. Quality assessment

All 12 RCT studies were subject to quality assessment according to the Cochrane review criteria. The risk of bias summary is shown in Figure 2. According to the Grades of Recommendation, Assessment, Development and Evaluation approach, 2 pooled outcomes displayed high quality evidence, 5 showed moderate quality evidence and 2 contained low quality evidence (Table 2).

# 3.3. Meta-analysis results

**3.3.1. Operation time.** A total of 7 articles reported the operation time. The operation time of the HVC group was significantly shorter than that of the LVC group (MD: -11.73;



Figure 1. Flow chart of the study selection procedure.

#### Table 1

The characteristics of included studies

analysis, and the results still showed no significant difference between HVC and LVC (MD: -0.08; 95% CI: -0.18 to 0.02; P = .10) with no heterogeneity (P = .77,  $I^2 = 0\%$ ) (Fig. 4B).

3.3.3. Bone cement leakage. A total of 12 randomized controlled trials reported bone cement leakage. We performed a subgroup analysis on the amount of bone cement leakage according to the different surgical methods (Fig. 5A). Overall, the bone cement leakage of the HVC group was significantly lower than that of the LVC group (RR: 0.40; 95% CI: 0.29-0.54; P < .00001) with high heterogeneity ( $P = .0008, I^2 = 63\%$ ). On the subgroup side, for the bone cement leakage, the results revealed a significant difference in the PVP when using HVC versus PVP using LVC (RR: 0.34; 95% CI: 0.28-0.42; [P < .00001]) with no heterogeneity  $(P = .86, I^2 = 0\%)$  and PKP using HVC versus PKP using LVC (RR: 0.26; 95% CI: 0.10-0.67; P = .005) with no heterogeneity (P = .69,  $I^2 = 0\%$ ), while no significant differences were found in the PVP when using HVC versus PKP using LVC (RR: 0.61; 95% CI: 0.26–1.42; P = .25) with high heterogeneity (P = .005,  $I^2 = .77\%$ ). We removed PVP with HVC versus PKP with LVC for the sensitivity analysis, and the pooled results still showed that the bone cement leakage of the HVC group was significantly lower than that of the LVC group (RR: 0.34; 95% CI: 0.28-0.41; P < .00001) with no

				Levels of VCF		Sample siz	e (Male/Female)	Меа	n age (yr)	
Studies	Country	Surgical methods		HVC	LVC	HVC	LVC	HVC	LVC	Follow-up
Huang 2014	China		PVP		92	30 (6/24)	30 (2/28)	68.1	67.8	2–5 yr
Xu 2014	China		PVP	98	92	30 (6/24)	30 (2/28)	71.3	73.2	2–5 yr
Zhou 2015	China		PVP vs PKP*	56	54	40 (13/27)	40 (10/30)	65.6	66.0	1 yr
Zhang 2015	China		PVP	17	22	14 (2/12)	18 (3/15)	75.5	75.8	1.5–3.5 yr
Li 2016	China		PVP vs PKP*	49	49	49 (19/30)	49 (18/31)	62.1	63.6	3 d
Guo 2017	China		PVP	98	86	50 (25/25)	50 (28/22)	77.2	75.4	HVC:2.5y LVC:2.2y
Yang 2017	China		PVP	45	45	45 (28/17)	45 (26/19)	54.4	56.3	NA
Liu 2018	China	PVP	HVC vs.LVC	64	68	47 (6/41)	46(5/41)	64.27	65.33	1 yr
		PKP	HVC vs.LVC	66	67	44 (4/40)	46(6/40)	64.55	63.99	-
Wang 2019	China		PKP	42	48	42 (14/28)	48 (15/33)	65.34	66.42	3 mon
Fang 2019	China		PVP	100	100	100 (40/60)	100 (42/58)	70.23	71.14	1 yr
Alhashash 2019	Germany		PVP	37	36	30 (12/18)	30 (13/17)	68.63	71.53	2 yr
Lv 2020	China		PVP vs.PKP*	33	33	33 (15/18)	33 (13/20)	73.06	73.39	1 yr

PKP = percutaneous kyphoplasty, PVP = percutaneous vertebroplasty.

HVC = high-viscosity cement, LVC = low-viscosity cement, VCF = vertebral compressive fracture, NA = not available, d = days, m = months, y = years.

\*PVP using HVC versus PKP using LVC.

95% CI: -13.10 - -10.36; *P* < .00001) with low heterogeneity (*P* = .08, *I*<sup>2</sup> = 46%) (Fig. 3).

3.3.2. Bone cement injection. A total of 8 randomized controlled trials reported the bone cement injection volumes. We performed a subgroup analysis on the bone cement injection quantity according to different surgical methods (Fig. 4A). In general, there was no significant difference between HVC and LVC in the amount of bone cement injection (MD: -0.49; 95%) CI: -1.03 to 0.04; *P* = .07) with high heterogeneity (*P* < .00001,  $I^2$  = 98%). In terms of subgroups, for the injected cement volume, the results revealed no significant difference with PVP when using HVC versus PVP using LVC (MD: -0.11; 95% CI: -0.23 to 0.01; P = .08) with no heterogeneity (P = .72,  $I^2 = 0\%$ ) and PKP using HVC versus PKP using LVC (MD: -0.03; 95% CI: -0.21 to 0.15; P = .75) with no heterogeneity ( $P = .41, I^2 = 0\%$ ). A significant difference was found for PVP when using HVC versus PKP using LVC (MD: -1.44; 95% CI: -2.46 to 0.43; P = .005) with high heterogeneity (P < .00001,  $I^2 = 98\%$ ) We removed PVP with HVC versus PKP with LVC for the sensitivity heterogeneity ( $P = .93, I^2 = 0\%$ ) (Fig. 5B).

In addition, we performed a subgroup analysis of bone cement leakage according to its location (Fig. 6). The pooled results for the leakages of the veins (RR: 0.24; 95% CI:0.17–0.34; P < .00001), the intervertebral disc (RR: 0.36; 95% CI: 0.25–0.54; P < .00001), the paravertebral area (RR: 0.53; 95% CI: 0.35–0.81; P = .003) and the intraspinal space (RR: 0.40; 95% CI: 0.18–0.90; P = .03) in the HVC group were significantly reduced compared with those in the LVC group with no heterogeneity.

**3.3.4.** VAS, ODI and adjacent vertebral fracture. We extracted data on the VAS and ODI from the included randomized controlled trials, and we performed a subgroup analysis based on the length of the follow-up time. On the whole, for the VAS, the HVC group was significantly lower than the LVC group (MD: -0.11; 95% CI: -0.19 to 0.04; P = .003) with low heterogeneity (P = .006,  $I^2 = 45$ %). In terms of subgroups, the results revealed no significant differences at the preoperative time (MD: -0.06; 95% CI: -0.21 to -0.09; P = .45)



Figure 2. Risk of bias summary of RCTs.

with no heterogeneity (P = .54,  $I^2 = 0\%$ ) within 7 days postoperation (MD: -0.04; 95% CI: -0.12 to 0.04; P = .36) with no heterogeneity (P = .62,  $I^2 = 0\%$ ), midterm follow-up (MD: -0.04; 95% CI: -0.13 to 0.04; P = .30) with no heterogeneity (P = .38,  $I^2 = 0\%$ ) and long-term follow-up (MD: -0.29; 95% CI: -0.73 to 0.15; P = .20) with high heterogeneity (P = .07,  $I^2 = 62\%$ ), and a significant difference was present at the short term follow-up (MD: -0.27; 95% CI: -0.47 to -0.06; P = .01) with high heterogeneity (P = .002,  $I^2 = 74\%$ ) (Fig. 7).

For the ODI, on the whole, the pooled results revealed no significant differences between the HVC group and the LVC group (MD: 0.50; 95% CI: -0.01 to 1.02; P = .06) with low heterogeneity (P = .17,  $I^2 = 22\%$ ). In terms of subgroups, the results revealed no significant differences at the preoperative time (MD:

0.07; 95% CI: -1.71 to 1.84; P = .94) with low heterogeneity (P = .12,  $I^2 = 39\%$ ) within 7 days post-operation (MD: -0.01; 95% CI: -1.04 to 1.01; P = .98) with no heterogeneity (P = .40,  $I^2 = 0\%$ ), midterm follow-up (MD: 0.24; 95% CI: -0.78 to 1.26; P = .64) with no heterogeneity (P = .19,  $I^2 = 37\%$ ) and long-term follow-up (MD: 1.06; 95% CI: -0.94 to 3.06; P = .30) with low heterogeneity (P = .14,  $I^2 = 48\%$ ), and a significant difference was found at the short term follow-up (MD: 0.88; 95% CI: 0.08–1.67; P = .03) with no heterogeneity (P = .68,  $I^2 = 0\%$ ) (Fig. 8).

A total of 5 articles have reported on adjacent vertebral fractures. No significant difference was found between the HVC group and the LVC group (RR: 1.32; 95% CI: 0.60–2.90; P = .50) with low heterogeneity (P = .35,  $I^2 = 10\%$ ) (Fig. 9).

**3.3.5.** Publication bias. The funnel plots for bone cement leakage (Fig. 10A), VAS (Fig. 10B) and ODI (Fig. 10C) showed no obvious publication bias, and the Egger test results on bone cement leakage (t = 0.43, P = .678), VAS (t = -0.38, P = .709) and ODI (t = -0.56, P = .578) also showed no obvious evidence of publication bias.

## 4. Discussion

In recent years, PVP and PKP have become important minimally invasive surgical techniques for treating osteoporotic vertebral compression fractures. However, care must be taken when performing this operation, because there is a risk of bone cement leakage. Bone cement leakage is closely related to the quality of the vertebrae, fracture-related factors, bone cement factors, and bone cement injection methods. Short-term activity does not affect the established vertebral fracture morphology at the moment of the fracture, and the operational steps and bone cement injection pattern have been streamlined, therefore, improving the properties of the bone cement to reduce the leakage rate has become the focus of research. Fluidity and viscosity are important properties of bone cement. The diffusion velocity and filling degree of bone cement are directly affected by its viscosity. One study<sup>[33]</sup> found that the viscosity of bone cement was an independent risk factor for bone cement leakage. Compared with LVC, HVC has the characteristics of a short mixing liquid period, high instantaneous viscosity, long injection time, low polymerization temperature, and dispersion of bone cement, etc.<sup>[34]</sup> Since the advent of HVC, many researchers have evaluated its safety and effectiveness; however, its effect on the efficacy and leakage rate of vertebral compression fractures remains controversial.<sup>[17-19,35,36]</sup>

At present, 1 meta-analysis has compared the efficacy of HVC and LVC in treating vertebral compression fractures.<sup>[37]</sup> The meta-analysis concluded that HVC and LVC both had the same satisfactory effect. In addition, in terms of bone cement leakage, the incidence of leakage was higher with HVC was lower than with LVC, especially in the peripheral vein and intervertebral disc space, but there was no significant difference in the paravertebral and intraspinal areas. However, this meta-analysis only included 2 randomized controlled trials and 5 cohort studies, and the methodological quality of one randomized controlled trial was very low, so the research results had some limitations.

Our meta-analysis results showed that the operation time of the HVC group was significantly shorter than that of the LVC group, but the amount of bone cement injection between the 2 groups were equivalent. The subgroup analysis showed that there was a significant difference in the amount of bone cement injection in this subgroup of PVP versus PKP, and there was no difference in the other 2 groups. Due to high heterogeneity, after this subgroup was eliminated, the results still indicated that there was no difference in the bone cement injection volume between the 2 HVC and LVC groups. This finding is consistent with the study by Zhang et al.<sup>[37]</sup> In our analysis, the amount of injected

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Summary of strength of evidence with regard to the outcomes.

Outcomes	Studies	Risk of bias	Inconsistency	Indirectness	Imprecision	Quality	
Operation time	7	Serious †	No	No	No	Moderate	
Injected cement volume	8	Serious +	Serious ‡	No	No	Low	
Cement leakage	12	Serious +	Serious ‡	No	No	Low	
VAS scores	9	Serious +	No	No	No	Moderate	
ODI	8	Serious †	No	No	No	Moderate	
Cobb angle	3	No	No	No	Serious 🕂	Moderate	
Adjacent vertebral fracture	5	No	No	No	Serious 🕂	Moderate	
Injected cement volume *	6	No	No	No	No	High	
Cement leakage *	9	No	No	No	No	High	

VAS = Visual analog scale, ODI = Oswestry Disability Index.

\* Injected cement volume after the sensitivity analysis.

+ Serious risk of selection bias.

‡ Significant heterogeneity existed across the trials.

+ Wide confidence intervals are around the estimate of the effect or total population size is less than 400.

\* Cement leakage after the sensitivity analysis.



Figure 3. Meta-analyses of operation time between high-viscosity cement (HVC) and low-viscosity cement (LVC). HVC = High-viscosity cement, LVC = Low-viscosity cement.

bone cement was not directly related to its viscosity, but to the operation method. Some scholars have shown that the amount of bone cement injection in the PKP group is significantly greater than that in the PVP group. They believe the reason is that the balloon is inserted into the vertebra before the injection of bone cement during the PKP operation, creating a low-pressure injection environment compared with the high-pressure environment in the PVP, and PKP may be injected with more sufficient bone cement.<sup>[38]</sup> Therefore, because of the different surgical methods, the PVP versus PKP subgroup has high heterogeneity, and the amount of bone cement in the injection is significantly different. In addition, because the HVC does not have a liquid phase during the mixing process, it can instantly reach high viscosity, which makes the injectable period long, which is convenient for operations and shortens the injection and hardening time, so the operation time for a single vertebral body is significantly reduced.

In terms of bone cement leakage, our meta-analysis results suggest that the HVC group leakage was significantly lower than that of the LVC group, which is consistent with Rapan et al<sup>[39]</sup> and Lador et al<sup>[40]</sup> because the high viscosity of bone cement has strong resistance to pressure and resistance to distortion, and a better intraoperative enhancement effect, and its match accurately addresses the bone cement injection system to achieve good control. The subgroup analysis showed that there was no difference in bone cement leakage in the PVP versus PKP subgroup, and the other 2 groups showed significant differences. Due to high heterogeneity, after this subgroup was excluded, the results still indicated that the bone cement leakage for HVC was significantly lower than that of the LVC group. We believe that bone cement leakage is not only related to bone cement viscosity, but also to surgical methods. Due to the balloon technique used in PKP surgery, a low-pressure injection environment is created in the vertebral body, thereby reducing

the leakage of low-viscosity bone cement, which may cause no significant difference in bone cement leakage in the PVP versus PKP subgroup. Hu et al<sup>[38]</sup> also showed that the leakage rate for bone cement in the PKP group was lower than that in the PVP group. In this paper, a subgroup analysis on different positions of bone cement leakage was performed. The results showed that in the paravertebral region, intraspinal space, intervertebral disc space, and peripheral vein region, the bone cement leakage in the HVC group was significantly lower than that in the LVC group. Habib et al<sup>[41]</sup> used an in vitro bone cement leakage model to compare high-viscosity bone cement with low-viscosity bone cement, and they found that high-viscosity bone cement was superior to low-viscosity bone cement in terms of reducing leakage and the uniformity of distribution. Baroud et al<sup>[42]</sup> reported a correlation between bone cement viscosity and the leakage rate of bone cement from vertebral veins. The results of a randomized controlled study by Fang et al<sup>[16]</sup> showed that the rate of bone cement leakage in the spinal canal, intraspinal space and intervertebral disc space of the HVC group was significantly lower than that of the LVC group. The results of this meta-analysis are consistent with these findings. The high-viscosity bone cement has the characteristics of instantaneous high viscosity, low polymerization temperature and a long injection time. The surgeon can apply pressure under X-ray fluoroscopy through a special transmission device to control the injection amount and the flow of bone cement more accurately in the injured vertebra, and it is advantageous for the surgeon to inject bone cement into the injured vertebrae more accurately during the operation, and when the bone cement is close to the paravertebral area, intraspinal space and vertebral venous plexus, the cement can be stopped in time. Jung et al<sup>[43]</sup> used low-viscosity bone cement PVP to treat 20 cases of osteoporotic vertebral compression fractures. The most common type of postoperative bone cement leakage was intervertebral disc leakage (with

Α		HVC			LVC			Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% Cl	IV. Random, 95% Cl
3.3.2 PVP vs PVP									
Fang 2019	5.65	1.16	100	5.97	1.45	100	9.9%	-0.32 [-0.68, 0.04]	
Guo 2017	3.4	0.6	98	3.5	0.8	86	10.3%	-0.10 [-0.31, 0.11]	1
Liu 2018	3.81	0.62	64	3.94	0.74	68	10.2%	-0.13 [-0.36, 0.10]	
Xu 2014	2.6	0.9	98	2.6	0.8	92	10.2%	0.00 [-0.24, 0.24]	Ť
Zhang 2015	3.4	1	17	3.5	0.8	22	9.3%	-0.10 [-0.68, 0.48]	
Subtotal (95% CI)			377			368	49.9%	-0.11 [-0.23, 0.01]	
Heterogeneity: Tau <sup>2</sup> = Test for overall effect:	0.00; Cł Z = 1.75	ni² = 2. 6 (P = (	11, df = ).08)	= 4 (P =	0.72);	<sup>2</sup> = 0%	0		
3.3.2 PVP vs PKP									
Li 2016	4.28	1.53	49	5.67	1.42	49	9.3%	-1.39 [-1.97, -0.81]	
Liu 2018	3.51	0.62	64	4.3	0.58	67	10.3%	-0.79 [-1.00, -0.58]	
Lv 2020	3.81	0.42	33	5.95	0.33	33	10.3%	-2.14 [-2.32, -1.96]	*
Subtotal (95% CI)			146			149	29.8%	-1.44 [-2.46, -0.43]	-
Heterogeneity: Tau <sup>2</sup> = Test for overall effect:	0.77; Cł Z = 2.78	ni² = 92 (P = (	2.90, df ).005)	= 2 (P	< 0.00	001); l²	= 98%		
3.3.2 PKP vs PKP									
Liu 2018	3.95	0.69	66	4.03	0.58	67	10.2%	-0.08 [-0.30, 0.14]	*
Wang 2019	2.71	0.75	42	2.63	0.78	48	10.1%	0.08 [-0.24, 0.40]	Ť
Subtotal (95% CI)			108			115	20.3%	-0.03 [-0.21, 0.15]	• <b>•</b>
Heterogeneity: Tau <sup>2</sup> = Test for overall effect:	0.00; Cł Z = 0.32	ni² = 0. : (P = (	67, df = ).75)	= 1 (P =	0.41);	l <sup>2</sup> = 0%	b		
Total (95% CI)			631			632	100.0%	-0.49 [-1.03, 0.04]	•
Heterogeneity: Tau <sup>2</sup> =	0.73; Cł	ni² = 39	91.39, c	ff = 9 (F	< 0.0	0001);	<sup>2</sup> = 98%		-4 -2 0 2 4
Test for overall effect:	Z = 1.80	(P = ( $Chi^2 =$	).07) 7 32 c	lf = 2 (P	e = 0 0	3) I <sup>2</sup> = 1	72 7%		Favours [HVC] Favours [LVC]
D	101000.		1.02.0		- 0.0	u. i =			
D Study on Outparson		HVC	Tetel		LVC	Tetal	Malabé	Mean Difference	Mean Difference
3 2 2 DVD DVD	Mean	50	Iotai	Mean	30	Total	weight	IV, Random, 95% CI	IV, Random, 95% CI
3.3.2 PVP VS PVP	E 05	4.40	400	E 07	4 45	400	7 60/	0 00 1 0 00 0 0 0	
Fang 2019	5.65	1.16	100	5.9/	1.45	100	7.5%	-0.32 [-0.68, 0.04]	
Guo 2017	2.94	0.62	90	3.5	0.0	69	19 40/	-0.10 [-0.31, 0.11]	
Liu 2016	3.01	0.02	04	3.94	0.74	00	17.0%	-0.13 [-0.36, 0.10]	
Zhang 2015	3.4	0.5	17	2.0	0.0	22	2.0%	0.00 [-0.24, 0.24]	
Subtotal (95% CI)	0.4		377	0.0	0.0	368	69.0%	-0.11 [-0.23, 0.01]	•
Heterogeneity: Tau <sup>2</sup> = Test for overall effect:	0.00; Cł Z = 1.75	ni² = 2. ; (P = (	11, df = 0.08)	= 4 (P =	0.72);	<sup>2</sup> = 0%	0		
3.3.2 PKP vs PKP									
Liu 2018	3.95	0.69	66	4.03	0.58	67	21.1%	-0.08 [-0.30, 0.14]	
Wang 2019	2.71	0.75	42	2.63	0.78	48	9.9%	0.08 [-0.24, 0.40]	
Subtotal (95% CI)	vo	10040316735	108	000505005	100.07290.72	115	31.0%	-0.03 [-0.21, 0.15]	+
Heterogeneity: Tau <sup>2</sup> = Test for overall effect:	0.00; Cł Z = 0.32	ni² = 0. : (P = (	67, df = ).75)	= 1 (P =	0.41);	² = 0%	6		
Total (95% CI)			485			483	100.0%	-0.08 [-0.18, 0.02]	•
Heterogeneity: Tau <sup>2</sup> =	0.00; Cł	ni² = 3.	29, df =	= 6 (P =	0.77):	1 <sup>2</sup> = 0%	6		
Test for overall effect: . Test for subaroup diffe	Z = 1.63 rences:	(P = ( Chi² =	0.10) 0.51. d	lf = 1 (P	= 0.4	8),  ² =	0%		-1 -0.5 0 0.5 1 Favours [HVC] Favours [LVC]

Figure 4. (A) Subgroup analysis of injected cement volume based on different surgical methods. (B) Sensitivity analysis of injected cement volume based on different surgical methods.

leakage rates as high as 65.0%). Loeffel et al<sup>[44]</sup> concluded that fractures are likely to cause the endplate of cartilage to break due to basic diseases such as osteoporosis, and it is more likely that the puncture needle penetrates the cartilage plate during the operation, at which time the bone cement will enter the intervertebral disc along the fracture. The author believes that the dispersion difference caused by the difference in bone cement viscosity is an important factor that affects the bone cement leakage of the intervertebral disc, the bone cement has higher viscosity and lower fluidity, and it is cloud-like during its injection flow instead of having a finger flow, which makes the dispersion of high-viscosity bone cement in the injured vertebrae more uniform, simultaneously increasing the flow resistance in the injured vertebra. Therefore, the flow force of bone cement along the retrograde bone trabecula and the damaged upper and lower cartilage endplate is also lower than that of the low-viscosity bone cement, and the possibility of breaking through the upper and lower endplates is reduced.

