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Functional outcomes of open laminectomy, minimally invasive, and endoscopic biportal decompression surgery in lumbar stenosis: systematic review and meta-analysis

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Abstract: Lumbar spinal stenosis (LSS) is a common degenerative condition that often requires decompression surgery. Various techniques, including open laminectomy, minimally invasive unilateral laminotomy bilateral decompression (MIS-ULBD), and unilateral biportal endoscopic (UBE) surgery, are utilized. This study compares the functional outcomes and complications of these methods. A systematic review and meta-analysis were conducted, analyzing studies from PubMed, Springerlink, and other databases. The key variables studied included the Visual Analog Scale (VAS) for pain, Oswestry Disability Index (ODI), intraoperative blood loss, hospital stay duration, operative time, and postoperative complications. A total of 14 studies with 1,427 patients aged 52.35-74.52 years were included. MIS resulted in shorter operative times compared to UBE, but UBE had a lower complication rate. UBE also demonstrated superior outcomes in terms of VAS pain reduction, ODI scores, and shorter hospital stays compared to both MIS and open laminectomy. UBE and MIS each present post-operative advantages. UBE offers faster recovery and reduced pain, while MIS has the benefit of shorter surgery times. Despite the steep learning curve and more complex instrumentation required, UBE is a safe and effective alternative to traditional decompression techniques, offering better functional outcomes in LSS patients compared to MIS and open laminectomy.

Keywords: *Functional Outcomes, Lumbar Spinal Stenosis, Minimally Invasive Surgery, Open Laminectomy, Unilateral Biportal Endoscopy.*

1. Introduction

Lumbar spinal stenosis (LSS) is a condition that results from the narrowing of the spinal canal, which compresses the nerve roots and spinal cord. It is common among the elderly and leads to debilitating symptoms like back pain, leg pain, and neurological deficits. Conservative treatment options include physical therapy, medication, and epidural injections. However, surgery is considered when conservative measures fail. [1–3]

Surgical decompression for LSS aims to relieve pressure on the spinal nerves. The primary surgical approaches include open laminectomy, minimally invasive surgery (MIS), and unilateral biportal endoscopy (UBE).[4] Each technique has its advantages and limitations. Open laminectomy is the traditional approach, providing a wide decompression but it is associated with longer recovery and higher complication rates. MIS, which involves smaller incisions and less tissue disruption, offers faster recovery but can be technically demanding. UBE is a relatively new endoscopic technique that provides decompression through small incisions while minimizing tissue trauma.[5,6]

This study aims to compare the functional outcomes of these three surgical methods to determine which offers the best balance of efficacy and safety in treating lumbar spinal stenosis.

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2. Materials and Methods

This study is a systematic review and meta-analysis comparing the functional outcomes of three surgical techniques used for lumbar spinal stenosis decompression: open laminectomy, minimally invasive surgery, and unilateral biportal endoscopy. The analysis focuses on key outcomes such as pain Visual Analogue Scale, Oswestry Disability Index, blood loss, hospital stay, operative time, failure rate, and complications.

This research was conducted between May and April 2024. A comprehensive literature search was conducted using databases such as PubMed, SpringerLink, Science Direct, ResearchGate, Cochrane, and Google Scholar. The search involved combining free-text keywords with Boolean operators ("AND"/"OR") for precise results (Table 1).

- Population: ("Lumbar Spinal Stenosis" OR "LSS") AND ("decompression surgery" OR "spinal decompression")
- Intervention: ("decompression surgery" AND ("open laminectomy" OR "minimally invasive surgery" OR "MIS" OR "unilateral biportal endoscopy" OR "UBE"))
- Comparison: ("open laminectomy" OR "minimally invasive surgery" OR "MIS" OR "UBE" OR "BESS") AND "comparison"
- Outcomes: ("pain VAS" OR "Visual Analog Scale" OR "ODI score" OR "Oswestry Disability Index") AND ("complication" OR "postoperative outcomes")
- Inclusion Criteria: ("Lumbar Spinal Stenosis" AND ("decompression surgery" OR "open laminectomy" OR "MIS" OR "UBE")) AND ("minimum 6 months follow-up" OR "postoperative follow-up")
- Exclusion Criteria: NOT ("spinal tumors" OR "spinal fractures" OR "spinal infections" OR "pediatric" OR "adolescent") AND NOT ("revision surgery" OR "other surgical techniques")