We define 1 to 3 months as a short-term follow-up, 4 to 12 months as a mid-term follow-up, and more than 12 months as a long-term follow-up. A total of 9 randomized controlled trials reported data on VAS. The meta-analysis results showed that the VAS score of the HVC group was lower than that of the LVC group, indicating that the clinical effect of HVC was better

STURN OF SUBRITOUD	HVC		LVC			KISK Katio	RISK RATIO
	Events	Total	Events	Total	Weight	M-H, Random, 95% C	M-H. Random, 95% Cl
3.3.3 PVP vs PVP							
Alhashash 2019	9	37	20	36	8.3%	0.44 [0.23, 0.83]	
Fang 2019	9	100	27	100	7.7%	0.33 [0.17, 0.67]	
Guo 2017	27	98	63	86	11.1%	0.38 [0.27, 0.53]	- 1000
Huang 2014	14	98	50	92	9.4%	0.26 [0.16, 0.44]	
Liu 2018	4	64	11	68	4.9%	0.39 [0.13, 1.15]	
Xu 2014	22	98	61	92	10.6%	0.34 [0.23, 0.50]	
Yang 2017	6	45	26	45	7.0%	0.23 [0.11, 0.51]	
Zhang 2015	5	1/	15	22	6.9%	0.43 [0.20, 0.95]	× 1
Subtotal (95% CI)		55/		541	65.9%	0.34 [0.28, 0.42]	
l otal events	96		273				
Test for overall effect: 2	Z = 10.87	= 3.25, (P < 0.0	at = 7 (P 00001)	= 0.86	o); I^ = 0%		
3.3.3 PVP vs PKP							
Li 2016	8	49	13	49	6.9%	0.62 [0.28, 1.35]	+
Liu 2018	4	64	10	67	4.8%	0.42 [0.14, 1.27]	
Lv 2020	4	33	15	33	5.5%	0.27 [0.10, 0.72]	· · · _
Zhou 2015	25	56	16	54	9.6%	1.51 [0.91, 2.49]	
Subtotal (95% CI)		202		203	26.7%	0.61 [0.26, 1.42]	-
Total events	41		54				
Heterogeneity: Tau <sup>2</sup> = Test for overall effect: 2	0.54; Chi² Z = 1.15 (F	= 12.83 P = 0.25	3, df = 3 ( 5)	P = 0.0	105); l² = 7	7%	
3.3.3 PKP vs PKP							
Liu 2018	3	66	10	67	4.1%	0.30 [0.09, 1.06]	
Wang 2019	2	42	11	48	3.3%	0.21 [0.05, 0.88]	
Subtotal (95% CI)		108		115	7.4%	0.26 [0.10, 0.67]	
Total events	5		21				
Heterogeneity: Tau <sup>2</sup> =	0.00; Chi <sup>2</sup>	= 0.15,	df = 1 (P	= 0.69	);  ² = 0%		
Test for overall effect:	Z = 2.81 (F	P = 0.00	05)				
rest for overall effect.		- 0.0	,				
Total (95% CI)	142	867	349	859	100.0%	0.40 [0.29, 0.54]	•
Total (95% CI) Total events	142 0 19: Chi <sup>2</sup>	867 = 35 0	348	859 (P = 0	100.0%	0.40 [0.29, 0.54] = 63%	•
Total (95% Cl) Total events Heterogeneity: Tau <sup>2</sup> = 1	142 0.19; Chi <sup>2</sup> 7 = 5 91 (5	867 = 35.04	348 4, df = 13	859 (P = 0	100.0% .0008); l <sup>2</sup> =	0.40 [0.29, 0.54] = 63%	• · · · · · · · · · · · · · · · · · · ·
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2	142 0.19; Chi <sup>2</sup> Z = 5.91 (F	867 = 35.04 P < 0.00	348 4, df = 13 0001) 14, df = 2	859 (P = 0 (P = 0	100.0% .0008); l <sup>2</sup> = 34) l <sup>2</sup> = 6	0.40 [0.29, 0.54] = 63%	0.01 0.1 1 10 10 Favours [HVC] Favours [LVC]
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = Test for overall effect : Test for suboroup diffe	142 0.19; Chi <sup>2</sup> Z = 5.91 (F rences: Ch	867 = 35.04 <sup>2</sup> < 0.00 hi <sup>2</sup> = 2.1	348 4, df = 13 0001) 14. df = 2	859 (P = 0 (P = 0	100.0% .0008); l² = .34). l² = 6	0.40 [0.29, 0.54] = 63% .5%	.0.01 0.1 1 10 10     Favours [HVC] Favours [LVC]
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2 Test for subgroup diffe B	142 0.19; Chi <sup>2</sup> Z = 5.91 (F rences: Ch HVC	867 = 35.0 - < 0.0 hi <sup>2</sup> = 2.	348 4, df = 13 0001) 14. df = 2 LVC	859 (P = 0 (P = 0	100.0% .0008); l <sup>2</sup> = .34), l <sup>2</sup> = 6	0.40 [0.29, 0.54] = 63% .5% Risk Ratio	0.01 0.1 1 10 10 Favours [HVC] Favours [LVC]
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: $i$ Test for subgroup diffe B Study or Subgroup	142 0.19; Chi <sup>2</sup> Z = 5.91 (F rences: Ch HVC Events	867 = 35.0 <sup>2</sup> < 0.00 hi <sup>2</sup> = 2. <sup>-</sup> Total	348 4, df = 13 0001) 14. df = 2 LVC Events	859 (P = 0 (P = 0 <u>Total</u>	100.0% .0008); I <sup>2</sup> = .34). I <sup>2</sup> = 6 <u>Weight</u>	0.40 [0.29, 0.54] = 63% .5% Risk Ratio <u>M-H. Random. 95% C</u>	O.01 0.1 1 10 10     Favours [HVC] Favours [LVC]     Risk Ratio     M-H. Random. 95% Cl
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2 Test for subgroup diffe Study or Subgroup 3.3.3 PVP vs PVP	142 0.19; Chi <sup>2</sup> Z = 5.91 (F rences: Ch HVC <u>Events</u>	867 = 35.0 > < 0.00 hi <sup>2</sup> = 2. Total	348 4, df = 13 0001) 14. df = 2 LVC Events	859 (P = 0 (P = 0 <u>Total</u>	100.0% .0008); I <sup>2</sup> = .34). I <sup>2</sup> = 6 <u>Weight</u>	0.40 [0.29, 0.54] = 63% .5% Risk Ratio <u>M-H. Random. 95% Cl</u>	O.01 0.1 1 10 10     Favours [HVC] Favours [LVC]     Risk Ratio     M-H. Random. 95% Cl
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2 Test for subgroup diffe 3 Study or Subgroup 3.3.3 PVP vs PVP Alhashash 2019	142 0.19; Chi <sup>2</sup> Z = 5.91 (F rences: Ch HVC Events 9	867 = 35.04 > < 0.00 hi <sup>2</sup> = 2.1 Total 37	348 4, df = 13 0001) 14. df = 2 LVC Events 20	859 (P = 0 (P = 0. <u>Total</u> 36	100.0% .0008); l <sup>2</sup> = .34), l <sup>2</sup> = 6 <u>Weight</u> 8.7%	0.40 [0.29, 0.54] = 63% .5% Risk Ratio <u>M-H. Random. 95% Cl</u> 0.44 [0.23, 0.83]	
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Tost for overall effect: 2 Test for subgroup diffe 3 Study or Subgroup 3.3.3 PVP vs PVP Alhashash 2019 Fang 2019	142 0.19; Chi <sup>2</sup> Z = 5.91 (F rences: Ch HVC <u>Events</u> 9 9	867 = 35.0 - < 0.0 = 2. - - - - - - - - - - - - - - - - - - -	348 4, df = 13 0001) 14. df = 2 LVC Events 20 27	859 (P = 0 (P = 0. <u>Total</u> 36 100	100.0% .0008); l <sup>2</sup> = .34), l <sup>2</sup> = 6 <u>Weight</u> 8.7% 7.2%	0.40 [0.29, 0.54] = 63% .5% Risk Ratio M-H. Random. 95% Cl 0.44 [0.23, 0.83] 0.33 [0.17, 0.67]	
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = I Tost for overall effect: 7 Test for suboroup diffe 3.3.3 PVP vs PVP Alhashash 2019 Fang 2019 Guo 2017	142 0.19; Chi <sup>2</sup> Z = 5.91 (F rences: Ch HVC Events 9 9 27	867 = 35.0 > < 0.0 hi <sup>2</sup> = 2. Total 37 100 98	348 4, df = 13 0001) 14. df = 2 LVC <u>Events</u> 20 27 63	859 (P = 0 (P = 0 <b>Total</b> 36 100 86	100.0% .0008);   <sup>2</sup> = .34).   <sup>2</sup> = 6 <u>Weight</u> 8.7% 7.2% 29.8%	0.40 [0.29, 0.54] = 63% .5% Risk Ratio M-H. Random. 95% Cl 0.44 [0.23, 0.83] 0.33 [0.17, 0.67] 0.38 [0.27, 0.53]	
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect : Test for subgroup diffe Study or Subgroup 3.3.3 PVP vs PVP Alhashash 2019 Fang 2019 Guo 2017 Huang 2014	142 0.19; Chi <sup>2</sup> Z = 5.91 (F rences: Ch HVC Events 9 9 9 27 14	867 = 35.0 > < 0.0 hi <sup>2</sup> = 2. Total 37 100 98 98	348 4, df = 13 0001) 14. df = 2 LVC <u>Events</u> 20 27 63 50	859 (P = 0 (P = 0 <b>Total</b> 36 100 86 92	100.0% .0008);   <sup>2</sup> = .34).   <sup>2</sup> = 6 <u>Weight</u> 8.7% 7.2% 29.8% 13.2%	0.40 [0.29, 0.54] = 63% .5% Risk Ratio M-H. Random. 95% Cl 0.44 [0.23, 0.83] 0.33 [0.17, 0.67] 0.38 [0.27, 0.53] 0.26 [0.16, 0.44]	O.01 0.1 1 10 10     Favours [HVC] Favours [LVC]     Risk Ratio     M-H. Random. 95% Cl
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect : Test for subgroup diffe <b>3</b> 3.3.3 PVP vs PVP Alhashash 2019 Fang 2019 Guo 2017 Huang 2014 Liu 2018	142 0.19; Chi <sup>2</sup> Z = 5.91 (F rences: Ch HVC <u>Events</u> 9 9 9 27 14 4 4	867 = 35.0 > < 0.0 hi <sup>2</sup> = 2. Total 37 100 98 98 64	348 4, df = 13 0001) 14. df = 2 LVC Events 20 27 63 50 11	859 (P = 0 (P = 0) <b>Total</b> 36 100 86 92 68	100.0% .0008);  ² = .34).  ² = 6 <u>Weight</u> 8.7% 7.2% 29.8% 13.2% 3.0%	0.40 [0.29, 0.54] = 63% .5% Risk Ratio M-H. Random. 95% Cl 0.44 [0.23, 0.83] 0.33 [0.17, 0.67] 0.38 [0.27, 0.53] 0.26 [0.16, 0.44] 0.39 [0.13, 1.15]	0.01 0.1 1 10 10 Favours [HVC] Favours [LVC] Risk Ratio M-H. Random. 95% Cl
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 3 Test for subgroup 3.3.3 PVP vs PVP Alhashash 2019 Fang 2019 Guo 2017 Huang 2014 Liu 2018 Xu 2014	142 0.19; Chi <sup>2</sup> Z = 5.91 (F rences: Ch HVC <u>Events</u> 9 9 9 27 14 4 22	<b>867</b> = 35.00 P < 0.00 ni <sup>2</sup> = 2. <b>Total</b> 37 100 98 98 64 98	348 4, df = 13 0001) 14. df = 2 LVC <u>Events</u> 20 27 63 50 11 61	859 (P = 0 (P = 0) <b>Total</b> 36 100 86 92 68 92	100.0% .0008);   <sup>2</sup> = .34).   <sup>2</sup> = 6 <u>Weight</u> 8.7% 7.2% 29.8% 13.2% 3.0% 22.7%	0.40 [0.29, 0.54] = 63% .5% Risk Ratio M-H. Random. 95% C 0.44 [0.23, 0.83] 0.33 [0.17, 0.67] 0.38 [0.27, 0.53] 0.26 [0.16, 0.44] 0.39 [0.13, 1.15] 0.34 [0.23, 0.50]	0.01 0.1 1 10 10 Favours [HVC] Favours [LVC] Risk Ratio M-H. Random. 95% Cl
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: <i>i</i> Test for subgroup <b>3.3.3 PVP vs PVP</b> Alhashash 2019 Fang 2019 Guo 2017 Huang 2014 Liu 2018 Xu 2014 Yang 2017	142 0.19; Chi <sup>2</sup> Z = 5.91 (F rences: Ch HVC <u>Events</u> 9 9 9 27 14 4 4 22 6	<b>867</b> = 35.00 P < 0.00 ni <sup>2</sup> = 2. <b>Total</b> 37 100 98 98 64 98 64 98	348 4, df = 13 0001) 14. df = 2 LVC <u>Events</u> 20 27 63 50 11 61 26	859 (P = 0 (P = 0 <b>Total</b> 36 100 86 92 68 92 45	100.0% .0008);   <sup>2</sup> = 34).   <sup>2</sup> = 6 <u>Weight</u> 8.7% 7.2% 29.8% 13.2% 3.0% 22.7% 5.8%	0.40 [0.29, 0.54] = 63% .5% Risk Ratio M-H. Random. 95% C 0.44 [0.23, 0.83] 0.33 [0.17, 0.67] 0.38 [0.27, 0.53] 0.26 [0.16, 0.44] 0.39 [0.13, 1.15] 0.34 [0.23, 0.50] 0.23 [0.11, 0.51]	0.01 0.1 1 10 10 Favours [HVC] Favours [LVC] Risk Ratio M-H. Random. 95% Cl
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: <i>i</i> Test for subgroup <b>3.3.3 PVP vs PVP</b> Alhashash 2019 Fang 2019 Guo 2017 Huang 2014 Liu 2018 Xu 2014 Yang 2015	142 0.19; Chi <sup>2</sup> Z = 5.91 (F rences: Cl HVC <u>Events</u> 9 9 27 14 4 4 22 6 5	867 = 35.0 > < 0.00 ni <sup>2</sup> = 2. Total 37 100 98 98 64 98 64 98 45 17	348 4, df = 13 0001) 14. df = 2 LVC Events 20 27 63 50 11 61 26 15	859 (P = 0 (P = 0 <b>Total</b> 36 100 86 92 68 92 68 92 52	100.0% .0008);   <sup>2</sup> = .34),   <sup>2</sup> = 6 <u>Weight</u> 8.7% 7.2% 29.8% 13.2% 3.0% 22.7% 5.8% 5.7% 0.000	0.40 [0.29, 0.54] = 63% .5% Risk Ratio M-H. Random. 95% C 0.44 [0.23, 0.83] 0.33 [0.17, 0.67] 0.38 [0.27, 0.53] 0.26 [0.16, 0.44] 0.39 [0.13, 1.15] 0.34 [0.23, 0.50] 0.23 [0.11, 0.51] 0.43 [0.20, 0.95]	0.01 0.1 1 10 10 Favours [HVC] Favours [LVC] Risk Ratio M-H. Random. 95% Cl
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2 Test for subgroup 3.3.3 PVP vs PVP Alhashash 2019 Fang 2019 Guo 2017 Huang 2014 Liu 2018 Xu 2014 Yang 2015 Subtotal (95% CI)	142 0.19; Chi <sup>2</sup> Z = 5.91 (F rences: Cł HVC <u>Events</u> 9 9 9 27 14 4 22 6 5	867 = 35.00 > < 0.00 ni <sup>2</sup> = 2. Total 37 100 98 98 64 98 64 98 45 17 557	348 4, df = 13 0001) 14. df = 2 LVC Events 20 27 63 50 11 61 26 15	859 (P = 0 (P = 0 <b>Total</b> 36 100 86 92 68 92 45 22 541	100.0% .0008);   <sup>2</sup> = .34),   <sup>2</sup> = 6 <u>Weight</u> 8.7% 7.2% 29.8% 13.2% 3.0% 22.7% 5.8% 5.7% 96.0%	0.40 [0.29, 0.54] = 63% .5% Risk Ratio M-H. Random. 95% Cl 0.44 [0.23, 0.83] 0.33 [0.17, 0.67] 0.38 [0.27, 0.53] 0.26 [0.16, 0.44] 0.39 [0.13, 1.15] 0.34 [0.23, 0.50] 0.23 [0.11, 0.51] 0.43 [0.20, 0.95] 0.34 [0.28, 0.42]	♦ 0.01 0.1 1 10 10 Favours [HVC] Favours [LVC] Risk Ratio M-H. Random. 95% Cl
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect : Test for subgroup 3.3.3 PVP vs PVP Alhashash 2019 Fang 2019 Guo 2017 Huang 2014 Liu 2018 Xu 2014 Yang 2017 Zhang 2015 Subtotal (95% CI) Total events	142 0.19; Chi <sup>2</sup> Z = 5.91 (F rences: Ch HVC <u>Events</u> 9 9 9 27 14 4 22 6 5 9 6 5	867 = 35.0 > < 0.0 hi <sup>2</sup> = 2. <sup>-</sup> Total 37 100 98 98 64 98 64 98 45 17 557	348 4, df = 13 0001) 14. df = 2 LVC Events 20 27 63 50 11 61 26 15 273	859 (P = 0 (P = 0 Total 36 100 86 92 68 92 45 22 541	100.0% .0008);   <sup>2</sup> = .34).   <sup>2</sup> = 6 <u>Weight</u> 8.7% 7.2% 29.8% 13.2% 3.0% 22.7% 5.8% 5.7% 96.0%	0.40 [0.29, 0.54] = 63% .5% Risk Ratio M-H. Random. 95% Cl 0.44 [0.23, 0.83] 0.33 [0.17, 0.67] 0.38 [0.27, 0.53] 0.26 [0.16, 0.44] 0.39 [0.13, 1.15] 0.34 [0.23, 0.50] 0.23 [0.11, 0.51] 0.43 [0.20, 0.95] 0.34 [0.28, 0.42]	O.01 0.1 1 10 10     Favours [LVC]     Risk Ratio     M-H. Random. 95% Cl
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 3 Study or Subgroup 3.3.3 PVP vs PVP Alhashash 2019 Guo 2017 Huang 2014 Liu 2018 Xu 2014 Yang 2017 Zhang 2015 Subtotal (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1	142 0.19; Chi <sup>2</sup> Z = 5.91 (f rences: Cl HVC <u>Events</u> 9 9 9 27 14 4 22 6 5 96 0.00; Chi <sup>2</sup> Z = 10.87	867 = 35.0- - < 0.00 - < 0.00 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 	348 4, df = 13 0001) 14. df = 2 LVC <u>Events</u> 20 27 63 50 11 61 26 15 273 , df = 7 (F 00001)	859 (P = 0 (P = 0 Total 36 100 86 92 68 92 45 22 541 = 0.86	100.0% .0008);   <sup>2</sup> = .34).   <sup>2</sup> = 6 <u>Weight</u> 8.7% 7.2% 29.8% 13.2% 3.0% 22.7% 5.8% 5.7% 96,0% 3);   <sup>2</sup> = 0%	0.40 [0.29, 0.54] = 63% .5% Risk Ratio M-H. Random. 95% CI 0.44 [0.23, 0.83] 0.33 [0.17, 0.67] 0.38 [0.27, 0.53] 0.26 [0.16, 0.44] 0.39 [0.13, 1.15] 0.34 [0.23, 0.50] 0.23 [0.11, 0.51] 0.43 [0.20, 0.95] 0.34 [0.28, 0.42]	O.01 0.1 1 10 10     Favours [HVC] Favours [LVC]     Risk Ratio     M-H. Random. 95% Cl
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 1 Test for subgroup 3.3.3 PVP vs PVP Alhashash 2019 Fang 2019 Guo 2017 Huang 2014 Liu 2018 Xu 2014 Yang 2017 Zhang 2015 Subtotal (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 1 3.3.3 PKP vs PKP	142 0.19; Chi <sup>2</sup> Z = 5.91 (F rences: Ch HVC Events 9 9 9 27 14 4 22 6 5 5 96 0.00; Chi <sup>2</sup> Z = 10.87	867 = 35.0.0 > < 0.01 = 35.0.0 = 37.0.0 = 37.0.0 = 38.0.0 = 35.0.0 = 38.0.0 = 38.0.0 = 35.0.0 = 38.0.0 = 35.0.0 = 37.0.0 = 37.0.0	348 4, df = 13 0001) 14. df = 2 LVC Events 20 27 63 50 11 61 26 15 273 , df = 7 (F 00001)	859 (P = 0 (P = 0 Total 36 100 86 92 68 92 45 22 541 = 0.86	100.0% .0008);   <sup>2</sup> = .34).   <sup>2</sup> = 6 <u>Weight</u> 8.7% 7.2% 29.8% 13.2% 3.0% 22.7% 5.8% 5.7% 96.0% 5);   <sup>2</sup> = 0%	0.40 [0.29, 0.54] = 63% .5% Risk Ratio M-H. Random. 95% Cl 0.44 [0.23, 0.83] 0.33 [0.17, 0.67] 0.38 [0.27, 0.53] 0.26 [0.16, 0.44] 0.39 [0.13, 1.15] 0.34 [0.23, 0.50] 0.23 [0.11, 0.51] 0.43 [0.28, 0.42]	
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Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2 Test for subgroup 3.3.3 PVP vs PVP Alhashash 2019 Guo 2017 Huang 2014 Liu 2018 Xu 2014 Yang 2017 Zhang 2015 Subtotal (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2 3.3.3 PKP vs PKP Liu 2018 Wang 2019 Subtotal (95% CI)	142 0.19; Chi <sup>2</sup> Z = 5.91 (f rences: Ch HVC Events 9 9 27 14 4 22 6 5 96 0.00; Chi <sup>2</sup> Z = 10.87 3 2	867 = 35.0.0 > < 0.00 ni <sup>2</sup> = 2.	348 4, df = 13 0001) 14. df = 2 LVC Events 20 27 63 50 11 61 26 15 273 , df = 7 (F 00001) 10	859 (P = 0 (P = 0 Total 366 92 68 92 68 92 541 541 = 0.86 67 48 115	100.0% .0008);   <sup>2</sup> = .34).   <sup>2</sup> = 6 <u>Weight</u> 8.7% 7.2% 29.8% 13.2% 3.0% 22.7% 5.8% 5.7% 96.0° 96,0° 97,0° 1.7% 4.0%	0.40 [0.29, 0.54] = 63% .5% Risk Ratio M-H. Random. 95% CI 0.44 [0.23, 0.83] 0.33 [0.17, 0.67] 0.38 [0.27, 0.53] 0.26 [0.16, 0.44] 0.39 [0.13, 1.15] 0.34 [0.23, 0.50] 0.23 [0.11, 0.51] 0.43 [0.20, 0.95] 0.34 [0.28, 0.42] 0.34 [0.28, 0.42]	0.01 0.1 1 10 10 Favours [HVC] Favours [LVC] Risk Ratio M-H. Random. 95% Cl
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Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2 Test for subgroup 3.3.3 PVP vs PVP Alhashash 2019 Fang 2019 Guo 2017 Huang 2014 Liu 2018 Xu 2014 Yang 2017 Zhang 2015 Subtotal (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = Test for overall effect: 2 3.3.3 PKP vs PKP Liu 2018 Wang 2019 Subtotal (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = Heterogeneity: Tau <sup>2</sup> = Subtotal (95% CI) Total events Heterogeneity: Tau <sup>2</sup> =	142 0.19; Chi <sup>2</sup> Z = 5.91 (F rences: Ch <b>Events</b> 9 9 9 27 14 4 22 6 5 96 0.00; Chi <sup>2</sup> Z = 10.87 3 2 2 5 0.00; Chi <sup>2</sup>	867 = 35.00 > < 0.01    <sup>2</sup> = 2. : Total 37 100 98 98 64 99 98 64 45 17 557 = 3.25; (P < 0.1 66 42 108 = 0.15	348 4, df = 13 0001) 14. df = 2 LVC Events 20 27 63 50 11 61 26 15 273 , df = 7 (F 00001) 10 11 21 . df = 1 (F	859 (P = 0 (P = 0) Total 36 100 86 92 68 92 45 22 541 = 0.86 67 48 115 = 0.66	100.0% .0008);   <sup>2</sup> = .34),   <sup>2</sup> = 6 <u>Weight</u> 8.7% 7.2% 29.8% 13.2% 3.0% 22.7% 5.8% 5.7% 96.0% 5);   <sup>2</sup> = 0% 2.3% 1.7% 4.0% 5);   <sup>2</sup> = 0%	0.40 [0.29, 0.54] = 63% .5% Risk Ratio M-H. Random. 95% Cl 0.44 [0.23, 0.83] 0.33 [0.17, 0.67] 0.38 [0.27, 0.53] 0.26 [0.16, 0.44] 0.39 [0.13, 1.15] 0.34 [0.23, 0.51] 0.34 [0.23, 0.05] 0.34 [0.28, 0.42] 0.30 [0.09, 1.06] 0.21 [0.05, 0.88] 0.26 [0.10, 0.67]	O.01 O.1 1 10 10 Favours [LVC] Risk Ratio M-H. Random. 95% Cl
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2 Test for subgroup 3.3.3 PVP vs PVP Alhashash 2019 Fang 2019 Guo 2017 Huang 2014 Liu 2018 Xu 2014 Yang 2017 Zhang 2015 Subtotal (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2 3.3.3 PKP vs PKP Liu 2018 Wang 2019 Subtotal (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2 Subtotal (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2 Subtotal (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2 Test for overa	142 0.19; Chi <sup>2</sup> Z = 5.91 (F rences: Ch HVC Events 9 9 9 27 14 4 22 6 5 96 0.00; Chi <sup>2</sup> Z = 10.87 3 2 5 0.00; Chi <sup>2</sup> Z = 2.81 (F	867 = 35.0.0 > < 0.00 ni <sup>2</sup> = 2. Total 37 100 98 98 64 98 64 98 64 98 557 = 3.25 (P < 0.0 66 42 108 = 0.15,0 0 = 0.05	348 4, df = 13 0001) 14. df = 2 LVC Events 20 27 63 50 11 61 26 15 273 , df = 7 (F 00001) 10 11 21 , df = 1 (F 05)	859 (P = 0 (P = 0 Total 366 100 86 92 68 92 45 522 541 = 0.86 67 48 115 = 0.65	100.0% .0008);   <sup>2</sup> = 34).   <sup>2</sup> = 6 <u>Weight</u> 8.7% 7.2% 29.8% 13.2% 3.0% 22.7% 5.7% 96.0% 5.7% 96.0% 2.3% 1.7% 4.0% 4.0%	0.40 [0.29, 0.54] = 63% .5% Risk Ratio M-H. Random. 95% C 0.44 [0.23, 0.83] 0.33 [0.17, 0.67] 0.38 [0.27, 0.53] 0.26 [0.16, 0.44] 0.39 [0.13, 1.15] 0.34 [0.23, 0.50] 0.23 [0.11, 0.51] 0.43 [0.28, 0.42] 0.34 [0.28, 0.42] 0.30 [0.09, 1.06] 0.21 [0.05, 0.88] 0.26 [0.10, 0.67]	0.01 0.1 1 10 10 Favours [LVC] Risk Ratio M-H. Random. 95% Cl
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2 Test for subgroup 3.3.3 PVP vs PVP Alhashash 2019 Fang 2019 Guo 2017 Huang 2014 Liu 2018 Xu 2014 Yang 2017 Zhang 2015 Subtotal (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2 3.3.3 PKP vs PKP Liu 2018 Wang 2019 Subtotal (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2 Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2 Total (95% CI)	142 0.19; Chi <sup>2</sup> Z = 5.91 (F rences: Ch HVC Events 9 9 9 27 14 4 22 6 5 96 0.00; Chi <sup>2</sup> Z = 10.87 3 2 5 0.00; Chi <sup>2</sup> Z = 2.81 (F	867 = 35.0· - < 0.0i <sup>12</sup> = 2.	348 4, df = 13 0001) 14. df = 2 LVC Events 20 27 63 50 11 61 26 15 273 , df = 7 (F 00001) 10 11 21 , df = 1 (F 05)	859 (P = 0 (P = 0 Total 36 100 86 92 68 89 22 541 = 0.86 67 48 115 = 0.65	100.0% .0008);   <sup>2</sup> = .34).   <sup>2</sup> = 6 <u>Weight</u> 8.7% 7.2% 29.8% 13.2% 3.0% 22.7% 5.8% 5.7% 96.0% 5.7% 96.0% 3.0% 22.3% 1.7% 4.0% 4.0% 100.0%	0.40 [0.29, 0.54] = 63% .5% Risk Ratio M-H. Random. 95% CI 0.44 [0.23, 0.83] 0.33 [0.17, 0.67] 0.38 [0.27, 0.53] 0.26 [0.16, 0.44] 0.39 [0.13, 1.15] 0.34 [0.28, 0.42] 0.34 [0.28, 0.42] 0.30 [0.09, 1.06] 0.21 [0.05, 0.88] 0.26 [0.10, 0.67] 0.34 [0.28, 0.41]	O.01 O.1 1 10 10 Favours [LVC] Risk Ratio M-H. Random. 95% Cl
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 1 Test for subgroup 3.3.3 PVP vs PVP Alhashash 2019 Fang 2019 Guo 2017 Huang 2014 Liu 2018 Xu 2014 Yang 2017 Zhang 2015 Subtotal (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = Test for overall effect: 1 3.3.3 PKP vs PKP Liu 2018 Wang 2019 Subtotal (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = Test for overall effect: 1 Total events Heterogeneity: Tau <sup>2</sup> = Test for overall effect: 1 Total events Heterogeneity: Tau <sup>2</sup> = Test for overall effect: 1 Total (95% CI) Total events	142 0.19; Chi <sup>2</sup> Z = 5.91 (F rences: Ch HVC Events 9 9 9 27 14 4 22 6 5 96 0.00; Chi <sup>2</sup> Z = 10.87 3 2 2 5 0.00; Chi <sup>2</sup> Z = 2.81 (F	867 = 35.0- < 0.00 = 2.0.0 Total 37 100 98 98 64 98 64 98 557 = 3.25 (P < 0.1 66 42 108 = 0.15 D = 0.00 665	348 4, df = 13 0001) 14. df = 2 LVC Events 20 27 63 50 11 61 26 15 273 , df = 7 (F 00001) 10 11 21 , df = 1 (F 05) 294	859 (P = 0 (P = 0 Total 366 100 86 92 68 92 45 52 22 541 = 0.86 67 48 115 = 0.66	100.0% .0008);   <sup>2</sup> = 34).   <sup>2</sup> = 6 Weight 8.7% 7.2% 29.8% 13.2% 3.0% 22.7% 5.7% 96.0% 5.7% 96.0% 5.7% 96.0% 1.7% 4.0% 2.3% 1.7% 4.0% 100.0%	0.40 [0.29, 0.54] = 63% .5% Risk Ratio M-H. Random. 95% CJ 0.44 [0.23, 0.83] 0.33 [0.17, 0.67] 0.38 [0.27, 0.53] 0.26 [0.16, 0.44] 0.39 [0.13, 1.15] 0.34 [0.28, 0.42] 0.34 [0.28, 0.42] 0.30 [0.09, 1.06] 0.21 [0.05, 0.88] 0.26 [0.10, 0.67] 0.34 [0.28, 0.41]	O.01 O.1 1 10 10 Favours [LVC] Risk Ratio H-H. Random. 95% Cl
Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2 Test for suboroup diffe 3 Study or Subgroup 3.3.3 PVP vs PVP Alhashash 2019 Guo 2017 Huang 2014 Liu 2018 Xu 2014 Yang 2017 Zhang 2015 Subtotal (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2 3.3.3 PKP vs PKP Liu 2018 Wang 2019 Subtotal (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2 Total events Heterogeneity: Tau <sup>2</sup> = 1 Test for overall effect: 2 Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Total (95% CI) Total events Heterogeneity: Tau <sup>2</sup> = 1 Total (95% CI)	142 0.19; Chi <sup>2</sup> Z = 5.91 (F rences: Ch HVC Events 9 9 9 27 14 4 22 6 5 0.00; Chi <sup>2</sup> Z = 10.87 3 2 2 0.00; Chi <sup>2</sup> Z = 2.81 (F 101 0.00; Chi <sup>2</sup>	867 = 35.0.0 < 0.00 - <	348 4, df = 13 0001) 14. df = 2 LVC Events 20 27 63 50 11 61 26 15 273 , df = 7 (F 00001) 10 11 21 , df = 1 (F 05) 294 , df = 9 (F	859 (P = 0 (P = 0 <u>Total</u> 366 100 86 92 68 92 45 522 541 = 0.86 67 48 115 = 0.65 656 = 0.93	100.0% .0008);   <sup>2</sup> = 34).   <sup>2</sup> = 6 <u>Weight</u> 8.7% 7.2% 29.8% 13.2% 3.0% 22.7% 5.8% 5.7% 5.7% 5.7% 96.0% 13.2% 3.0% 22.7% 5.7% 5.7% 5.7% 96.0% 1.7% 4.0% 4.0% 100.0% 1);   <sup>2</sup> = 0%	0.40 [0.29, 0.54] = 63% .5% Risk Ratio M-H. Random. 95% CI 0.44 [0.23, 0.83] 0.33 [0.17, 0.67] 0.38 [0.27, 0.53] 0.26 [0.16, 0.44] 0.39 [0.13, 1.15] 0.34 [0.23, 0.50] 0.23 [0.11, 0.51] 0.43 [0.28, 0.42] 0.30 [0.09, 1.06] 0.21 [0.05, 0.88] 0.26 [0.10, 0.67] 0.34 [0.28, 0.41]	