The search adhered to PRISMA guidelines, focusing on studies that included terms related to LSS, decompression surgery, and the surgical techniques under review. From the initial pool of 1126 studies, 14 (4 Randomized Controlled Trials (RCTs) and 10 retrospective studies) were analyzed, involving 1427 patients aged between 52.35 and 74.52 years (Figure 1).

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Table 1.
PICO.

	Population	Intervention	Comparison	Outcomes
Inclusion criteria	• Lumbar Spinal Stenosis that has undergone decompression surgery with open laminectomy, MIS, and UBE. • Minimal 6 months follow-up post-operative	• Decompression operation	Operation method: • Open laminectomy • MIS • UBE	• Pain VAS • ODI score • Complication • Blood loss • Hospital stay • Operative tume • Failure rate
Exclusion criteria	• Patients with concurrent spinal conditions, such as spinal tumors, fractures, or infections. • Studies not providing full-text access or written in non-English or non-Indonesian languages. • Reviews, or meta-analyses instead of original research. • Pediatric or adolescent patients.	• Patients with repetitive or revision spinal surgery	• Studies involving other surgical techniques not including open laminectomy, MIS-ULBD, or UBE/BESS.	• Studies lacking VAS outcomes or other quantitative pain measurement postoperatively. • Incomplete postoperative data.

Note: PICO (Population, Intervention, Comparison, and Outcome) inclusion and exclusion criteria, MIS (Minimally Invasive Surgery), UBE (Unilateral Biportal Endoscopic)