Figure 5. (A) Subgroup analysis of cement leakage based on different surgical methods. (B) Sensitivity analysis of cement leakage based on different surgical methods.

than that of LVC. A further analysis of the subgroup showed that there were no significant differences between the 2 groups before surgery, mid-term and long-term follow-up, and in the short-term follow-up alone, the VAS score of the HVC group was less than that of the LVC, but this subgroup was highly heterogeneous. If a sensitivity analysis of the subgroup was excluded, no significant difference could be found between the 2 groups. The study by Guo et al<sup>[20]</sup> also showed that 3 months after surgery, the VAS score of the HVC group was significantly lower than that of the LVC group. Additionally, more studies

Study or Subprove         Events         Total         Weining         Mill         Random. 95% Cl         Mill           Alvatenia         2010         3         37         13         38         9.3%         0.22 (0.7, 0.72)           Fang 2019         2         100         7         100         5.3%         0.02 (0.07, 0.72)           Guo 2017         8         96         21         66         21.8%         0.33 (0.16, 0.72)           Liv 2018         3         130         7         135         7.1%         0.445 (0.12, 1.68)           Liv 2018         0         3         2.33         1.4%         0.20 (0.1, 0.10)         1.4%           Vang 2017         1         4.5         3.1%         0.06 [0.01, 0.68]		HVC		LVC	;		Risk Ratio	Risk Ratio
$ \begin{array}{c} 1.4.1 \ \mbox{ (wall heatings)} \\ Farg 2019 & 2 \ 100 & 7 \ 100 \ 5.5\% & 0.29 \ [0.07, 0.72] \\ Farg 2019 & 2 \ 100 & 7 \ 100 \ 5.5\% & 0.29 \ [0.06, 1.34] \\ Sub201 & 8 \ 98 \ 21 \ 85 \ 21.8\% & 0.29 \ [0.0, 0.40] \\ Lu 2018 & 3 \ 130 \ 7 \ 135 \ 7.5\% & 0.29 \ [0.0, 0.40] \\ Lv 2020 & 0 \ 33 \ 2 \ 33 \ 139 \ 7 \ 135 \ 7.5\% & 0.29 \ [0.0, 0.40] \\ Varg 2019 & 0 \ 42 \ 2 \ 48 \ 1.4\% & 0.29 \ [0.01, 0.40] \\ Varg 2019 & 0 \ 42 \ 2 \ 48 \ 1.4\% & 0.29 \ [0.01, 0.40] \\ Varg 2017 & 1 \ 45 \ 111 \ 45 \ 315 \ 0.09 \ [0.0, 0.40] \\ Varg 2017 & 1 \ 45 \ 111 \ 45 \ 315 \ 0.29 \ [0.10, 0.40] \\ Varg 2017 & 1 \ 45 \ 111 \ 45 \ 115 \ 45 \ 315 \ 0.29 \ [0.10, 0.40] \\ Varg 2017 & 1 \ 45 \ 111 \ 45 \ 115 \ 45 \ 315 \ 0.29 \ [0.10, 0.40] \\ Varg 2017 & 7 \ 98 \ 25 \ 88 \ 2.47\% & 0.28 \ [0.11, 0.51] \\ Sub2tal [85% C] & 681 \ 122 \ 17.4\% & 0.28 \ [0.15, 1.28] \\ Farug 2019 & 2 \ 100 \ 8 \ 100 \ 65\% & 0.29 \ [0.5, 1.15] \\ Farug 2019 & 1 \ 42 \ 3 \ 48 \ 3.1\% & 0.38 \ [0.24, 0.8] \\ Varg 2017 \ 7 \ 98 \ 25 \ 88 \ 2.47\% & 0.25 \ [0.11, 0.51] \\ Varg 2017 \ 7 \ 98 \ 22 \ 17.4\% & 0.47 \ [10.8] \ 2.29 \ [0.5, 1.52] \\ Varg 2017 \ 7 \ 98 \ 22 \ 86 \ 247 \ 7.4\% & 0.38 \ [0.24, 0.8] \ 1.40 \ 2.21 \ 1.65 \ 1.40 \ 2.21 \ 1.40 \ 2.21 \ 1.40 \ 2.21 \ 1.40 \ 2.21 \ 1.40 \ 2.21 \ 1.40 \ 2.21 \ 1.40 \ 2.21 \ 1.40 \ 2.21 \ 1.40 \ 2.21 \ 1.40 \ 2.21 \ 1.40 \ 2.21 \ 1.40 \ 2.21 \ 1.40 \ 2.21 \ 1.40 \ 2.21 \ 1.40 \ 2.21 \ 1.40 \ 2.21 \ 1.40 \ 2.21 \ 1.40 \ 2.21 \ 1.40 \ 2.21 \ 1.40 \ 2.21 \ 1.40 \ 2.40 \ 1.40 \ 2.21 \ 1.40 \ 2.40 \ 1.40 \ 2.21 \ 1.40 \ 2.40 \ 1.40 \ 2.21 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40 \ 2.40 \ 1.40$	Study or Subgroup	Events	Total	Events	Total	Weight	M-H. Random, 95% C	M-H. Random, 95% Cl
Alhabeahe 2019 3 37 13 36 3.3% 0.22 [0.7, 0.72] Fang 2019 2 100 7 100 5.3% 0.29 [0.06, 1.34] Guo 2017 8 98 38 92 25.3% 0.30 [0.16, 0.72] Liu 2018 3 130 7 135 7.1% 0.45 [0.12, 1.66] Liu 2018 3 130 7 135 7.1% 0.45 [0.12, 1.66] Liu 2018 0 42 2 48 1.4% 0.29 [0.01, 4.62] Xu 2014 8 98 38 92 25.3% 0.29 [0.10, 0.68] Subtotal (5% C)  681 667 100.0% 0.29 [0.01, 0.68] Subtotal (fest% C)  681 667 100.0% 0.28 [0.01, 0.68] Guo 2017 7 98 25 68 24.7% 0.29 [0.01, 0.68] Guo 2017 7 98 25 68 24.7% 0.28 [0.11, 0.54] Fang 2019 2 100 8 100 6.6% 0.22 [0.01, 0.68] Guo 2017 7 98 25 68 24.7% 0.48 [0.22 [0.01, 0.68] Guo 2017 7 98 25 68 24.7% 0.48 [0.22 [0.05, 1.15] Fang 2019 2 100 8 100 6.6% 0.28 [0.15, 1.28] Guo 2017 7 98 25 68 24.7% 0.47 [0.18, 1.20] Liu 2018 2 130 3 135 4.9% 0.48 [0.12, 1.05] Liu 2018 2 130 3 135 4.9% 0.48 [0.12, 1.05] Liu 2018 2 130 3 135 4.9% 0.48 [0.12, 1.05] Liu 2018 2 130 3 135 4.9% 0.48 [0.12, 1.05] Liu 2018 2 130 3 135 4.9% 0.48 [0.12, 1.05] Liu 2018 2 130 3 135 4.9% 0.48 [0.12, 1.05] Liu 2018 2 130 3 135 4.9% 0.48 [0.12, 1.05] Liu 2018 2 130 3 135 4.9% 0.48 [0.12, 1.05] Liu 2018 2 130 3 135 4.9% 0.48 [0.12, 1.05] Liu 2018 2 130 3 135 4.9% 0.43 [0.12, 1.30] Liu 2018 2 130 3 135 4.9% 0.43 [0.12, 1.30] Liu 2018 2 130 5 135 4.9% 0.43 [0.12, 1.30] Liu 2018 2 130 5 135 4.9% 0.43 [0.12, 1.30] Liu 2018 2 130 5 135 4.9% 0.43 [0.12, 1.30] Liu 2018 2 130 5 135 4.9% 0.43 [0.12, 1.30] Liu 2018 2 130 5 135 7.8% 0.28 [0.26, 0.56] Liu 2020 2 2 33 3 33 6.0% 0.67 [0.12, 3.73] Kue for overall effect: $2 = 5.05 (p = 0.00007)$ 1.4.3 Paravertebral laekage Alhaehaah 2019 5 37 7 36 16.2% 0.48 [0.28, 1.62] Liu 2018 2 130 5 135 7.8% 0.28 [0.06, 1.10] Liu 2018 2 130 5 135 7.8% 0.28 [0.06, 1.05] Liu 2018 2 130 5 135 7.7% 0.43 [0.12, 3.73] Liu 2018 0 130 2 135 7.7% 0.43 [0.12, 3.73] Liu 2018 0 130 2 135 7.7% 0.43 [0.32, 1.48] Liu 2018 0 130 2 135 7.7% 0.43 [0.32, 1.48] Liu 2018 0 130 2 135 7.7% 0.43 [0.32, 1.48] Liu 2018 0 130 2 135 7.7% 0.43 [0.32, 1.48] Liu 2018 0 130 2 135 7.7% 0.43 [0.32, 1.	1.4.1 Vein leakage							
Fang 2019 2 100 7 100 5.3% 0.29 [0.06, 1.34] Guo 2017 8 6 66 21 85 21.8% 0.33 [0.16, 0.72] Hung 2014 8 66 33 92 25.3% 0.20 [0.10, 0.40] Lu 2018 3 130 7 135 7.1% 0.45 [0.12, 1.68] Lv 2020 0 33 2 33 1.4% 0.23 [0.14, 4.62] Yang 2017 1 4 45 11 45 3.1% 0.09 [0.10, 0.66] Subtotal (95% C) 681 667 100.0% 0.24 [0.17, 0.34] Heterogeneity: Tau <sup>+</sup> = 0.00; Chi <sup>+</sup> = 3.14, df = 8 (P = 0.83); P = 0% Test for overall effect: Z = 7.94 (P < 0.00001) 1.4.2 Intervertabral disc leakage Alhashash 2019 4 37 9 36 13.0% 0.43 [0.15, 1.28] Guo 2017 7 8 68 22 47.% 0.25 [0.11, 0.54] Huang 2014 6 68 12 22 17.4% 0.47 [0.18, 1.20] Lu 2018 2 130 3 135 4.9% 0.66 [0.12, 4.08] Lu 2018 2 130 3 135 4.9% 0.66 [0.12, 4.08] Lu 2018 2 130 3 135 4.9% 0.66 [0.12, 4.08] Lu 2018 2 130 3 135 4.9% 0.66 [0.12, 4.08] Lu 2018 2 130 3 135 4.9% 0.66 [0.12, 4.08] Lu 2018 2 130 3 135 4.9% 0.66 [0.12, 4.08] Lu 2018 2 130 3 135 4.9% 0.66 [0.22, 1.10] Wang 2019 1 4.42 3 48 3.1% 0.38 [0.64, 3.52] Wang 2019 1 4.42 5.46 [P = 0.92]; P = 0% Test for overall effect: Z = 5.05 (P < 0.00001) 1.4.2 Paravertabral leakage Alhashash 2019 5 37 7 38 16.2% 0.43 [0.12, 1.55] Subtotal (6% C) 681 66 P 10.0% 0.43 [0.25, 0.54] Total events 32 68 Heterogeneity: Tau <sup>+</sup> = 0.00; Chi <sup>+</sup> = 3.25, df = 8 (P = 0.52); P = 0.% Test for overall effect: Z = 5.05 (P < 0.00001) 1.4.3 Paravertabral leakage Alhashash 2019 5 37 7 7 38 16.2% 0.66 [0.24, 1.99] Total events 32 68 Heterogeneity: Tau <sup>+</sup> = 0.00; Chi <sup>+</sup> = 3.57, df = 7 (P = 0.79); P = 0% Test for overall effect: Z = 5.05 (P < 0.0001) 1.4.4 Intraspinal leakage Alhabasha 2019 5 1 37 7 4 36 14.5% 0.28 [0.03, 1.18] Wang 2019 1 3 27 4 4 86 4.9% 0.23 [0.03, 1.88] Wang 2019 3 1 00 7 100 37 9% 0.43 [0.22, 100] Heterogeneity: Tau <sup>+</sup> = 0.00; Chi <sup>+</sup> = 3.57, df = 7 (P = 0.79); P = 0% Test for overall effect: Z = 2.95 (P = 0.003) 1.4.4 Intraspinal leakage Alhabasha 2019 3 100 7 100 37 9% 0.43 [0.24 [0.03, 2.07] Heterogeneity: Tau <sup>+</sup> = 0.00; Chi <sup>+</sup> = 3.57, df = 4 (P = 0.57); P = 0% Test for overall effect: Z = 2.21 (P	Alhashash 2019	3	37	13	36	9.3%	0.22 [0.07, 0.72]	
Gue 2017 6 6 96 36 92 25.3% 0.29 [0.10, 0.40] Hung 2019 0 42 2 48 1.4% 0.29 [0.0, 0.40] Value 2019 0 42 2 48 1.4% 0.29 [0.0, 4.01] Value 2019 0 42 2 48 1.4% 0.29 [0.0, 4.01] Value 2019 0 42 2 48 1.4% 0.29 [0.0, 4.01] Value 2017 1 45 11 45 3.1% 0.09 [0.0, 0.40] Partograms(Y) $u^{2} = 0.00$ ; Ch <sup>2</sup> = 3.1% $d^{2} = 6(P = 0.33); P = 0\%$ Test for overall effect: Z = 7.94 ( $P < 0.00001$ ) 1.4.2 Interventsbral disc leakage Albestoal 2019 2 100 8 100 6.6% 0.28 [0.05, 1.15] Gue 2017 7 6 86 25 86 24.7% 0.28 [0.05, 1.15] Gue 2017 7 6 86 12 92 17.4% 0.28 [0.11, 0.54] $u^{2}$ 2010 1 42 3 48 3.1% 0.39 [0.04, 3.52] Value 2014 6 68 12 92 17.4% 0.47 [0.15, 1.20] Ual 2018 2 150 3 135 4.9% 0.68 [0.12, 4.08] Ual 2019 1 42 3 48 3.1% 0.39 [0.04, 3.52] Value 2017 6 86 12 92 17.4% 0.47 [0.15, 1.20] Ual 2018 2 150 3 135 6.49% 0.68 [0.12, 4.08] Ual 2018 2 150 3 135 6.49% 0.68 [0.12, 4.08] Ual 2018 2 150 3 135 6.49% 0.68 [0.24, 1.99] Total events 32 66 Heterogeneily: Tau' = 0.00; ChP = 3.25; d' = 6 (P = 0.52); P = 0% Test for overall effect: Z = 5.06 ( $P < 0.00001$ ) 1.4.3 Paravertebral leakage Albeateal 2019 5 37 7 38 16.2% 0.48 [0.12, 1.16] Total events 32 66 Heterogeneily: Tau' = 0.00; ChP = 3.25; d' = 6 (P = 0.52); P = 0% Test for overall effect: Z = 5.06 ( $P < 0.00001$ ) 1.4.3 Paravertebral leakage Albeateal 2019 5 37 7 38 16.2% 0.48 [0.24, 1.99] Total events 31 60 Heterogeneily: Tau' = 0.00; ChP = 3.25; d' = 6 (P = 0.57); P = 0% Test for overall effect: Z = 2.95 ( $P = 0.03$ ) 1.4.4 Intraspinal leakage Albeateal 2019 1 3 77 4 38 14.5% 0.28 [0.03, 2.07] Total events 7 19 Heterogeneily: Tau' = 0.00; ChP = 0.55; d' = 4 (P = 0.57); P = 0% Test for overall effect: Z = 2.21 ( $P = 0.03$ ) 1.4.4 Intraspinal leakage Albeateal 2019 1 3 77 4 38 14.5% 0.24 [0.03, 2.07] Total events 7 19 Heterogeneily: Tau' = 0.00; ChP = 0.55; d' = 4 (P = 0.57); P = 0% Test for overall effect: Z = 2.21 ( $P = 0.03$ ) 1.4.4 Intraspinal leakage Albeateal 2019 1 3 100 7 100 37.9% 0.43 [0.24 [0.30, 2.07] Favour Dif VC[ Favour [L	Fang 2019	2	100	7	100	5.3%	0.29 [0.06, 1.34]	
Huang 2014 6 6 6 7 100.0% 0.48 (0.24, 1.99) Huang 2019 0 42 2 48 1.4% 0.23 (0.01, 4.62) Wang 2019 0 42 2 48 1.4% 0.23 (0.01, 4.62) Wang 2019 0 42 2 48 1.4% 0.23 (0.01, 4.62) Wang 2019 0 42 2 48 1.4% 0.23 (0.01, 4.62) Wang 2019 0 42 2 48 1.4% 0.23 (0.01, 4.62) Wang 2017 1 45 11 45 3.1% Eletrogenelly: Tau <sup>4</sup> = 0.00; Ch <sup>2</sup> = 3.14, df = 6 (P = 0.83); P = 0% Test for overall effect; Z = 7.24 (P < 0.00001) 1.4.2 Intervertabral disc leakage Alhabatasi 2016 4 37 9 36 13.0% Gui 2017 7 0 86 25 86 24.7% O 44 [0.15, 1.28] Heterogenelly: Tau <sup>4</sup> = 0.00; Ch <sup>2</sup> = 3.13 5 4.9% O 44 [0.15, 1.28] Wang 2019 1 42 3 48 3.1% O 43 [0.15, 1.28] Wang 2019 1 42 3 48 3.1% O 43 [0.15, 1.28] U 2020 1 33 7 33 3.7% O 44 [0.02, 1.10] U 2020 1 33 7 33 3.7% O 44 [0.02, 1.10] Wang 2019 1 42 3 48 3.1% O 49 [0.04, 3.52] Wang 2019 1 42 3 46 7 45 9.2% O 43 [0.14, 1.20] U 2020 1 33 7 7 38 16.2% O 43 [0.25, 0.54] O 100 6 69 [0.24, 1.99] Al-k3 Paravertebral leakage Alhabatasi 2019 5 37 7 38 16.2% O 49 [0.02, 2.01] 1.4.3 Paravertebral leakage Alhabatasi 2019 5 37 7 38 16.2% Vang 2017 3 46 7 45 9.2% O 49 [0.02, 2.01] U 2020 Ch <sup>2</sup> = 3.25, df = 8 (P = 0.92); F = 0% Test for overall effect; Z = 5.05 (P < 0.00001) 1.4.3 Paravertebral leakage Alhabatasi 2019 5 37 7 38 16.2% Vang 2019 1 42 5 48 4.0% O 23 [0.02, 1.03] Wang 2019 1 42 5 48 4.0% O 23 [0.03, 1.08] Wang 2019 1 42 5 48 4.0% O 23 [0.03, 1.08] Wang 2019 1 3 100 7 100 37.9% O 40 [0.02, 1.02] Wang 2019 1 3 100 7 100 37.9% O 42 [0.03, 2.07] Alhabatasi 2019 1 3 77 4 38 14.5% O 24 [0.03, 2.07] Heterogeneliy: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 3.05; df = 4 (P = 0.97); F = 0% Test for overall effect; Z = 2.95 (P = 0.03) 1.4.4 Intraspinal leakage Alhabatasi 2019 1 3 100 7 100 37.9% O 42 [0.03, 2.07] D 40 events 7 19 Heterogeneliy: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 0.5; df = 4 (P = 0.97); F = 0.% Test for overall effect; Z = 2.21 (P = 0.03) 1.4.4 Intraspinal leakage Alhabatasi 2019 0 0 42 1 1 48 6.6% O 24 [0.03, 2.07] D 40 events 7 19 Heterogeneliy: Tau <sup>4</sup> = 0.00; Ch <sup>2</sup>	Guo 2017	8	98	21	86	21.8%	0.33 [0.16, 0.72]	
Lu 2018 3 130 7 135 7.1% 0.45 [0.12, 1.68] Lv 2020 0 33 2 3 1.4% 0.29 [0.1, 4.01] Wang 2019 0 42 2 48 1.4% 0.29 [0.1, 4.01] Yang 2017 1 45 11 45 3.1% 0.06 [0.0, 0.69] Wang 2017 1 45 11 45 3.1% 0.09 [0.0, 0.40] Heterogeneity. Tat - 0.00; ChF - 3.14, df = 6 (P - 0.83); P = 0% Test for overall effect: Z = 7.94 (P < 0.00001) 1.4.2 Interventshmid disc leakage Habashash 2019 4 37 9 36 13.0% 0.43 [0.15, 1.28] Heterogeneity. Tat - 0.00; ChF - 3.25, df = 6 (P - 0.83); P = 0% Test for overall effect: Z = 7.94 (P < 0.00001) 1.4.2 Interventshmid disc leakage Habashash 2019 4 37 9 36 13.0% 0.43 [0.15, 1.28] Habashash 2019 4 7 98 25 86 24.7% 0.47 [0.18, 1.20] Un 2010 7 7 98 25 86 24.7% 0.47 [0.18, 1.20] Wang 2019 1 42 3 48 3.1% 0.38 [0.04, 3.52] Wang 2019 1 42 3 48 3.1% 0.38 [0.04, 3.52] Wang 2019 1 42 3 48 3.1% 0.38 [0.04, 3.52] Wang 2019 1 42 5 48 1.0% 0.43 [0.12, 1.15] Subtotal gfrex; Cl) 5 61 6 6 P = 0.29; P = 0% Total events Haterogeneity: Tat = 0.00; ChF = 3.25, df = 6 [P = 0.59]; P = 0% Test for overall effect: Z = 5.00; P < 0.00001) 1.4.3 Paravertebral leakage Alhaehaeh 2010 5 37 7 38 16.2% 0.48 [0.24, 1.99] Mahashash 2019 5 33 7.7 8% 0.22 [0.05, 1.05] Un 2017 9 96 12 48 27.0% 0.46 [0.22, 1.49] Un 2018 2 130 9 135 7.8% 0.23 [0.05, 1.05] Un 2017 9 0 41 42 5 48 4.0% 0.23 [0.03, 1.08] Wang 2019 1 42 5 48 4.0% 0.23 [0.03, 1.08] Wang 2019 1 42 5 48 4.0% 0.23 [0.03, 1.08] Wang 2019 1 42 5 6 8 45 8.0% 0.25 [0.05, 1.11] Mahashash 2016 5 37 7 180 8.3% 0.43 [0.11, 1.61] Mahashash 2019 1 3 77 4 38 14.5% 0.24 [0.03, 2.07] Total events 31 60 Heterogeneity: Tat = 0.00; ChF = 3.25, df = 4 (P = 0.37); P = 0% Test for overall effect: Z = 2.95 (P = 0.03) 1.4.4 Intraspinal leakage Alhaehaeh 2019 1 3 77 4 38 14.5% 0.24 [0.03, 2.07] Total events 7 19 Heterogeneity: Tat = 0.00; ChF = 0.55, df = 4 (P = 0.37); P = 0% Total events 7 19 Heterogeneity: Tat = 0.00; ChF = 0.55, df = 4 (P = 0.37); P = 0% Total events 7 19 Heterogeneity: Tat = 0.00; ChF = 0.55, df = 4 (P = 0.37); P = 0% Total events 7	Huang 2014	8	<del>9</del> 8	38	<del>9</del> 2	25.3%	0.20 [0.10, 0.40]	