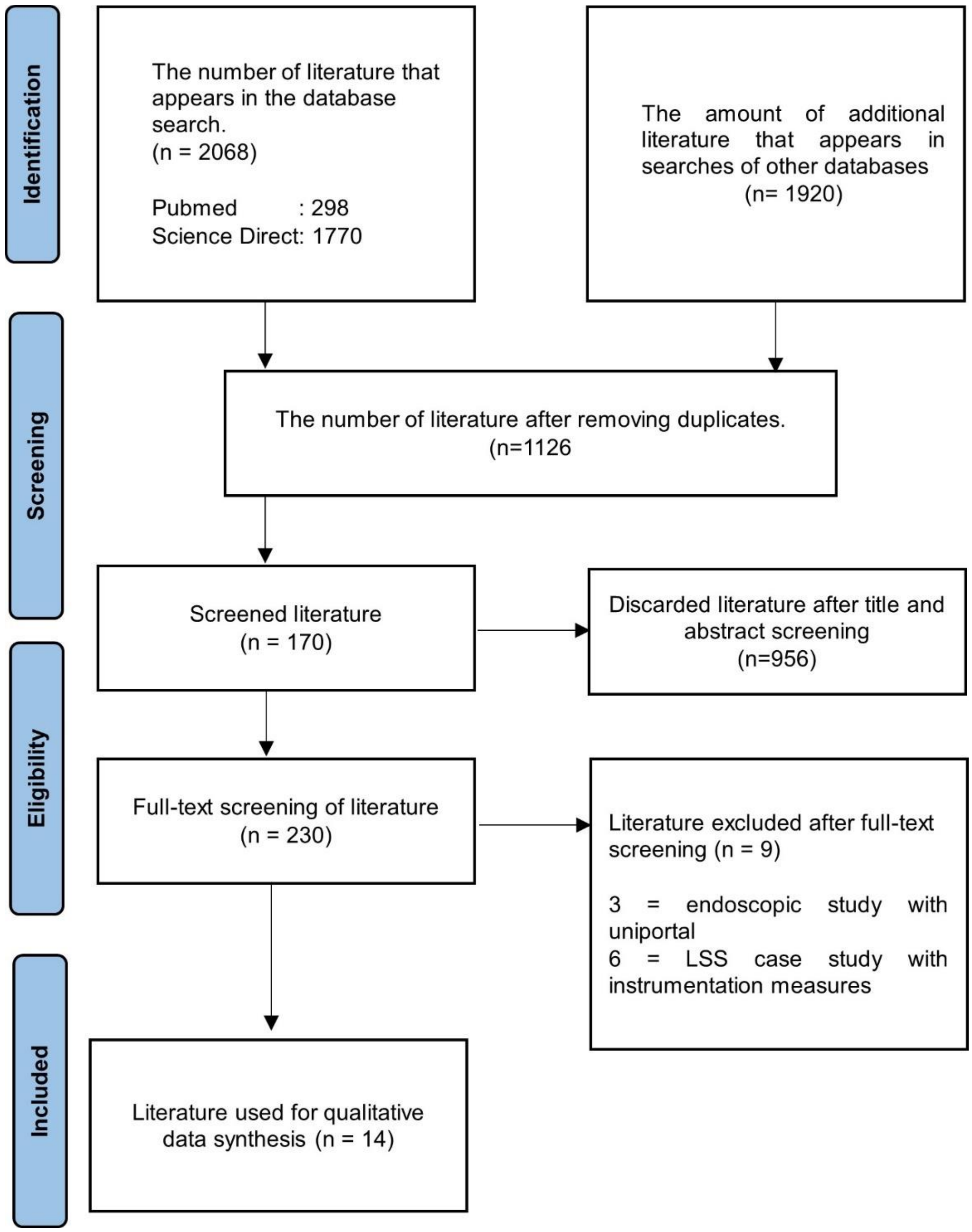

Figure 1.
PRISMA Diagram used in the study.

These studies compared the outcomes of open laminectomy, MIS, and UBE. Meta-analysis was performed using software tools like Microsoft Excel 2019 and Revman 5.4. Both fixed-effect and random-effect models were used depending on the heterogeneity of the studies. Heterogeneity was measured using the I^2 statistic, with I^2 values above 50% indicating significant heterogeneity and warranting the use of a random-effects model.

3. Results

The analysis included 14 studies (4 randomized controlled trials and 10 retrospective studies) involving a total of 1427 patients with lumbar spinal stenosis, aged between 52.35 and 74.52 years. The studies compared the outcomes of decompression surgeries using open laminectomy, minimally invasive surgery, and unilateral biportal endoscopy (Figure 2) (Table 2).