Lv 2020 0 0 33 2 33 14% 022 [0.01, 4.01] Vang 2019 0 42 2 445 14% 023 [0.01, 4.62] Xu 2014 8 98 38 92 25.3% 0.20 [0.10, 0.40] Total events 33 139 Heterogeneity: Tau* = 0.00; Ch* = 3.14, df = 6 (P = 0.33); P = 0% Test for overall effect Z = 7.94 (P < 0.0001) 1.4.2 Interventabral disc leakage Alhashash 2019 4 37 9 36 13.0% 0.43 [0.15, 1.28] Alhashash 2019 4 37 9 36 13.0% 0.43 [0.15, 1.25] Fang 2019 2 100 8 100 6.6% 0.22 [0.05, 1.15] Guo 2017 7 98 25 88 24.7% 0.47 [0.16, 1.20] Vang 2014 6 98 12 92 17.4% 0.47 [0.16, 1.20] Vang 2019 1 42 3 48 3.1% 0.38 [0.04, 3.52] Vang 2017 3 45 7 45 9.2% 0.43 [0.15, 1.26] Vang 2017 3 45 7 45 9.2% 0.43 [0.15, 1.26] Total events 32 86 Heterogeneity: Tau* = 0.00; Ch* = 3.25, df = 8 (P = 0.32); P = 0% Test for overall effect: Z = 5.05 (P < 0.0001) 1.4.3 Paravertebral leakage Alhashash 2019 5 37 7 36 16.2% 0.43 [0.24, 1.69] Ua 2017 3 45 7 45 9.2% 0.43 [0.24, 1.65] Subtotal (95% C1) 681 667 100.0% 0.43 [0.22, 1.62] Vang 2017 2 45 8 45 8.0% 0.22 [0.05, 1.65] Uv 2020 2 33 3 33 6.0% 0.67 [0.12, 9.73] Vang 2017 3 445 7 48 4.0% 0.68 [0.24, 1.99] 1.4.4 Intraspinal leakage Alhashash 2019 5 37 7 0.81 152 2.40% 0.68 [0.28, 1.62] Vang 2017 4 9 98 12 26 27.0% 0.68 [0.28, 1.69] Vang 2019 1 42 5 48 4.0% 0.67 [0.12, 9.73] Vang 2017 3 45 7 4 35 7.40% 0.43 [0.11, 1.61] Vang 2018 1 42 5 48 4.0% 0.68 [0.28, 1.62] Vang 2017 3 98 5 78 100.0% 0.43 [0.12, 9.73] Vang 2018 1 42 5 48 4.0% 0.62 [0.02, 1.61] Vang 2019 2 130 9 3 100 7 100 37.9% 0.43 [0.13, 2.14] Vang 2019 3 100 7 100 37.9% 0.43 [0.13, 2.14] Vang 2019 3 100 7 100 37.9% 0.43 [0.14, 1.81] Vang 2019 3 100 7 100 37.9% 0.43 [0.14, 1.61] Vang 2019 3 100 7 100 37.9% 0.43 [0.13, 2.14] Vang 2019 3 100 7 100 37.9% 0.43 [0.14, 2.81] Vang 2019 3 100 7 100 37.9% 0.43 [0.14, 2.81] Vang 2019 3 100 7 100 37.9% 0.43 [0.14, 2.81] Vang 2019 1 3 100 7 100 37.9% 0.43 [0.14, 2.81] Vang 2019 1 3 100 7 100 37.9% 0.43 [0.14, 2.81] Vang 2019 0 1 42 1 148 6.68 0.33 [0.02, 0.86] Subtotal (95% C1) 605 67 -0.030 100 Vang 2019 0 0 42	Liu 2018	3	130	7	135	7.1%	0.45 [0.12, 1.68]	+
Wang 2019 0 42 2 48 1.4% 0.23 [0.07, 4.82] Va 2014 8 98 38 92 25.3% 0.20 [0.10, 0.40] Yang 2017 1 45 11 45 3.1% 0.09 [0.01, 0.60] Total events 33 139 Total events 33 139 Test for overall effect: $Z = 7.94$ ( $P < 0.030$ ); $P = 0\%$ Test for overall effect: $Z = 7.94$ ( $P < 0.0000$ ) 1.4.2 Intervertabral disc leakage Alhashash 2019 4 37 9 36 13.0% 0.43 [0.15, 1.28] Thang 2019 2 100 6 100 6.6% 0.22 [0.05, 1.15] Guo 2017 7 98 25 88 24.7% 0.22 [0.11, 0.54] Uv 2020 1 33 73 3 3.7% 0.43 [0.02, 1.10] Wang 2019 1 42 3 48 3.1% 0.38 [0.04, 3.52] Va 2014 6 98 12 92 17.4% 0.47 [0.16, 1.20] Va 2017 3 45 7 45 9.2% 0.43 [0.12, 1.65] Total events 32 86 Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 3.25, df = 6 (P = 0.32); P = 0% Test for overall effect: $Z = 5.05$ ( $P < 0.0000$ ) 1.4.3 Paravertabral leakage Alhashash 2019 5 37 7 38 16.2% 0.68 [0.24, 1.99] Test for overall effect: $Z = 5.05$ ( $P < 0.0000$ ) 1.4.3 Paravertabral leakage Alhashash 2019 5 37 7 38 16.2% 0.68 [0.24, 1.99] Test for overall effect: $Z = 5.05$ ( $P < 0.0000$ ) 1.4.3 Paravertabral leakage Alhashash 2019 5 37 7 38 16.2% 0.68 [0.24, 1.99] Total events 32 66 Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 3.25, df = 6 (P = 0.92); P = 0% Test for overall effect: $Z = 2.96$ ( $P = 0.03$ ) 1.4.4 Intraepinal leakage Alhashash 2019 1 37 ( $P = 0.79$ ); $P = 0\%$ Test for overall effect: $Z = 2.96$ ( $P = 0.03$ ) 1.4.4 Intraepinal leakage Alhashash 2019 1 3100 7 100 37.9% 0.43 [0.12, 3.73] Alhashash 2019 1 3100 7 100 37.9% 0.43 [0.11, 1.61] 4.4 Intraepinal leakage Alhashash 2019 1 3100 7 100 37.9% 0.43 [0.11, 1.61] 4.4 Intraepinal leakage Alhashash 2019 1 3100 7 100 37.9% 0.43 [0.12, 0.30] 1.4.4 Intraepinal leakage Alhashash 2019 1 3100 7 100 37.9% 0.43 [0.11, 1.61] 4.4 Intraepinal leakage Alhashash 2019 1 3100 7 100 37.9% 0.43 [0.11, 0.43] 4.4 Intraepinal leakage Alhashash 2019 1 3100 7 100 37.9% 0.43 [0.11, 0.43] 4.4 Intraepinal leakage Alhashash 2019 1 3100 7 100 37.9% 0.43 [0.11, 0.43] 4.4 Intraepinal leakage Alhashash 2019 1 3100 7 100 37.9%	Lv 2020	0	33	2	33	1.4%	0.20 [0.01, 4.01]	
Xu 2014 8 98 38 92 25.3% 0.20 [0.10, 0.40] Yang 2017 1 45 11 45 31.59 Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 3.4, df = 9 (P = 0.33); P = 0% Test for overall effect: 2 = 7.94 (P < 0.0001) 1.4.2 Intervartabral disc leakage Albahashab 2019 4 37 9 36 13.0% 0.43 [0.15, 1.28] Fang 2019 2 100 8 100 6.6% 0.25 [0.05, 1.15] Guo 2017 7 98 25 68 24.7% 0.25 [0.11, 0.54] Huang 2014 6 98 12 92 17.4% 0.47 [0.18, 1.20] Varg 2019 1 42 34 8 31% 0.38 [0.04, 3.52] Yang 2017 3 45 7 45 9.2% 0.47 [0.18, 1.20] Yang 2017 3 45 7 45 9.2% 0.47 [0.18, 1.20] Yang 2017 3 45 7 45 9.2% 0.47 [0.18, 1.20] Total events Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 3.25, df = 8 (P = 0.32); P = 0% Test for overall effect: Z = 5.05 (P < 0.00001) 1.4.3 Paravertebral leakage Albahashab 2019 5 37 7 36 16.2% 0.69 [0.24, 1.99] Yang 2019 1 42 5 48 4.0% 0.23 [0.05, 1.65] Yang 2019 2 100 5 100 6.9% 0.40 [0.08, 2.01] Total events 1.4.3 Paravertebral leakage Albahashab 2019 5 37 7 36 16.2% 0.69 [0.24, 1.99] Yang 2019 1 42 5 48 4.0% 0.23 [0.05, 1.65] Yang 2019 1 42 5 48 4.0% 0.23 [0.05, 1.65] Yang 2019 1 42 5 48 4.0% 0.22 [0.05, 1.65] Yang 2019 1 42 5 48 4.0% 0.22 [0.05, 1.65] Yang 2019 1 42 5 48 4.0% 0.22 [0.05, 1.65] Yang 2019 1 42 5 48 4.0% 0.22 [0.05, 1.65] Yang 2019 1 42 5 48 4.0% 0.22 [0.05, 1.65] Yang 2019 1 42 5 48 4.0% 0.22 [0.05, 1.65] Yang 2019 1 42 5 48 4.0% 0.22 [0.05, 1.65] Yang 2019 1 42 5 48 4.0% 0.22 [0.05, 1.65] Yang 2019 1 42 5 48 4.0% 0.22 [0.05, 1.65] Yang 2019 1 42 5 48 6.2% 0.28 [0.28, 0.51] Albahash 2019 5 37 7 4 36 14.5% Yang 2019 3 100 7 100 37.9% Ala [0.11, 1.51] Guo 2017 3 9.8 5 86 33.8% O.53 [0.13, 2.14] Yang 2019 3 100 7 100 37.9% Parag 2019 0 142 148 6.6% 0.38 [0.29, 0.68] Yang 2019 0 142 148 6.6% O.24 [0.03, 2.07] Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 0.55, df = 4 (P = 0.57); P = 0% Test for overall effect: Z = 2.21 (P = 0.03) 1.4.4 Intraspiral leakage Albahash 2019 0 0 42 1 48 6.6% O.24 [0.03, 2.07] Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 0.55, df = 4 (P = 0.57); P = 0% Test for overall ef	Wang 2019	0	42	2	48	1.4%	0.23 [0.01, 4.62]	
Yang 2017 1 4 45 11 45 3.1% 0.09 [0.01, 0.68] Subtotal (8% C1) 681 667 100.0% 0.24 [0.17, 0.34] Total events 33 139 Heterogeneity: Tau* 2.00; Ch* 3.4, df = 6 (P = 0.39; P = 0% Test for overall effect: Z = 7.94 (P < 0.00001) 1.4.2 Interventabral disc leakage Alhashash 2019 4 37 9 36 13.0% 0.43 [0.15, 1.28] Test for overall effect: Z = 7.94 (P < 0.00001) 1.4.2 Interventabral disc leakage Alhashash 2019 4 37 9 36 13.0% 0.43 [0.15, 1.28] Test for overall effect: Z = 7.94 (P < 0.00001) 1.4.2 Interventabral disc leakage Alhashash 2019 4 37 9 36 13.0% 0.43 [0.15, 1.28] Liu 2018 2 130 3 135 4.9% 0.46 [0.12, 4.08] Liu 2018 1 42 3 48 3.1% 0.38 [0.04, 3.52] Yang 2017 3 45 7 45 9.2% 0.43 [0.12, 1.55] Total events 32 86 Heterogeneity: Tau* = 0.00; Ch* = 3.25, df = 6 (P = 0.32); P = 0% Test for overall effect: Z = 5.05 (P < 0.00001) 1.4.3 Paravertabral leakage Alhashash 2019 5 37 7 36 16.2% 0.68 [0.24, 1.99] Liu 2018 2 130 9 135 7.8% 0.28 [0.05, 1.65] Liu 2020 1 33 3 33 6.0% 0.67 [0.12, 3.73] Yang 2017 2 45 8 45 8.0% 0.45 [0.29, 1.49] Test for overall effect: Z = 5.05 (P < 0.00001) 1.4.4 Intraepinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Test for overall effect: Z = 2.96 (P = 0.003) 1.4.4 Intraepinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Test for overall effect: Z = 2.96 (P = 0.003) 1.4.4 Intraepinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Test for overall effect: Z = 2.96 (P = 0.003) 1.4.4 Intraepinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Test for overall effect: Z = 2.96 (P = 0.003) 1.4.4 Intraepinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Test for overall effect: Z = 2.96 (P = 0.003) 1.4.4 Intraepinal leakage Alhashash 2019 3 100 7 100 37.9% 0.43 [0.11, 1.61] U 2018 0 130 2 135 7.2% 0.24 [0.03, 2.07] Test for overall effect: Z = 2.21 (P = 0.03) 1.4.4 Intraepinal leakage Alhashash (2019 0 3 100 7 100 37.9% 0.43 [0.14, 1.61] Deffectione 7 19 Heterogeneity: Tau* = 0.00; Ch* = 0.55, df = 4	Xu 2014	8	<del>9</del> 8	38	92	25.3%	0.20 [0.10, 0.40]	
Subtotal (95% CI) 681 667 100.0% 0.24 [0.17, 0.34] Heterogeneity: Tau* = 0.00; Ch <sup>µ</sup> = 3.14, df = 8 (P = 0.93); P = 0% Test for overall effect: Z = 7.94 (P < 0.0001) 1.4.2 Interversibral disc leakage Alhashash 2019 4 37 9 38 13.0% 0.43 [0.15, 1.28] Guo 2017 7 98 25 88 24.7% 0.25 [0.11, 0.64] Huang 2014 6 98 12 92 17.4% 0.47 [0.18, 1.20] Lv 2020 1 33 7 33 3.7% 0.14 [0.02, 1.10] Verng 2019 1 42 34 8 3.1% 0.38 [0.04, 3.52] Xu 2014 6 98 12 92 17.4% 0.47 [0.18, 1.20] Lv 2020 1 33 7 45 7 45 9.2% 0.43 [0.12, 4.08] Total events 32 86 Heterogeneity: Tau* = 0.00; Ch <sup>µ</sup> = 3.25, df = 8 (P = 0.92); P = 0% Test for overall effect: Z = 5.05 (P < 0.0001) 1.4.3 Paravertebral leakage Alhashash 2019 5 37 7 38 16.2% 0.69 [0.24, 1.99] Fang 2019 2 100 5 100 6.9% 0.40 [0.28, 1.49] Heterogeneity: Tau* = 0.00; Ch <sup>µ</sup> = 3.25, df = 8 (P = 0.92); P = 0% Test for overall effect: Z = 5.05 (P < 0.0001) 1.4.3 Paravertebral leakage Alhashash 2019 5 37 7 38 16.2% 0.69 [0.24, 1.99] Fang 2019 1 42 5 48 4.0% 0.23 [0.03, 1.88] Xu 2014 8 96 11 92 24.0% 0.68 [0.28, 1.49] Lv 2020 2 13 33 3 6 6.0% 0.67 (1.2, 3.73] Wang 2019 1 42 5 48 4.0% 0.23 [0.08, 1.18] Xu 2014 8 96 11 92 24.0% 0.68 [0.29, 1.49] Huang 2019 1 42 5 48 5 4.0% 0.23 [0.08, 1.18] Xu 2014 8 96 11 92 24.0% 0.68 [0.29, 1.49] Huang 2019 1 42 5 48 5 6.0% 0.62 [0.17], 3.78] Wang 2019 1 42 5 48 5 6.0% 0.62 [0.28, 1.49] Huang 2019 1 42 5 48 5 6.0% 0.23 [0.08, 1.18] Xu 2014 8 96 5 86 33.8% 0.53 [0.13, 2.14] Lu 2016 0 130 2 135 7.2% 0.24 [0.03, 2.07] Fang 2019 1 37 4 38 14.5% Oz4 [0.03, 2.07] 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 38 14.5% Castoola (97% CI) 407 7 405 100.0%, 0.40 [0.18, 0.39] 1.4.4 Intraspinal leakage Alhashash 2019 1 37 7 4 38 14.5% Castoola (97% CI) 407 7 405 100.0%, 0.40 [0.18, 0.39] 1.4.4 Intraspinal leakage Alhashash 2019 1 3 100 7 100 37.9% Oz4 [0.02, 2.08] Subtotal (95% CI) 407 7 45 100.0%, 0.40 [0.18, 0.39] 1.4.4 Intraspinal leakage Alhashash 2019 1 3 100 7 100 37.9% Oz4 [0.02, 2.08] Subtotal (95% CI) 407 7 45 100.0%	Yang 2017	1	45	11	45	3.1%	0.09 [0.01, 0.68]	
Total events 33 139 Heterogeneity: Tau <sup>2</sup> = 0.0; Ch <sup>2</sup> = 3.14, df = 6 (P = 0.93); P = 0% Test for overall effect: Z = 7.94 (P < 0.00001) 1.4.2 Interversibral disc leakage Alhashash 2019 4 37 9 38 130% Luang 2017 7 98 25 88 24.7% 0.25 (D.11, 0.54] Luang 2014 6 98 12 92 17.4% 0.47 (D.18, 1.20] Wang 2019 1 42 3 48 3.1% 0.43 (D.15, 1.28] Lu 2018 2 130 3 135 4.9% 0.43 (D.12, 1.08] Lu 2018 2 130 3 135 4.9% 0.43 (D.12, 1.08] Wang 2019 1 42 3 48 3.1% 0.38 (D.02, 1.10] Wang 2019 1 42 3 48 3.1% 0.38 (D.04, 3.52] Ju 2014 6 98 12 92 17.4% 0.47 (D.18, 1.20] Wang 2017 3 45 7 45 9.2% 0.43 (D.12, 1.55] Subtotal (95% Cl) 661 667 100.0% 0.36 (D.28, 0.54] Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 3.25, df = 8 (P = 0.92); P = 0% Test for overall effect: Z = 5.05 (P < 0.0001) 1.4.3 Paravertebral leakage Alhashash 2019 5 37 7 38 16.2% 0.68 (D.24, 1.99] Fang 2019 2 100 5 100 6.9% 0.40 (D.8, 2.01] 1.4.2 5 48 4.0% 0.23 (D.29, 1.82] Yang 2017 9 86 12 86 27.0% 0.68 (D.24, 1.99] Fang 2019 1 42 5 48 4.0% 0.23 (D.28, 0.54] Wang 2019 1 42 5 48 4.0% 0.24 (D.03, 2.01, 1.16] Ux 2016 2 130 9 135 7.8% 0.24 (D.03, 2.07] 1.4.4 Intraspinal leakage Alhashash 2019 5 37 7 100 37.9% 0.43 (D.11, 1.61] Ux 2017 3 98 5 88 33.8% 0.23 (D.02, 1.16] 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 38 14.5% 0.24 (D.03, 2.07] 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 38 14.5% 0.24 (D.03, 2.07] 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 38 14.5% 0.24 (D.03, 2.07] 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 38 14.5% 0.24 (D.03, 2.07] 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 38 14.5% 0.24 (D.03, 2.07] 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 38 14.5% 0.24 (D.03, 2.07] 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 38 14.5% 0.24 (D.03, 2.07] 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 38 14.5% 0.24 (D.03, 2.07] 1.4.4 Intraspinal leakage Alhashash 2019 1 0 422 1 48 6.6% 0.38 (D.02, 9.08] 3.00 (D.11, 0.1] 0.00 (D.11, 0.1] 0.00 (D.11, 0.1] 0.00 (D.12, 1.00] 0.00 (	Subtotal (95% CI)		681		667	100.0%	0.24 [0.17, 0.34]	▼
Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 3.14, df = 8 (P = 0.93); P = 0% Test for overall effect: Z = 7.34 (P < 0.0001) 1.4.2 Intervertabral disc leakage Alhashash 2019 4 37 9 36 13.0% Guo 2017 7 98 25 88 24.7% 0.25 [0.51, 15] Guo 2017 7 98 25 88 24.7% 0.43 [0.15, 1.28] Huang 2014 6 96 12 92 17.4% 0.47 [0.18, 1.20] Lu 2018 1 33 7 33 3.7% 0.14 [0.02, 1.10] Vang 2019 1 42 3 48 3.1% 0.38 [0.04, 3.52] Xu 2014 6 98 12 92 17.4% 0.47 [0.18, 1.20] Lv 2020 1 3 34 5 7 45 9.2% 0.43 [0.12, 1.65] Subtotal (95% Cl) 681 667 100.0% 0.36 [0.25, 0.54] Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 3.25, df = 8 (P = 0.92); P = 0% Test for overall effect: Z = 5.05 (P < 0.0001) 1.4.3 Paravertabral leakage Alhashash 2019 5 37 7 38 16.2% 0.69 [0.24, 1.99] Fang 2019 2 100 5 100 6.9% 0.23 [0.02, 9, 1.49] Lu 2018 2 130 9 155 7.8% 0.23 [0.05, 1.05] Lu 2020 2 2 33 3 3 6 6.0% 0.67 (1.2, 3.73] Vang 2017 3 46 5 7 00.0% 0.26 [0.28, 1.49] Lu 2018 2 130 9 155 7.8% 0.23 [0.02, 1.48] Xu 2014 8 96 11 92 24.0% 0.68 [0.24, 1.99] Lu 2018 2 130 9 135 7.8% 0.23 [0.05, 1.05] Lu 2020 2 2 33 3 3 6 6.0% 0.67 (1.2, 3.73] Vang 2017 3 14 42 5 48 4.0% 0.28 [0.03, 1.88] Xu 2014 8 96 11 92 24.0% 0.68 [0.24, 1.99] Lu 2018 2 130 9 135 7.8% 0.24 [0.03, 2.01] Guo 2017 3 98 5 8 35 575 100.0% 0.53 [0.38, 0.81] Vang 2019 1 3.47 df = 7 (P = 0.79); P = 0% Test for overall effect: Z = 2.56 (P = 0.003) 1.4.4 Intraspinal leakage Alhashash 2019 5 3 7 7 4 8 14.5% Call 2001 1 30 2 135 7.2% 0.24 [0.03, 2.07] Alhashash 2019 1 37 4 8 14.5% Call 2003 1 30 0 7 100 37.9% 0.43 [0.13, 4.81] Ju 2018 0 130 2 135 7.2% 0.24 [0.03, 2.07] 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 48 14.5% Call 2003 1 30 0 7 100 37.9% 0.43 [0.13, 4.81] Ju 2018 0 130 2 135 7.2% 0.24 [0.03, 2.07] Heterogeneily: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 0.55, df = 4 (P = 0.79); P = 0% Test for overall effect: Z = 2.21 (P = 0.03) 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 9 5 100.0% 0.40 [0.18, 0.90] Ju 2016 0 140 7 445 100.0% 0.40 [0.18, 0.90] Ju 2017 3 98 5 86 33.8% 0.53 [0.13, 2.14]	Total events	33		139				
Test for verail effect: $Z = 7.54$ ( $P < 0.00001$ ) 1.4.2 Intervertebral disc leakage Albashab 2019 4 37 9 36 13.0%, 0.43 [0.15, 1.28] Fang 2019 2 100 8 100 6.6%, 0.25 [0.05, 1.15] Guo 2017 7 98 25 88 24.7%, 0.47 [0.18, 1.20] Huang 2014 8 69 12 92 17.4%, 0.47 [0.18, 1.20] Val 2014 1 42 3 46 3.1%, 0.38 [0.02, 1.10] Vang 2019 1 42 3 46 3.1%, 0.38 [0.04, 3.52] Val 2014 6 98 12 92 17.4%, 0.47 [0.18, 1.20] Val 2014 6 98 12 92 17.4%, 0.47 [0.18, 1.20] Val 2014 6 98 12 92 17.4%, 0.47 [0.18, 1.20] Total events 32 86 Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 3.25, df = 8 (P = 0.92); P = 0%, Test for overall effect: Z = 5.6 (P < 0.00001) 1.4.3 Paravertebral leakage Albashab 2019 5 37 7 36 16.2%, 0.68 [0.24, 1.99] Guo 2017 9 18 19 2 100 5 100 6.9%, 0.40 [0.08, 2.01] Guo 2017 9 18 19 2 68 27.0%, 0.68 [0.29, 1.49] Guo 2017 9 18 19 2 7.0%, 0.68 [0.29, 1.69] Val 2014 8 98 11 92 24.0%, 0.68 [0.29, 1.69] Val 2014 8 98 11 92 24.0%, 0.68 [0.29, 1.69] Yang 2019 1 42 5 48 4.0%, 0.23 [0.03, 1.88] Val 2014 8 98 11 92 24.0%, 0.68 [0.29, 1.69] Yang 2017 2 45 8 45 8.0%, 0.25 [0.06, 1.11] Subtotal (6% Cl) 5583 575 100.0%, 0.53 [0.35, 0.81] Total events 31 60 Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 3.87, df = 7 (P = 0.79); P = 0%, Test for overall effect: Z = 2.59 (P = 0.003) 1.4.4 Intraspinal leakage Albashab 2019 1 37 4 38 14.5%, 0.24 [0.03, 2.07] 1.4.4 Intraspinal leakage Albashab 2019 1 37 4 38 14.5%, 0.24 [0.03, 2.07] 1.4.4 Intraspinal leakage Albashab 2019 1 37 4 38 14.5%, 0.24 [0.03, 2.07] 1.4.4 Intraspinal leakage Albashab 2019 1 37 4 38 14.5%, 0.24 [0.03, 2.07] 1.4.4 Intraspinal leakage Albashab 2019 1 37 4 38 14.5%, 0.24 [0.03, 2.07] 1.4.4 Intraspinal leakage Albashab 2019 1 37 4 38 14.5%, 0.24 [0.03, 2.07] 1.4.4 Intraspinal leakage Albashab 2019 0 422 1 48 6.6%, 0.38 [0.02, 9.08] Subtotal (6% Cl) 407 406 190.0%, 0.40 [0.14, 4.8] Veng 2019 0 422 1 48 6.6%, 0.38 [0.02, 9.08] Subtotal (6% Cl) 407 406 190.0%, 0.40 [0.14, 6.90] Val 2017 1 9 80 5 80 33.8%, 0.53 [0.13, 2.14] Vang 2019 0 422 1 48	Heterogeneity: Tau <sup>2</sup> =	0.00; Chi <sup>2</sup>	= 3.14	, df = 8 (P	9 = 0.93	s); l² = 0%		