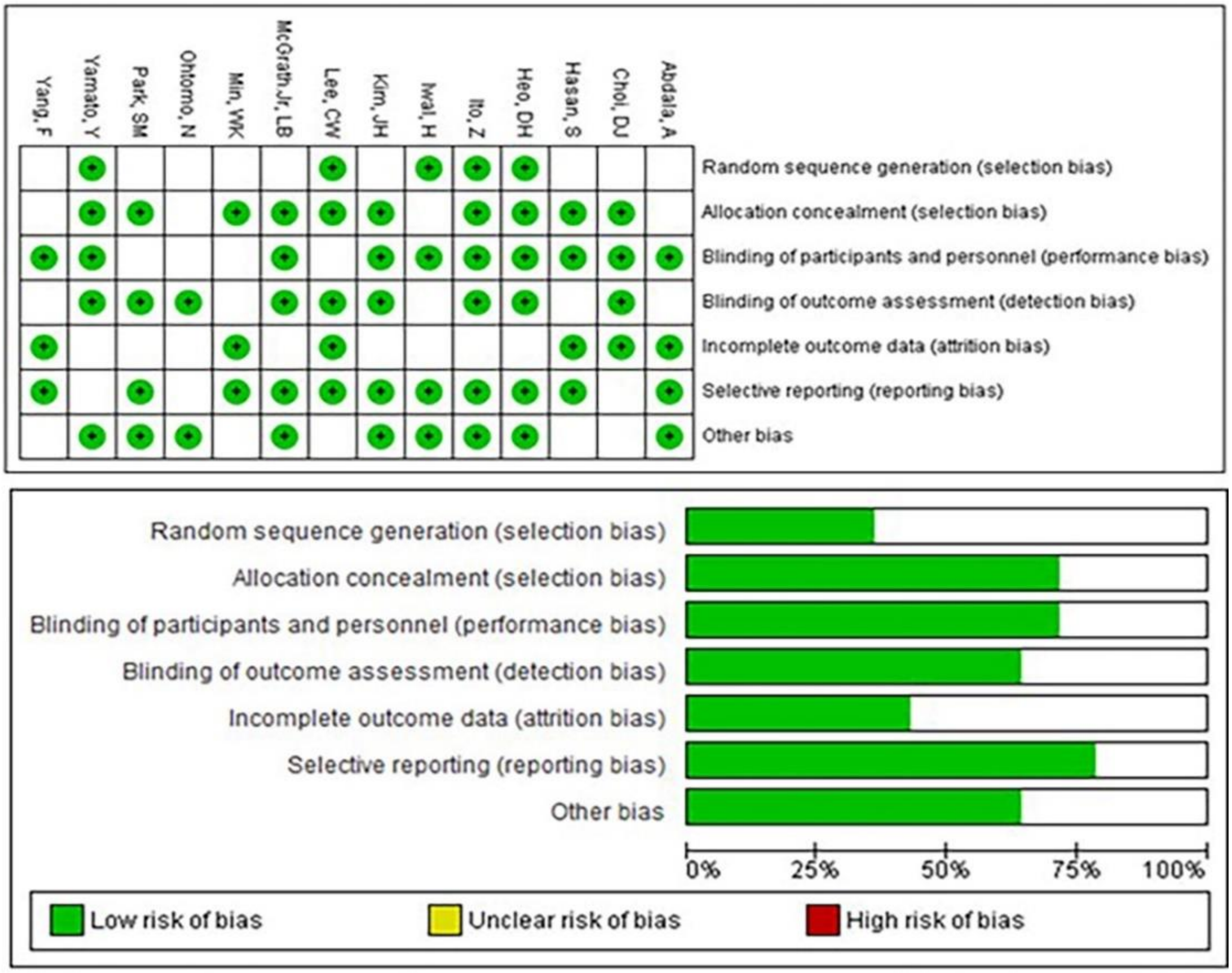

Figure 2.
Risk of bias assessment using the Risk of Bias in Non-Randomized Studies tool. (ROBINS-I).

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Table 2.
Demographic results.

Writers	Year	Research Design	Operation Method	Sample Size (n)	Genders (M/F; n)	Age (years)*	Outcomes
Min, WK	2019	R	MIS vs. UBE	89	MIS (19/16); UBE (2727)	66.24	VAS back and leg pain, ODI score, complication, failure rate, hospital stay, operative times
Park, SM	2020	RCT	MIS vs. UBE	64	MIS (18/14); UBE (13/19)	66.65	VAS back and leg pain, ODI score, complication, failure rate, hospital stay, operative times
Yamato, Y	2023	R	*Open* vs. MIS	80	Open (22/7); MIS (38/13)	71.9	VAS back and leg pain, ODI score, complication, blood loss, hospital stay, operative times
Ohtomo, N	2021	R	*Open* vs. MIS	252	*Open* (68/54); MIS (69/61)	74.2	VAS back and leg pain, ODI score, complication, blood loss, failure rate, hospital stay, operative times
Yang, F	2020	R	MIS vs. UBE	61	MIS (10/18); UBE (14/19)	74.52	VAS back and leg pain, ODI score, complication, hospital stay, operative times
Kim, JH	2023	RCT	*Open* vs. UBE	45	*Open* (11/10); UBE (9/15)	65.35	VAS back and leg pain, ODI score, complication, failure rate, hospital stay