1.4.2 Intervertebral disc leakage         Alhashash 2019       4       37       9       36       13.0%       0.43 [0.15, 1.28]         Feng 2019       2       100       8       100       6.6%       0.25 [0.05, 1.15]         Guo 2017       7       98       25       88       24.7%       0.25 [0.11, 0.54]         Huang 2014       6       98       12       92       17.4%       0.47 [0.18, 1.20]         Lv 2020       1       33       7       33       3.7%       0.14 [0.02, 1.10]         Vang 2019       1       42       3       43       10.15, 1.28]         Yang 2017       3       45       7       45       9.2%       0.43 [0.24, 1.20]         Vang 2016       1.42       3.45       7       45       9.2%       0.43 [0.24, 1.99]         Felterogeneity: Tau <sup>2</sup> = 0.00, Ch <sup>2</sup> = 3.25, df = 6 (P = 0.92); P = 0%       Test for overall effect Z = 5.05 (P < 0.00001)	Test for overall effect: 2	Z = 7.94 (F	<b>&gt;</b> < 0.0	0001)				
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Gub 2017 7 9 98 25 88 24.7% 0.25 [0.17, 0.54] Huang 2014 6 98 12 92 17.4% 0.47 [0.18, 1.20] LU 2016 2 130 3 135 4.9% 0.68 [0.12, 4.08] LV 2020 1 33 7 33 3.7% 0.14 [0.02, 1.10] Wang 2019 1 4.2 3 48 3.1% 0.38 [0.04, 3.52] Yang 2017 3 45 7 45 9.2% 0.38 [0.25, 0.54] Total events 32 86 Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 3.25, df = 8 (P = 0.92); P = 0% Test for overall effect: Z = 5.05 (P < 0.00001) 1.4.3 Paravertebral leakage Alhashash 2019 5 37 7 36 16.2% 0.69 [0.24, 1.99] Gub 2017 9 98 12 86 27.0% 0.68 [0.29, 1.49] LU 2018 2 130 9 135 7.8% 0.23 [0.05, 1.05] Lu 2018 2 130 9 135 7.8% 0.23 [0.05, 1.05] Lu 2018 2 130 9 135 7.8% 0.23 [0.05, 1.05] Lu 2018 2 45 8 45 8.0% 0.25 [0.06, 1.11] Subtotal (95% Cl) 583 575 100.0% 0.53 [0.35, 0.81] 4.4 Intraspinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Farg 2017 2 45 8 45 8.0% 0.25 [0.06, 1.11] Subtotal (95% Cl) 583 575 100.0% 0.53 [0.35, 0.81] 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Farg 2019 3 100 7 100 37.9% 0.43 [0.11, 1.61] Gub 2017 3 98 5 86 38.8% 0.38 [0.22, 9.08] 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Farg 2019 0 42 1 48 6.6% 0.38 [0.22, 9.08] Vang 2019 0 42 1 48 6.6% 0.38 [0.22, 9.08] Vang 2019 0 42 1 48 6.6% 0.38 [0.22, 9.08] Vang 2019 0 42 1 48 6.6% 0.38 [0.22, 9.08] Vang 2019 0 42 1 48 6.6% 0.38 [0.22, 9.08] Vang 2019 0 42 1 48 6.6% 0.38 [0.22, 9.08] Vang 2019 0 42 1 48 6.6% 0.38 [0.22, 9.08] Vang 2019 0 42 1 48 6.6% 0.38 [0.22, 9.08] Vang 2019 0 42 1 48 6.6% 0.38 [0.22, 9.08] Vang 2019 0 42 1 48 6.6% 0.38 [0.22, 9.08] Vang 2019 0 42 1 48 6.6% 0.38 [0.22, 9.08] Vang 2019 0 42 1 48 6.6% 0.38 [0.02, 9.08] Vang 2019 0 42 1 48 6.6% 0.38 [0.02, 9.08] Vang 2019 0 42 1 48 6.6% 0.38 [0.02, 9.08] Vang 2019 0 42 1 48 6.6% 0.38 [0.02, 9.08] Vang 2019 0 42 1 48 6.6% 0.38 [0.02, 9.08] Vang 2019 0 42 1 40 6.6% 0.38 [0.22, 9.08] Vang 2019 0 42 1 40 6.6% 0.38 [0.22, 9.08] Vang 2019 0 42 1 40 6.6% 0.38 [0.29, 16.29] Vang 2019 0 42 1 48 6.6% 0.38 [0.	Fang 2019	2	100	8	100	6.6%	0.25 [0.05, 1.15]	
Huang 2014 6 98 12 92 17.4% 0.47 (0.18, 1.20) Lu 2018 2 130 3 135 4.9% 0.49 (0.18, 1.20) Vang 2019 1 42 3 48 3.1% 0.89 (0.12, 4.08) Lv 2020 1 3 31 7 33 3.7% 0.14 (0.02, 1.10) Wang 2019 1 42 3 48 3.1% 0.38 (0.04, 3.52) Yang 2017 3 45 7 45 9.2% 0.43 (0.12, 1.55) Subtotal (95% Cl) 681 667 100.0% 0.36 (0.25, 0.54] Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 3.25, df = 8 (P = 0.92); P = 0% Test for overall effect: Z = 2.55 (P < 0.00001) 1.4.3 Paravertebral leakage Ahashash 2019 5 37 7 36 16.2% 0.69 (0.24, 1.99) Fang 2019 2 100 5 100 6.9% 0.40 (0.08, 2.01] Guo 2017 9 98 12 86 27.0% 0.68 (0.29, 1.49] Lu 2018 2 130 9 135 7.8% 0.23 (0.05, 1.05] Lu 2018 2 130 9 135 7.8% 0.23 (0.05, 1.05] Lu 2018 1 92 24.0% 0.68 (0.29, 1.49] Mag 2019 1 42 5 48 4.0% 0.23 (0.03, 1.88] Xu 2014 8 98 11 92 24.0% 0.68 (0.29, 1.62] Yang 2017 2 45 8 45 8.0% 0.25 (0.06, 1.11] Subtotal (95% Cl) 583 575 100.0% 0.53 (0.35, 0.81] 1.4.4 Intraspinal leakage Ahashash 2019 1 3 70 7 100 37.9% 0.43 (0.11, 1.61] Guo 2017 3 98 5 86 33.8% 0.53 (0.13, 2.07] Fang 2019 3 100 7 100 37.9% 0.43 (0.11, 1.61] Guo 2017 3 98 5 168 33.8% 0.53 (0.13, 2.01] 1.4.4 Intraspinal leakage Ahashash 2019 1 3 70 4 36 14.5% 0.24 (0.03, 2.07] Fang 2019 0 42 1 48 6.6% 0.38 (0.02, 9.08] Subtotal (95% Cl) 407 4.05 100.0% 0.53 (0.33, 0.31 [0.02, 1.02] Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 0.55, df = 4 (P = 0.97); P = 0% Test for overall effect: Z = 2.21 (P = 0.03) 1.4.4 Intraspinal leakage Ahashash 2019 1 3 70 4 36 14.5% 0.24 (0.03, 2.07] Fang 2019 0 4.2 1 4.8 6.6% 0.38 (0.02, 9.08] Subtotal (95% Cl) 407 4.05 100.0% 0.40 (0.18, 0.90] Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 0.55, df = 4 (P = 0.97); P = 0% Test for overall effect: Z = 2.21 (P = 0.03)	Guo 2017	7	98	25	86	24.7%	0.25 [0.11, 0.54]	
Lu 2016 2 130 3 135 4.9% 0.09 (0.12,4.08] Lv 2020 1 33 7 33 3.7% 0.14 (0.02, 1.10) Wang 2019 1 42 3 48 3.1% 0.38 (0.04, 3.52) Xu 2014 6 98 12 92 17.4% 0.47 (0.18, 1.20] Yang 2017 3 45 7 45 9.2% 0.43 (0.12, 1.55] Subtotal (95% CI) 681 667 100.0% 0.36 (0.25, 0.54] Total events 3 2 86 Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 3.25, df = 8 (P = 0.92); P = 0% Test for overall effect Z = 5.05 (P < 0.00001) 1.4.3 Paravertebral leakage Alhashash 2019 5 37 7 36 16.2% 0.69 (0.24, 1.99) Guo 2017 9 98 12 86 27.0% 0.66 (0.29, 1.49) Lv 2020 2 33 3 33 6.0% 0.67 (0.12, 3.73) Wang 2019 1 42 5 48 4.0% 0.23 (0.03, 1.88] Val 2014 8 98 11 92 24.0% 0.68 (0.29, 1.62] Yang 2017 2 4.5 8 45 8.0% 0.25 (0.06, 1.11) Subtotal (95% CI) 583 575 100.0% 0.53 (0.35, 0.81] Total events 31 60 Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 3.67, df = 7 (P = 0.79); P = 0% Test for overall effect: Z = 2.96 (P = 0.003) 1.4.4 Intrapinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 (0.03, 2.07] Guo 2017 3 98 5 86 33.8% 0.40 [0.11, 1.61] Guo 2017 3 98 5 86 33.8% 0.38 [0.02, 9.08] Subtotal (95% CI) 407 7 405 100.0% 0.40 [0.18, 0.39] 1.4.4 Intrapinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 (0.03, 2.07] Fang 2019 0 42 1 48 6.6% 0.38 [0.02, 9.08] Subtotal (95% CI) 407 7 405 100.0% 0.40 [0.18, 0.39] 1.4.4 Intrapinal leakage Alhashash 2019 1 30 2 135 7.2% 0.21 [0.01, 4.28] Wang 2019 0 42 1 48 6.6% 0.38 [0.02, 9.08] Subtotal (95% CI) 407 7 405 100.0% 0.40 [0.18, 0.39] Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.05, df = 4 (P = 0.97); P = 0% Test for overall effect: Z = 2.21 (P = 0.03)	Huang 2014	6	98	12	92	17.4%	0.47 [0.18, 1.20]	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Liu 2018	2	130	3	135	4.9%	0.69 [0.12, 4.08]	
Wang 2019 1 42 3 48 3.1% 0.38 [0.04, 3.52] Yang 2017 3 45 7 45 9.2% 0.43 [0.12, 1.55] Subtotal (95% CI) 681 667 100.0% 0.36 [0.25, 0.54] Total events 32 86 Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 3.25, df = 8 (P = 0.52); P = 0% Test for overall effect: $Z = 5.05$ (P < 0.00001) 1.4.3 Paravertebral leakage Alhashash 2019 5 37 7 36 16.2% 0.69 [0.24, 1.99] Fang 2019 2 100 5 100 6.9% 0.40 [0.08, 2.01] Guo 2017 9 98 12 86 27.0% 0.66 [0.29, 1.49] Liu 2018 2 130 9 135 7.8% 0.23 [0.05, 1.05] Liv 2020 2 2 33 3 3 6.0% 0.67 [0.12, 3.73] Wang 2019 1 42 5 48 4.0% 0.23 [0.03, 1.88] Xu 2014 8 98 11 92 24.0% 0.68 [0.29, 1.62] Yang 2017 2 45 8 45 8.0% 0.25 [0.04, 1.11] Subtotal (95% CI) 583 575 100.0% 0.53 [0.35, 0.81] 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Test for overall effect: $Z = 2.95$ (P = 0.003) 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Test for overall effect: $Z = 2.95$ (P = 0.003) 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Test for overall effect: $Z = 2.95$ (P = 0.003) 1.4.4 Intraspinal leakage Alhashash 2019 1 310 2 135 7.2% 0.21 [0.01, 4.28] Subtotal (95% CI) 407 405 100.0% 0.40 [0.18, 0.90] Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 0.55, df = 4 (P = 0.97); P = 0% Test for overall effect: $Z = 2.21$ (P = 0.03) 1.001 0.1 1 10 1000 Favours [LVC] Favours [LVC]	LV 2020	1	33	1	33	3.7%	0.14 [0.02, 1.10]	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Wang 2019	1	42	3	48	3.1%	0.38 [0.04, 3.52]	
Tang 2017 3 45 7 45 9.2% 0.43 [0.12, 1.85] Subtotal (95% Cl) 681 667 100.0% 0.36 [0.25, 0.54] Total events 32 86 Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 3.25, df = 8 (P = 0.92); P = 0% Test for overall effect: Z = 5.05 (P < 0.0001) 1.4.3 Paravertebral leakage Alhashesh 2019 5 37 7 36 16.2% 0.69 [0.24, 1.99] Fang 2019 2 100 5 100 6.9% 0.40 [0.08, 2.01] Guo 2017 9 98 12 86 27.0% 0.66 [0.29, 1.49] Uu 2018 2 130 9 135 7.8% 0.23 [0.05, 1.05] Lv 2020 2 3 3 3 33 6.0% 0.67 [0.12, 3.73] Wang 2019 1 42 5 48 4.0% 0.23 [0.03, 1.88] Vang 2019 1 42 5 48 4.0% 0.23 [0.03, 1.88] Vang 2017 2 45 8 45 8.0% 0.25 [0.06, 1.11] Subtotal (95% Cl) 583 575 100.0% 0.53 [0.35, 0.81] Total events 31 60 Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 3.87, df = 7 (P = 0.79); P = 0% Test for overall effect: Z = 2.95 (P = 0.003) 1.4.4 Intraspinal leakage Alhashesh 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Fang 2019 3 100 7 100 37.9% 0.43 [0.11, 1.61] Guo 2017 3 98 5 86 33.8% 0.53 [0.13, 2.14] Liu 2018 0 130 2 135 7.2% 0.21 [0.01, 4.28] Wang 2019 0 42 1 448 6.6% 0.38 [0.02, 9.08] Subtotal (95% Cl) 407 405 100.0% 0.40 [0.18, 0.90] Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 0.55, df = 4 (P = 0.97); P = 0% Test for overall effect: Z = 2.21 (P = 0.03) Dotal events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 0.55, df = 4 (P = 0.97); P = 0% Test for overall effect: Z = 2.21 (P = 0.03)	Xu 2014	6	98	12	92	17.4%	0.47 [0.18, 1.20]	
Subtolat (95% Cl) 001 (100 (100 (100 (100 (100 (100 (100	Yang 2017 Subtotol (05% CI)	3	45	1	45	9.2%	0.43 [0.12, 1.55]	Ă. I
Total events 3 0.00 Ch <sup>2</sup> = 3.25, df = 8 (P = 0.92); P = 0% Test for overall effect: Z = 5.05 (P < 0.00001) <b>1.4.3 Paravertebral leakage</b> Alhashash 2019 5 37 7 36 16.2% 0.69 [0.24, 1.99] Fang 2019 2 100 5 100 6.9% 0.40 [0.08, 2.01] Uu 2018 2 130 9 135 7.8% 0.23 [0.05, 1.05] Uv 2020 2 2 33 3 3 3 6.0% 0.67 [0.12, 3.73] Wang 2019 1 42 5 48 4.0% 0.23 [0.03, 1.88] Xu 2014 8 98 11 92 24.0% 0.68 [0.29, 1.62] Yang 2017 2 45 8 45 8.0% 0.25 [0.06, 1.11] Subtotal (95% Cl) 583 575 100.0% 0.53 [0.35, 0.81] Total events 31 60 Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 3.87, df = 7 (P = 0.79); P = 0% Test for overall effect: Z = 2.95 (P = 0.003) <b>1.4.4 intraspinal leakage</b> Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Fang 2019 3 100 7 100 37.9% 0.43 [0.11, 1.61] Guo 2017 3 98 5 86 33.8% 0.53 [0.32, 0.3] Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 0.55, df = 4 (P = 0.97); P = 0% Test for overall effect: Z = 2.21 (P = 0.03) <b>1.4.4 intraspinal leakage</b> Alhashash 2019 1 3 100 7 100 37.9% 0.43 [0.11, 1.61] Guo 2017 3 98 5 6.68 3.8% 0.53 [0.29, 0.63] Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 0.55, df = 4 (P = 0.97); P = 0% Test for overall effect: Z = 2.21 (P = 0.03)	Sublotal (95% CI)	20	001	00	007	100.0%	0.30 [0.25, 0.54]	•
The form of the transmission of the term	I otal events	32 0.00. Chiz	- 2 25	4f - 0 /D	- 0.02	), 12 - 00/		
14.3 Paravertebral leakage         Alhashash 2019       5       37       7       36       16.2%       0.69       [0.24, 1.99]         Guo 2017       9       98       12       86       27.0%       0.66       [0.29, 1.49]         Lu 2018       2       130       9       135       7.8%       0.23       [0.03, 1.05]         Lv 2020       2       3       3       36.0%       0.67       [0.12, 3.73]         Wang 2019       1       42       5       48       4.0%       0.23       [0.03, 1.88]         Xu 2014       8       98       11       92       24.0%       0.68       [0.29, 1.62]         Yang 2017       2       45       8       45       8.0%       0.25       [0.03, 1.82]         Yang 2017       2       45       8       45       8.0%       0.53       [0.35, 0.81]         Total events       31       60       60       1.621       1.622       1.621         Heterogeneity: Tau <sup>2</sup> = 0.00; Chl <sup>2</sup> = 3.87, df = 7 (P = 0.79); l <sup>2</sup> = 0%       0.43       [0.11, 1.61]       1.61         Guo 2017       3       98       5       86       33.8       [0.53, 0.13, 2.07]       1.62	Test for overall effect:	7 = 5 05 (E	- 0.25	, ui – 0 (F 0001)	- 0.92	., ⊢− 0%		
1.4.3 Paravertebral leakage         Alhashash 2019       5       37       7       36       16.2%       0.69       [0.24, 1.99]         Fang 2019       2       100       5       100       6.9%       0.40       [0.08, 2.01]         Guo 2017       9       98       12       86       27.0%       0.66       [0.29, 1.49]         Liu 2018       2       130       9       135       7.8%       0.23       [0.03, 1.05]         Lv 2020       2       33       3       3       6.0%       0.67       [0.12, 3.73]         Wang 2019       1       42       5       48       4.0%       0.23       [0.03, 1.88]         Xu 2014       8       98       11       92       24.0%       0.68       [0.29, 1.62]         Yang 2017       2       45       8       45       8.0%       0.25       [0.06, 1.11]         Subtotal (95% Ct)       583       575       100.0%       0.53       [0.33, 2.07]         Farg 2019       1       37       4       36       14.5%       0.24       [0.03, 2.07]         Guo 2017       3       98       5       86       33       [0.30, 0.2]       [0.11,	rest for overall effect.	2 – 5.05 (r	- 0.0	0001)				
Alhashash 2019 5 37 7 38 16.2% 0.69 [0.24, 1.99] Fang 2019 2 100 5 100 6.9% 0.40 [0.08, 2.01] Guo 2017 9 9 88 12 86 27.0% 0.66 [0.29, 1.49] Lu 2018 2 130 9 135 7.8% 0.23 [0.05, 1.05] Lv 2020 2 33 3 3 6.0% 0.67 [0.12, 3.73] Wang 2019 1 42 5 48 4.0% 0.23 [0.03, 1.88] Xu 2014 8 98 11 92 24.0% 0.68 [0.29, 1.62] Yang 2017 2 45 8 45 8.0% 0.25 [0.06, 1.11] Subtotal (95% Cl) 583 575 100.0% 0.53 [0.35, 0.81] Total events 31 60 Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 3.87, df = 7 (P = 0.79); P = 0% Test for overall effect: Z = 2.95 (P = 0.003) 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Fang 2019 3 100 7 100 37.9% 0.43 [0.11, 1.61] Guo 2017 3 98 5 86 33.8% 0.53 [0.13, 2.14] Liu 2018 0 130 2 135 7.2% 0.21 [0.01, 4.28] Wang 2019 0 42 1 48 6.6% 0.38 [0.02, 9.08] Subtotal (95% Cl) 407 405 100.0% 0.40 [0.18, 0.90] Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 0.55, df = 4 (P = 0.97); P = 0% Test for overall effect: Z = 2.21 (P = 0.03)	1.4.3 Paravertebral le	akaqe						
Fang 2019 2 100 5 100 6.9% 0.40 [0.08, 2.01] Guo 2017 9 98 12 86 27.0% 0.66 [0.29, 1.49] Llu 2018 2 130 9 135 7.8% 0.23 [0.05, 1.05] Lv 2020 2 3 3 3 3 6.0% 0.67 [0.12, 3.73] Wang 2019 1 42 5 48 4.0% 0.23 [0.03, 1.88] Xu 2014 8 98 11 92 24.0% 0.68 [0.29, 1.62] Yang 2017 2 45 8 45 8.0% 0.25 [0.06, 1.11] Subtotal (95% CI) 583 575 100.0% 0.53 [0.35, 0.81] Total events 31 60 Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 3.87, df = 7 (P = 0.79); I <sup>2</sup> = 0% Test for overall effect: Z = 2.95 (P = 0.003) 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Fang 2019 3 100 7 100 37.9% 0.43 [0.11, 1.61] Guo 2017 3 98 5 86 33.8% 0.53 [0.13, 2.14] Liu 2018 0 130 2 135 7.2% 0.21 [0.01, 4.28] Wang 2019 0 42 1 48 6.6% 0.38 [0.02, 9.08] Subtotal (95% CI) 407 405 100.0% 0.40 [0.18, 0.90] Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 0.55, df = 4 (P = 0.97); I <sup>2</sup> = 0% Test for overall effect: Z = 2.21 (P = 0.03)	Albashash 2019	5	37	7	36	16.2%	0.69 [0.24, 1.99]	
Guo 2017       9       98       12       86       27.0%       0.66 $[0.29, 1.49]$ Liu 2018       2       130       9       135       7.8%       0.23 $[0.05, 1.05]$ Lv 2020       2       33       3       3 $6.0\%$ 0.67 $[0.12, 3.73]$ Wang 2019       1       42       5       48       4.0%       0.23 $[0.03, 1.86]$ Xu 2014       8       98       11       92       24.0%       0.68 $[0.29, 1.62]$ Yang 2017       2       45       8       45       8.0%       0.25 $[0.06, 1.11]$ Subtotal (95% CI)       583       575       100.0%       0.53 $[0.35, 0.81]$ Total events       31       60         Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>p</sup> = 3.87, df = 7 (P = 0.79); i <sup>p</sup> = 0%         Test for overall effect: Z = 2.95 (P = 0.003)         1.4.4 Intraspinal leakage         Alhashash 2019       1       37       4       36       14.5%       0.24 [0.03, 2.07]         Fang 2019       0       42       1       48       6.6%       0.38 [0.02, 9.08]       0.43 [0.11, 1.61]         Subtotal (95% CI)       407	Fano 2019	2	100	. 5	100	6.9%	0.40 [0.08, 2.01]	
Liu 2018 2 130 9 135 7.8% 0.23 [0.05, 1.05] Lv 2020 2 33 3 33 6.0% 0.67 [0.12, 3.73] Wang 2019 1 42 5 48 4.0% 0.23 [0.03, 1.88] Xu 2014 8 98 11 92 24.0% 0.68 [0.29, 1.62] Yang 2017 2 45 8 45 8.0% 0.25 [0.06, 1.11] Subtotal (95% Cl) 583 575 100.0% 0.53 [0.35, 0.81] Total events 31 60 Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>p</sup> = 3.87, df = 7 (P = 0.79); l <sup>2</sup> = 0% Test for overall effect: Z = 2.95 (P = 0.003) 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Fang 2019 3 100 7 100 37.9% 0.43 [0.11, 1.61] Guo 2017 3 98 5 86 33.8% 0.53 [0.13, 2.14] Liu 2018 0 130 2 135 7.2% 0.21 [0.01, 4.28] Wang 2019 0 42 1 48 6.6% 0.38 [0.02, 9.08] Subtotal (95% Cl) 407 405 100.0% 0.40 [0.18, 0.90] Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 0.55, df = 4 (P = 0.97); l <sup>2</sup> = 0% Test for overall effect: Z = 2.21 (P = 0.03)	Guo 2017	9	98	12	86	27.0%	0.66 [0.29, 1.49]	
Lv 2020 2 33 3 33 6.0% 0.67 [0.12, 3.73] Wang 2019 1 42 5 48 4.0% 0.23 [0.03, 1.88] Xu 2014 8 98 11 92 24.0% 0.68 [0.29, 1.62] Yang 2017 2 45 8 45 8.0% 0.25 [0.06, 1.11] Subtotal (95% Cl) 533 575 100.0% 0.53 [0.35, 0.81] Total events 31 60 Heterogeneity: Tau <sup>2</sup> = 0.00; Chl <sup>2</sup> = 3.87, df = 7 (P = 0.79); l <sup>2</sup> = 0% Test for overall effect: Z = 2.95 (P = 0.003) 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Fang 2019 3 100 7 100 37.9% 0.43 [0.11, 1.61] Guo 2017 3 98 5 86 33.8% 0.53 [0.33, 0.13] 2.14] Liu 2018 0 130 2 135 7.2% 0.21 [0.01, 4.28] Wang 2019 0 42 1 48 6.6% 0.38 [0.02, 9.08] Subtotal (95% Cl) 407 405 100.0% 0.40 [0.18, 0.90] Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Chl <sup>2</sup> = 0.55, df = 4 (P = 0.97); l <sup>2</sup> = 0% Test for overall effect: Z = 2.21 (P = 0.03)	Liu 2018	2	130	9	135	7.8%	0.23 [0.05, 1.05]	
Wang 2019 1 42 5 48 4.0% 0.23 [0.03, 1.88] Xu 2014 8 98 11 92 24.0% 0.68 [0.29, 1.62] Yang 2017 2 45 8 45 8.0% 0.25 [0.06, 1.11] Subtotal (95% CI) 583 575 100.0% 0.53 [0.35, 0.81] Total events 31 60 Heterogeneity: Tau <sup>2</sup> = 0.00; Chl <sup>2</sup> = 3.87, df = 7 (P = 0.79); l <sup>2</sup> = 0% Test for overall effect: Z = 2.95 (P = 0.003) 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Fang 2019 3 100 7 100 37.9% 0.43 [0.11, 1.61] Guo 2017 3 98 5 86 33.8% 0.53 [0.13, 2.14] Liu 2018 0 130 2 135 7.2% 0.21 [0.01, 4.28] Wang 2019 0 42 1 48 6.6% 0.38 [0.02, 9.08] Subtotal (95% CI) 407 405 100.0% 0.40 [0.18, 0.90] Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Chl <sup>2</sup> = 0.55, df = 4 (P = 0.97); l <sup>2</sup> = 0% Test for overall effect: Z = 2.21 (P = 0.03)	Lv 2020	2	33	3	33	6.0%	0.67 [0.12, 3.73]	
Xu 2014 8 98 11 92 24.0% 0.68 [0.29, 1.62] Yang 2017 2 45 8 45 8.0% 0.25 [0.06, 1.11] Subtotal (95% CI) 583 575 100.0% 0.53 [0.35, 0.81] Total events 31 60 Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 3.87, df = 7 (P = 0.79); l <sup>2</sup> = 0% Test for overall effect: Z = 2.95 (P = 0.003) 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Fang 2019 3 100 7 100 37.9% 0.43 [0.11, 1.61] Guo 2017 3 98 5 88 6 33.8% 0.53 [0.13, 2.14] Liu 2018 0 130 2 135 7.2% 0.21 [0.01, 4.28] Wang 2019 0 42 1 48 6.6% 0.38 [0.02, 9.08] Subtotal (95% CI) 407 405 100.0% 0.40 [0.18, 0.90] Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Ch <sup>2</sup> = 0.55, df = 4 (P = 0.97); l <sup>2</sup> = 0% Test for overall effect: Z = 2.21 (P = 0.03)	Wang 2019	1	42	5	48	4.0%	0.23 [0.03, 1.88]	
Yang 2017 2 45 8 45 8.0% 0.25 $[0.06, 1.11]$ Subtotal (95% Cl) 583 575 100.0% 0.53 $[0.35, 0.81]$ Total events 31 60 Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 3.87, df = 7 (P = 0.79); i <sup>2</sup> = 0% Test for overall effect: Z = 2.95 (P = 0.003) 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 $[0.03, 2.07]$ Fang 2019 3 100 7 100 37.9% 0.43 $[0.11, 1.61]$ Guo 2017 3 98 5 86 33.8% 0.53 $[0.13, 2.14]$ Liu 2018 0 130 2 135 7.2% 0.21 $[0.01, 4.28]$ Wang 2019 0 42 1 48 6.6% 0.38 $[0.02, 9.08]$ Subtotal (95% Cl) 407 405 100.0% 0.40 $[0.18, 0.90]$ Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 0.55, df = 4 (P = 0.97); i <sup>2</sup> = 0% Test for overall effect: Z = 2.21 (P = 0.03)	Xu 2014	8	98	11	92	24.0%	0.68 [0.29, 1.62]	
Subtotal (95% Cl)       583       575       100.0%       0.53 [0.35, 0.81]         Total events       31       60         Heterogeneity: Tau <sup>2</sup> = 0.00; Chl <sup>2</sup> = 3.87, df = 7 (P = 0.79); l <sup>2</sup> = 0%       0.53 [0.35, 0.81]         Test for overall effect: Z = 2.95 (P = 0.003)       1       37       4       36       14.5%       0.24 [0.03, 2.07]         Fang 2019       3       100       7       100       37.9%       0.43 [0.11, 1.61]         Guo 2017       3       98       5       86       33.8%       0.53 [0.13, 2.14]         Liu 2018       0       130       2       135       7.2%       0.21 [0.01, 4.28]         Wang 2019       0       42       1       48       6.6%       0.38 [0.02, 9.08]         Subtotal (95% Cl)       407       405       100.0%       0.40 [0.18, 0.90]       0.41 [0.11, 10]         Test for overall effect: Z = 2.21 (P = 0.03)       10       0.01       0.1       1       10       1000	Yang 2017	2	45	8	45	8.0%	0.25 [0.06, 1.11]	
Total events 31 60 Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 3.87, df = 7 (P = 0.79); i <sup>2</sup> = 0% Test for overall effect: Z = 2.95 (P = 0.003) 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Fang 2019 3 100 7 100 37.9% 0.43 [0.11, 1.61] Guo 2017 3 98 5 86 33.8% 0.53 [0.13, 2.14] Liu 2018 0 130 2 135 7.2% 0.21 [0.01, 4.28] Wang 2019 0 42 1 48 6.6% 0.38 [0.02, 9.08] Subtotal (95% CI) 407 405 100.0% 0.40 [0.18, 0.90] Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 0.55, df = 4 (P = 0.97); i <sup>2</sup> = 0% Test for overall effect: Z = 2.21 (P = 0.03) 0.001 0.1 1 10 1000 Favours [HVC] Favours [LVC]	Subtotal (95% CI)		583		575	100.0%	0.53 [0.35, 0.81]	$\bullet$
Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 3.87, df = 7 (P = 0.79); l <sup>2</sup> = 0% Test for overall effect: Z = 2.95 (P = 0.003) 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Fang 2019 3 100 7 100 37.9% 0.43 [0.11, 1.61] Guo 2017 3 98 5 86 33.8% 0.53 [0.13, 2.14] Liu 2018 0 130 2 135 7.2% 0.21 [0.01, 4.28] Wang 2019 0 42 1 48 6.6% 0.38 [0.02, 9.08] Subtotal (95% Cl) 407 405 100.0% 0.40 [0.18, 0.90] Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 0.55, df = 4 (P = 0.97); l <sup>2</sup> = 0% Test for overall effect: Z = 2.21 (P = 0.03) 0.001 0.1 1 10 1000 Favours [LVC]	Total events	31		60				
Test for overall effect: $Z = 2.95$ (P = 0.003) 1.4.4 Intraspinal leakage Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Fang 2019 3 100 7 100 37.9% 0.43 [0.11, 1.61] Guo 2017 3 98 5 86 33.8% 0.53 [0.13, 2.14] Liu 2018 0 130 2 135 7.2% 0.21 [0.01, 4.28] Wang 2019 0 42 1 48 6.6% 0.38 [0.02, 9.08] Subtotal (95% Cl) 407 405 100.0% 0.40 [0.18, 0.90] Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 0.55, df = 4 (P = 0.97); l <sup>2</sup> = 0% Test for overall effect: $Z = 2.21$ (P = 0.03) 1000 Favours [HVC] Favours [LVC]	Heterogeneity: Tau <sup>2</sup> =	0.00; Chi <sup>2</sup>	= 3.87	, df = 7 (P	9 = 0.79	);  ² = 0%		
1.4.4 Intraspinal leakage         Alhashash 2019       1       37       4       36       14.5% $0.24$ [0.03, 2.07]         Fang 2019       3       100       7       100       37.9% $0.43$ [0.11, 1.61]         Guo 2017       3       98       5       86       33.8% $0.53$ [0.13, 2.14]         Liu 2018       0       130       2       135       7.2% $0.21$ [0.01, 4.28]         Wang 2019       0       42       1       48       6.6% $0.38$ [0.02, 9.08]         Subtotal (95% Cl)       407       405       100.0% $0.40$ [0.18, 0.90]         Total events       7       19         Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 0.55, df = 4 (P = 0.97); l <sup>2</sup> = 0%         Test for overall effect: Z = 2.21 (P = 0.03)	Test for overall effect: 2	Z = 2.95 (F	P = 0.0	03)				
1.4.4 Intraspinal leakage         Alhashash 2019       1 $37$ 4 $36$ $14.5\%$ $0.24$ [ $0.03, 2.07$ ]         Fang 2019       3 $100$ 7 $100$ $37.9\%$ $0.43$ [ $0.11, 1.61$ ]         Guo 2017       3 $98$ 5 $86$ $33.8\%$ $0.53$ [ $0.13, 2.14$ ]         Liu 2018       0 $130$ 2 $135$ $7.2\%$ $0.21$ [ $0.01, 4.28$ ]         Wang 2019       0 $42$ 1 $48$ $6.6\%$ $0.38$ [ $0.02, 9.08$ ]         Subtotal (95% Cl)       407 $405$ $100.0\%$ $0.40$ [ $0.18, 0.90$ ]         Total events       7 $19$ Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 0.55, df = 4 (P = 0.97); l <sup>2</sup> = 0%         Test for overall effect: Z = 2.21 (P = 0.03) $0.001$ $0.1$ $1$ $1000$ Favours [LVC]								
Alhashash 2019 1 37 4 36 14.5% 0.24 [0.03, 2.07] Fang 2019 3 100 7 100 37.9% 0.43 [0.11, 1.61] Guo 2017 3 98 5 86 33.8% 0.53 [0.13, 2.14] Liu 2018 0 130 2 135 7.2% 0.21 [0.01, 4.28] Wang 2019 0 42 1 48 6.6% 0.38 [0.02, 9.08] Subtotal (95% Cl) 407 405 100.0% 0.40 [0.18, 0.90] Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 0.55, df = 4 (P = 0.97); l <sup>2</sup> = 0% Test for overall effect: Z = 2.21 (P = 0.03) 0.001 0.1 1 10 1000 Favours [HVC] Favours [LVC]	1.4.4 Intraspinal leaka	age						
Fang 2019       3       100       7       100       37.9%       0.43 [0.11, 1.61]         Guo 2017       3       98       5       86       33.8%       0.53 [0.13, 2.14]         Liu 2018       0       130       2       135       7.2%       0.21 [0.01, 4.28]         Wang 2019       0       42       1       48       6.6%       0.38 [0.02, 9.08]         Subtotal (95% Cl)       407       405       100.0%       0.40 [0.18, 0.90]         Total events       7       19         Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 0.55, df = 4 (P = 0.97); l <sup>2</sup> = 0%         Test for overall effect: Z = 2.21 (P = 0.03)	Alhashash 2019	1	37	4	36	14.5%	0.24 [0.03, 2.07]	
Guo 2017       3       98       5       86       33.8%       0.53 [0.13, 2.14]         Liu 2018       0       130       2       135       7.2%       0.21 [0.01, 4.28]         Wang 2019       0       42       1       48       6.6%       0.38 [0.02, 9.08]         Subtotal (95% Cl)       407       405       100.0%       0.40 [0.18, 0.90]         Total events       7       19         Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 0.55, df = 4 (P = 0.97); l <sup>2</sup> = 0%         Test for overall effect: Z = 2.21 (P = 0.03)         Output       0.1       1       10         Note that the second se	Fang 2019	3	100	7	100	37.9%	0.43 [0.11, 1.61]	
Liu 2018 0 130 2 135 7.2% 0.21 [0.01, 4.28] Wang 2019 0 42 1 48 6.6% 0.38 [0.02, 9.08] Subtotal (95% Cl) 407 405 100.0% 0.40 [0.18, 0.90] Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 0.55, df = 4 (P = 0.97); l <sup>2</sup> = 0% Test for overall effect: Z = 2.21 (P = 0.03) 0.001 0.1 1 10 1000 Favours [HVC] Favours [LVC]	Guo 2017	3	98	5	86	33.8%	0.53 [0.13, 2.14]	
Wang 2019       0       42       1       48       6.6%       0.38       [0.02, 9.08]         Subtotal (95% Cl)       407       405       100.0%       0.40       [0.18, 0.90]         Total events       7       19         Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 0.55, df = 4 (P = 0.97); l <sup>2</sup> = 0%       0.40       [0.118, 0.90]         Test for overall effect: Z = 2.21 (P = 0.03)       0.001       0.1       1       10       1000         Favours [HVC] Favours [LVC]	Liu 2018	0	130	2	135	7.2%	0.21 [0.01, 4.28]	
Subtotal (95% Cl) 407 405 100.0% 0.40 [0.18, 0.90] Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 0.55, df = 4 (P = 0.97); l <sup>2</sup> = 0% Test for overall effect: Z = 2.21 (P = 0.03) 1000 Favours [HVC] Favours [LVC]	Wang 2019	0	42	1	48	6.6%	0.38 [0.02, 9.08]	
Total events 7 19 Heterogeneity: Tau <sup>2</sup> = 0.00; Chi <sup>2</sup> = 0.55, df = 4 (P = 0.97); l <sup>2</sup> = 0% Test for overall effect: Z = 2.21 (P = 0.03) 	Subtotal (95% CI)	_	407		405	100.0%	0.40 [0.18, 0.90]	
Heterogeneity: Tau* = 0.00; Chl* = 0.55, df = 4 (P = 0.97); l* = 0% Test for overall effect: Z = 2.21 (P = 0.03) 	Total events	7	•	19				
I est for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P = 0.03)         Image: Dest for overall effect: 2 = 2.21 (P	Heterogeneity: Tau <sup>2</sup> = (	0.00; Chi <sup>2</sup>	= 0.55	, df = 4 (P	' = 0.97	'); I² = 0%		
L	est for overall effect: 2	2 = 2.21 (F	-= 0.0	3)				
0.001 0.1 1 10 1000 Favours [HVC] Favours [LVC]								
Favours [HVC] Favours [LVC]								0.001 0.1 1 10 1000
								Favours [HVC] Favours [LVC]