Hasan, S	2019	R	MIS vs. UBE	45	MIS (12/14); UBE (12/7)	68.25	VAS back and leg pain, ODI score, complication, failure rate, blood loss, hospital stay
Choi, DJ	2019	R	MIS vs. UBE	65	MIS (17/13); UBE (14/21)	65.3	VAS back and leg pain, complication
Heo, DH	2019	R	MIS vs. UBE	70	MIS (12/21); UBE (15/22)	65.05	VAS back and leg pain, ODI score, complication, operative times
Mc Grath. Jr, LB	2019	R	MIS vs. UBE	95	MIS (27/18); UBE (27/23)	62	VAS back and leg pain, ODI score, complication, failure rate, blood loss, hospital stay, operative times
Ito, Z	2021	RCT	MIS vs. UBE	181	MIS (71/68); UBE (28/14)	65.65	VAS back and leg pain, ODI score, complication, failure rate, operative times
Lee, CW	2019	R	MIS vs. UBE	236	MIS (21/51); UBE (52/112)	56.27	VAS back and leg pain, ODI score, complication, failure rate, blood loss, hospital stay, operative times
Iwai, H	2020	R	MIS vs. UBE	114	MIS (29/25); UBE (39/21)	70.75	VAS back and leg pain, complication, hospital stay, operative times
Abdala, A	2019	RCT	*Open* vs. MIS	30	*Open* (8/10); MIS (7/5)	52.35	VAS leg pain, ODI score, complication, blood loss, hospital stay, operative times

Note: R = Retrospective; RCT = Randomized Controlled Trial
*Data is presented in Mean

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3.1. Visual Analogue Scale (VAS) for Back and Leg Pain

The results demonstrated that UBE showed a significantly lower VAS for back and leg pain at the final follow-up compared to MIS ($p<0.05$). However, on both back and leg MIS demonstrated a better ΔVAS (change in VAS from baseline) compared to UBE ($p<0.05$). The comparison between MIS and open laminectomy did not show a significant difference in VAS scores for either back or leg pain (Table 3) (Figure 3) (Figure 4) (Figure 5) (Figure 6).

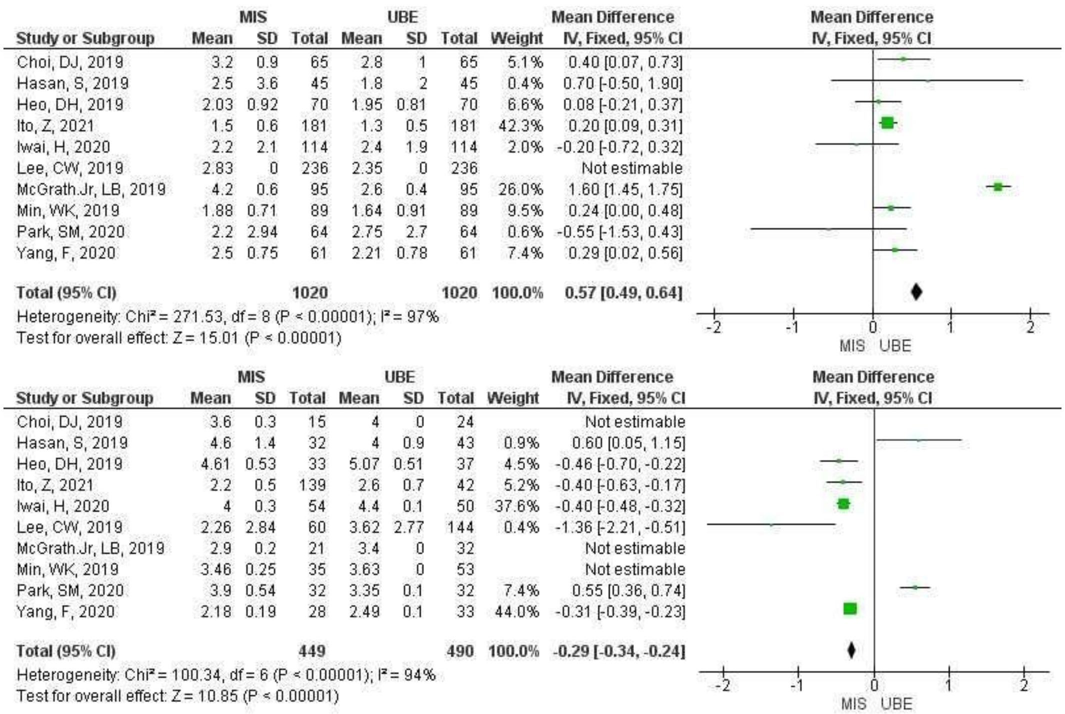

Figure 3.
Forest Plot VAS (Back) pain MIS vs. UBE; a) Final follow up; b) ΔVAS

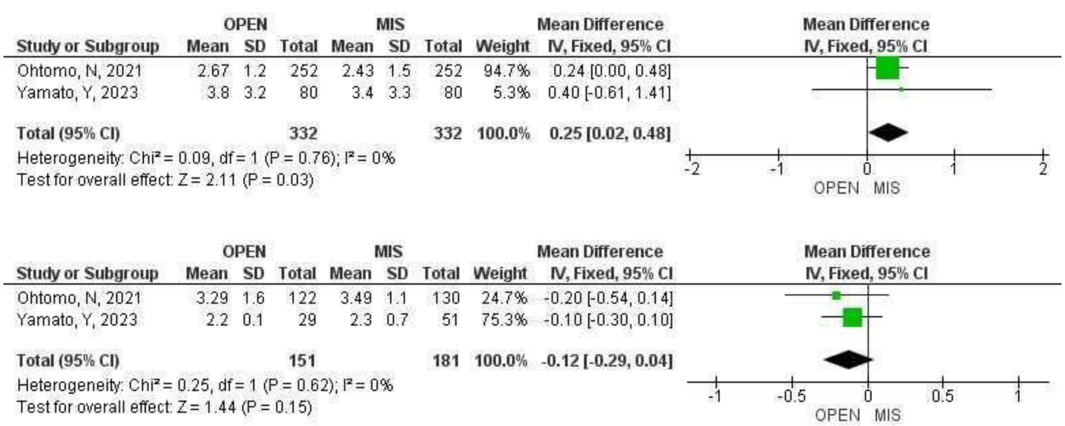

Figure 4.
Forest Plot VAS (Back) pain Open vs. MIS; a) Final follow up; b) ΔVAS

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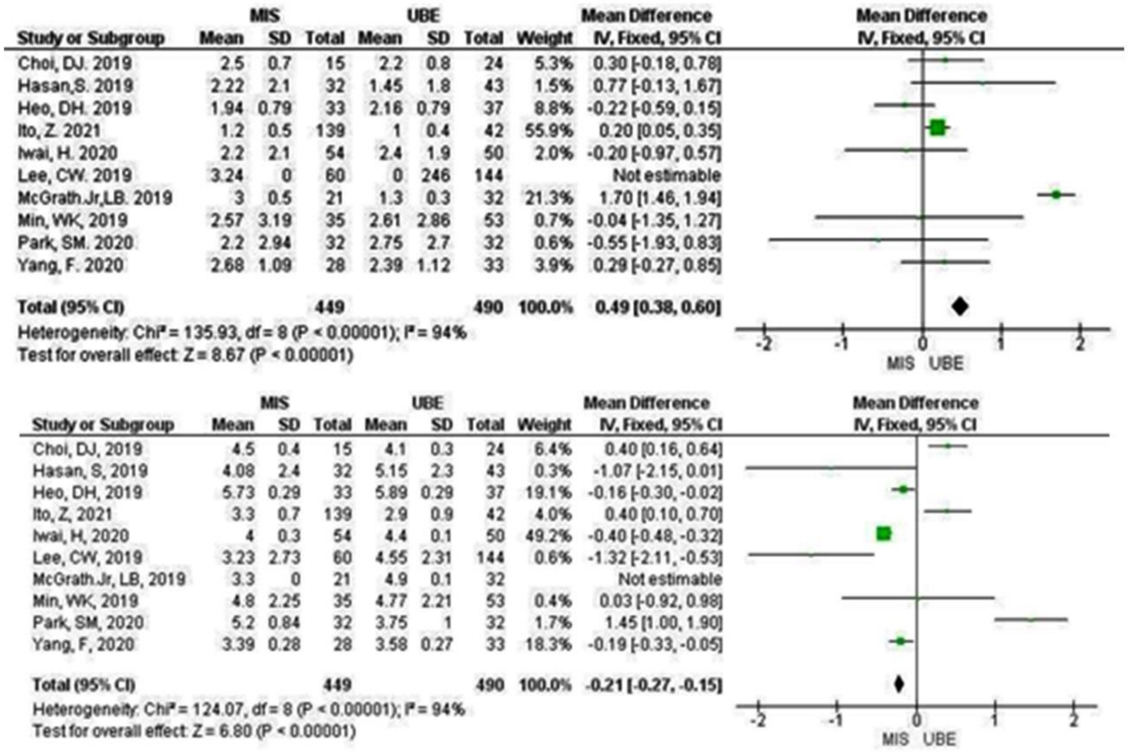