Figure 6. Subgroup analysis of cement leakage based on different locations of cement leakage.

suggest that there is no significant difference in the VAS between HVC and LVC.<sup>[25,27,32]</sup> At present, the clinical effect of HVC is at least equivalent to that of LVC. In the future, more large-sample multi-center prospective randomized controlled studies are needed to determine whether HVC is superior to LVC in terms of VAS. In addition, for ODI, there is no significant difference between HVC and LVC.

The pooled results showed no statistically significant difference between HVC and LVC in the incidence of postoperative adjacent vertebral fractures. This finding is consistent with the results of Alhasash et al<sup>[25]</sup> and Zhang et al.<sup>[31]</sup> According to reports, the probability of recurrence for new fractures in patients with osteoporotic vertebral fractures after minimally invasive surgery is 5.5% to 52%.<sup>[45]</sup> Alhasash et al believed that

		HVC			LVC			Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% Cl	IV. Random, 95% Cl
1.5.1 Pre-OP									
Alhashash 2019	7.5	1.5	30	8	1.4	30	1.0%	-0.50 [-1.23, 0.23]	
Fang 2019	7.78	1.21	100	7.63	1.06	100	3.8%	0.15 [-0.17, 0.47]	+
Guo 2017	8.5	1.5	50	8.8	1	50	1.9%	-0.30 [-0.80, 0.20]	
Huang 2014	7.7	0.8	30	7.7	1	30	2.2%	0.00 [-0.46, 0.46]	
Li 2016	7.42	1.4	49	7.82	1.21	49	1.8%	-0.40 [-0.92, 0.12]	
Liu 2018	9.05	1.64	130	9.17	1.32	135	3.1%	-0.12 [-0.48, 0.24]	
Lv 2020	7.15	1.03	33	6.98	0.87	33	2.2%	0.17 [-0.29, 0.63]	
Xu 2014	8.4	1.4	30	8.3	1.5	30	1.0%	0.10 [-0.63, 0.83]	
Zhou 2015	7.34	0.95	40	7.45	1.15	40	2.1%	-0.11 [-0.57, 0.35]	
Subtotal (95% CI)			492			497	19.0%	-0.06 [-0.21, 0.09]	•
Heterogeneity: Tau <sup>2</sup> =	0.00; CI	hi² = 6.	.98, df :	= 8 (P =	0.54);	12 = 0%	6		
Test for overall effect:	Z = 0.76	6 (P = )	0.45)						
1.5.2 Within 7 days fo	ollow-up	0							
Alhashash 2019	3.5	2	30	4	2	30	0.5%	-0.50 [-1.51, 0.51]	
Guo 2017	3.2	2.5	50	3	1.8	50	0.7%	0.20 [-0.65, 1.05]	
Li 2016	1.33	0.32	49	1.38	0.26	49	8.9%	-0.05 [-0.17. 0.07]	+
Liu 2018	2.88	0.55	130	2.92	0.55	135	8.3%	-0.04 [-0.17, 0.09]	*
Lv 2020	2.18	0.77	33	2.02	0.45	33	4.0%	0.16 [-0.14, 0.46]	200 <b></b>
Zhou 2015	3.11	1.05	40	3.34	0.89	40	2.4%	-0.23 [-0.66, 0.20]	
Subtotal (95% CI)	2. TRESOUTIV	0.00000	332	147.152.552.6	1001010000	337	24.8%	-0.04 [-0.12, 0.04]	<b>+</b>
Heterogeneity: Tau <sup>2</sup> =	0.00: CI	hi² = 3.	.55. df :	= 5 (P =	0.62);	$ ^2 = 0\%$	6		
Test for overall effect:	Z = 0.92	2 (P = )	0.36)						
1.5.3 Short term follo	w-up								
Alhashash 2019	2	1	30	2.5	1	30	1.8%	-0.50 [-1.01, 0.01]	
Fang 2019	2.58	0.54	100	3.09	0.81	100	6.5%	-0.51 [-0.70, -0.32]	
Guo 2017	0.5	0.7	50	0.9	0.9	50	3.8%	-0.40 [-0.72, -0.08]	
Liu 2018	2.86	0.52	130	2.9	0.54	135	8.5%	-0.04 [-0.17, 0.09]	T
Lv 2020	1.11	0.82	33	1.19	0.55	33	3.4%	-0.08 [-0.42, 0.26]	
Zhou 2015	2.05	0.63	40	2.23	0.71	40	4.1%	-0.18 [-0.47, 0.11]	
Subtotal (95% CI)			383			388	28.2%	-0.27 [-0.47, -0.06]	<b>T</b>
Heterogeneity: Tau <sup>2</sup> = Test for overall effect:	0.05; Cl Z = 2.53	hi² = 19 3 (P = 1	9.56, dí 0.01)	ʻ= 5 (P	= 0.00	2);  ² =	74%		
1.5.4 Midterm follow-	up								
Fang 2019	1.17	0.41	100	1.25	0.46	100	8.7%	-0.08 [-0.20, 0.04]	*
Liu 2018	1.8	0.52	130	1.84	0.5	135	8.6%	-0.04 [-0.16, 0.08]	1
Zhou 2015	1.98	0.62	40	1.84	0.68	40	4.3%	0.14 [-0.15, 0.43]	1
Subtotal (95% CI)			270			275	21.6%	-0.04 [-0.13, 0.04]	•
Heterogeneity: Tau <sup>2</sup> = Test for overall effect:	0.00; Cl Z = 1.04	hi² = 1.   (P = 1	.94, df = 0.30)	= 2 (P =	0.38);	<sup>2</sup> = 0%	6		
1551 one term follo	Wallp		10						
Albachach 2010	4 E	4.6	90	2.2		20	1 20/	0 70 [ 1 25 0 05]	
Allastasti 2019	1.0	1.0	30	2.2	0.0	30	2 69/	-0.70 [-1.35, -0.05]	
Yu 2014	2.3	0.0	30	2.2	0.0	30	2.0%	0.10[-0.30, 0.50]	
Subtotal (95% Cl)	0.0	0.7	90	0.9	0.9	90	8 5%	-0.40 [-0.61, 0.01]	-
Heterogeneity: Tau <sup>2</sup> = Test for overall effect:	0.09; Cl Z = 1.28	hi² = 5. 3 (P = 1	.25, df = 0.20)	= 2 (P =	0.07);	l² = 62	%	-area [-artai arta]	
Total (95% CI)		1011	1567			1597	100.0%	-0 11 1-0 19 -0 041	•
Heterogeneity: Tav2 -	0.01.0	hi2 - 4	7 69 7	- 26 /	= 0 0	06)- 12 -	- 15%		
Test for overall effect	7 - 2 05	(D - 4	1.00, di 0.002)	- 20 (F	- 0.0	ooj, i			-2 -1 0 1 2
Test for subaroup diffe	z = 2.90 arences:	Chi <sup>2</sup> =	5.29. d	df = 4 (P	= 0.2	6),  ² = ;	24.4%		Favours [HVC] Favours [LVC]

Figure 7. Subgroup analysis of visual analog scale based on the length of follow-up time before and after surgery.

the bone cement viscosity was not an important risk factor for new vertebral fractures after surgery. Rho YJ<sup>[46]</sup> thinks that the leakage of intervertebral disc bone cement can increase the risk of fracture, specifically postoperative adjacent vertebral fractures, perhaps after the injection of vertebral body bone cement, although its strength is comparable to that of normal vertebral bodies. However, compared with the osteoporotic vertebral body in the adjacent segment, its strength is clearly too high and its elastic modulus increases. After bone cement penetrates the intervertebral disc space, it will cause a change in the stress distribution in the intervertebral disc and reduce the buffer effect of the intervertebral disc. After the patient resumed weight-bearing activities, the adjacent vertebral body was subjected to greater stress, resulting in fracture. However, Ren et al<sup>[45]</sup> and Alhasash et al believed that the postoperative occurrence of new vertebral fractures was unrelated to disc leakage. At present, many scholars recognize that a risk factor for new postoperative fractures is the discovery of multiple initial fractures before surgery.<sup>[45,47-49]</sup>

Our research has some advantages. First, this is the latest and most comprehensive meta-analysis to evaluate the effectiveness and safety of HVC and LVC in the treatment of VCF. Second, we used the Cochrane bias risk and classification

		HVC			LVC			Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	ŞD	Total	Weight	IV, Random, 95% C	I IV. Random, 95% CI
1.6.1 Pre-OP									
Alhashash 2019	60	18	30	65	12.5	30	0.4%	-5.00 [-12.84, 2.84]	
Fang 2019	82.01	7.23	100	80.19	6.78	100	5.5%	1.82 [-0.12, 3.76]	
Huang 2014	76.4	8.2	30	76.3	8.4	30	1.4%	0.10 [-4.10, 4.30]	
Li 2016	58.4	15.7	49	53.5	13.6	49	0.8%	4.90 [-0.92, 10.72]	
Liu 2018	72.83	8.9	130	72.79	8.77	135	4.8%	0.04 [-2.09, 2.17]	
Lv 2020	70.31	11.28	33	71.19	11.06	33	0.9%	-0.88 [-6.27, 4.51]	
Xu 2014	59.7	18	30	67.7	12.5	30	0.4%	-8.00 [-15.84, -0.16]	
Zhou 2015	74.3	9.5	40	75.3	8.5	40	1.6%	-1.00 [-4.95, 2.95]	
Subtotal (95% CI)			442			447	15.9%	0.07 [-1.71, 1.84]	•
Heterogeneity: Tau <sup>2</sup> =	2.20; Cł	ni² = 11.	39, df =	= 7 (P =	0.12); F	2 = 39%			
Test for overall effect:	Z = 0.07	(P = 0.	94)						
	0.25								
1.6.2 Within 7 days fo	ollow-up	•							
Li 2016	20.37	13.6	49	19.92	13.43	49	0.9%	0.45 [-4.90, 5.80]	
Liu 2018	22.91	4.4	130	22.68	4.82	135	11.5%	0.23 [-0.88, 1.34]	T
Zhou 2015	42.3	7.2	40	44.3	6.7	40	2.6%	-2.00 [-5.05, 1.05]	
Subtotal (95% CI)			219			224	15.0%	-0.01 [-1.04, 1.01]	•
Heterogeneity: Tau <sup>2</sup> =	0.00; Ch	ni² = 1.8	5, df =	2 (P = 0	).40); l²	= 0%			
Test for overall effect:	Z = 0.03	(P = 0.	98)						
1.6.3 Short term folio	w-up				-				
Alhashash 2019	30	9	30	28	8	30	1.4%	2.00 [-2.31, 6.31]	
Fang 2019	37.28	6.34	100	35.65	6.26	100	6.5%	1.63 [-0.12, 3.38]	
Liu 2018	22.08	4.34	130	21.71	4.32	135	12.3%	0.37 [-0.67, 1.41]	-
Lv 2020	35.61	8.42	33	34.58	7.47	33	1.7%	1.03 [-2.81, 4.87]	
Zhou 2015	32.5	5.2	40	30.9	4.9	40	4.5%	1.60 [-0.61, 3.81]	
Subtotal (95% CI)			333			338	26.3%	0.88 [0.08, 1.67]	
Heterogeneity: 1 au <sup>2</sup> =	0.00; Cr	$11^2 = 2.3$	0, df =	4 (P = 0	).68); I*	= 0%			
Test for overall effect:	Z = 2.15	(P = 0.	03)						
4.6.4 Midtorm follow									
1.6.4 Midterm follow-	-up	0.07	400	00.07	7.47	400	4 50/	4 00 1 0 04 4 00	
Fang 2019	34.13	8.37	100	32.21	1.41	100	4.5%	1.86 [-0.34, 4.06]	1
Liu 2018	17.09	2.96	130	17.14	2.83	135	17.0%	-0.05 [-0.75, 0.65]	
Lv 2020	16.77	5.68	33	18.52	5.91	33	3.0%	-1.75 [-4.55, 1.05]	
Zhou 2015	23.3	4	40	22.6	3.9	40	6.6%	0.70 [-1.03, 2.43]	
Subtotal (95% CI)	0 40. 01	12 - 4 7	202	a /n - a	401.12	300	31.170	0.24 [-0.70, 1.20]	
Test for overall effects	0.42; Cr	(D - 0	0, 01 =	5 (P = 0	. 19); ۴	- 31%			
Test for overall effect:	2 = 0.46	(I= = 0.	04)						
1.6.5 Long term follo	W-UD								
Albachach 2010	15	5	30	12	45	30	3 00/	3 00 10 50 5 411	
Huana 2014	24.0	16	30	24 5	4.5	30	5.7%	0.40 [.1.51, 2.241]	
Yu 2014	24.9	4.0	30	24.5	7.0	30	2 10/	0.40 [-1.51, 2.51]	
Subtotal (95% CD	0.1	0.0	00	0./	1.0	90	11 7%	1.06 [-0.94 3.06]	-
Heterogeneity: Tauz =	1 51- 0	ni² = 3 8	8 df =	2 (P = 0	14). 12	= 48%	/0	Tool and a soul	-
Test for overall effect	7 = 1 04	(P = 0.0)	30)	- ( 0		40/0			
	2 - 1.04	(r – 0.	50)						
Total (95% CI)			1387			1407	100.0%	0.50 [-0.01, 1.02]	•
Heterogeneity: Tau <sup>2</sup> =	0.29: CH	1 <sup>2</sup> = 28.	05. df =	22 (P	= 0.17):	12 = 22	%		
Test for overall effect:	Z = 1.91	(P = 0.	06)	(-	<i>h</i>	MA SHARE			-20 -10 0 10 20
Test for subaroun diffe	erences:	Chi <sup>2</sup> = 2	2.58. df	= 4 (P =	= 0.63)	$ ^2 = 0\%$			Favours [HVC] Favours [LVC]
					2.001.				

Figure 8. Subgroup analysis of oswestry disability index based on the length of follow-up time before and after surgery.



Figure 9. Meta-analyses of adjacent vertebral fractures between high-viscosity cement (HVC) and low-viscosity cement (LVC). HVC = High-viscosity cement, LVC = Low-viscosity cement.



Figure 10. (A) The funnel plot for the cement leakage. (B) The funnel plot for the visual analog scale.(C) The funnel plot for the oswestry disability index.

method to assess the quality of the evidence. Other advantages include rigorous search strategies, including only randomized controlled trials, no language restrictions, publication bias tests, subgroup analyses and sensitivity analyses to ensure the consistency and accuracy of the results. However, our research also has some limitations. First, due to inadequate blindness, significant heterogeneity or imprecision, several of the pooled results consisted of low-quality evidence. Second, 11 of the 12 included studies were conducted in China, which could limit the application of the results to other populations.

## 5. Conclusions

Compared with LVC, HVC had a shorter operation time, lower bone cement leakage rate and better VAS score improvement, but in terms of bone cement injection volume, ODI and adjacent vertebral body fractures, the 2 are equivalent. More large-sample, multi-center, high-quality studies and longer-term follow-ups are needed to evaluate the effectiveness and safety between the 2 bone cements.

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