Figure 5.
Forest Plot VAS (Leg) pain MIS vs. UBE; a) Final follow up; b) ΔVAS.

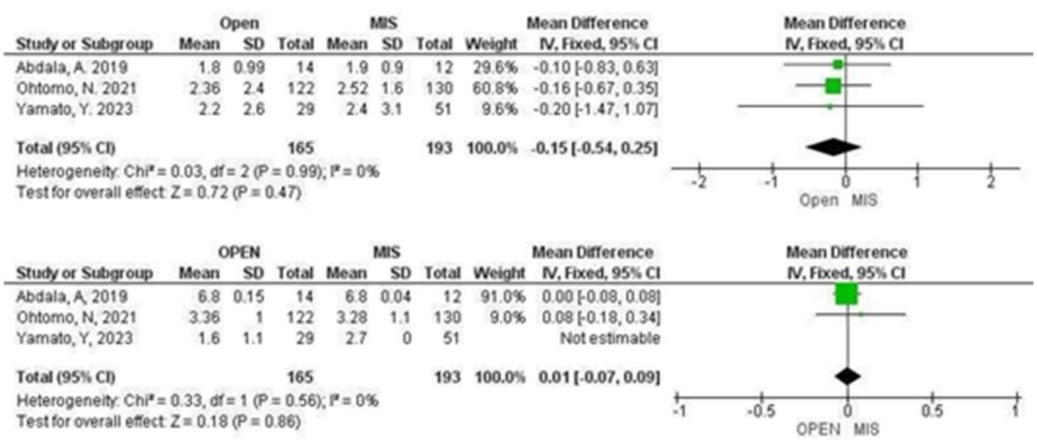

Figure 6:
Forest Plot VAS (Leg) pain Open vs. MIS; a) Final follow up; b) ΔVAS

Table 3.
VAS for Back, Leg, and ODI

Reference	Operation Method	*Pre-Operative*			*Final Follow-Up*			*Difference (Δ)*		
		VAS (Back)	*VAS (leg)*	ODI (%)	*VAS (Back)*	*VAS (leg)*	ODI (%)	*VAS (Back)*	*VAS (leg)*	ODI (%)
Min, WK. 2019	MIS	5.34 ± 0.96	7.37 ± 0.94	61.1 ± 4.89	1.88 ± 0.71	2.57 ± 3.19	16.4 ± 6.52	3.46 ± 0.25	4.8 ± 2.25	44.7 ±1.63
	UBE	5.27 ± 0.91	7.38 ± 0.65	60.4 ± 6.88	1.64 ± 0.91	2.61 ± 2.86	15.4 ± 8.49	3.63 ± 0	4.77 ± 2.21	55 ± 1.61
Park, SM. 2020	MIS	6.1 ± 2.4	7.4 ± 2.1	47.0 ± 14.4	2.20 ± 2.94	2.20 ± 2.95	18.03 ± 18.80	3.9 ± 0.54	5.2 ± 0.84	28.97 ± 4.4
	UBE	6.1 ± 2.6	6.5 ± 1.7	46.2 ± 20.5	2.75 ± 2.70	2.75 ± 2.70	9.79 ± 19.67	3.35 ± 0.1	3.75 ± 1.0	26.41 ± 0.83
Yamato, Y. 2023	*Open*	6.0 ± 3.1	3.8 ± 3.7	43.6 ± 18.7	3.8 ± 3.2	2.2 ± 2.6	26.2 ± 23.2	2.2 ± 0.1	1.6 ± 1.1	17.4 ± 4.5
	MIS	5.7 ± 2.6	5.1 ± 3.1	39.3 ± 16.6	3.4 ± 3.3	2.4 ± 3.1	20.6 ± 20.0	2.3 ± 0.7	2.7 ± 0	18.7 ± 3.4
Ohtomo, N. 2021	*Open*	5.96 ± 2.8	5.72 ± 3.4	20.2 ± 9.7	2.67 ± 1.2	2.36 ± 2.4	11.8 ± 6.2	3.29 ± 1.6	3.36 ± 1.0	8.4 ± 3.5
	MIS	5.92 ± 2.6	5.80 ± 2.7	20.8 ± 8.2	2.43 ± 1.5	2.52 ± 1.6	12.0 ± 5.8	3.49 ± 1.1	3.28 ± 1.1	8.8 ± 2.4
Yang, F. 2020	MIS	4.68 ± 0.94	6.07 ± 0.81	61.86 ± 7.32	2.50 ± 0.75	2.68 ± 1.09	28.75 ± 7.06	2.18 ± 0.19	3.39 ± 0.28	33.1 ± 0.26
	UBE	4.70 ± 0.88	5.97 ± 0.85	60.58 ± 5.85	2.21 ± 0.78	2.39 ±1.12	29.42 ± 8.84	2.49 ± 0.1	3.58 ± 0.27	31.16 ± 2.99
Kim, JH. 2023	*Open*	5.0 ± 2.7	6.7 ± 1.7	42.6 ± 22.0	1.3 ± 1.3	1.6 ± 2.1	31.0 ± 22.6	3.7 ± 1.4	5.1 ± 0.4	11.6 ± 0.6
	UBE	5.3 ± 2.4	7.3 ± 1.7	52.9 ± 16.3	2.0 ± 2.2	1.7 ± 2.1	36.8 ± 18.4	3.3 ± 0.2	5.6 ± 0.4	16.1 ± 2.1
Hasan, S. 2019	MIS	7.1 ± 2.2	6.3 ± 2.4	46.6 ± 16.0	2.5 ± 3.6	2.22 ± 2.1	22.1 ±16.4	4.6 ± 1.4	4.08 ± 2.4	24.5 ± 16
	UBE	5.8 ± 2.9	6.6 ± 2.3	52.8 ± 10.7	1.8 ± 2.0	1.45 ± 1.8	19.9 ± 16.2	4.0 ± 0.9	5.15 ± 2.3	32.9 ± 10.7
Choi, DJ. 2019	MIS	6.8 ± 1.2	7.0 ± 1.1	N/A	3.2 ± 0.9	2.5 ± 0.7	N/A	3.6 ± 0.3	4.5 ± 0.4	N/A
	UBE	6.8 ± 1.0	6.3 ± 1.1	N/A	2.8 ± 1.0	2.2 ± 0.8	N/A	4.0 ± 0.9	4.1 ± 0.3	N/A
Heo, DH. 2019	MIS	6.64 ±1.45	7.67 ± 1.08	56.36 ± 5.91	2.03 ± 0.92	1.94 ± 0.79	22.58 ± 4.57	4.61 ± 0.53	5.73 ± 0.29	33.78 ± 1.34
	UBE	7.02 ± 1.34	8.05 ± 1.08	58.68 ± 5.57	1.95 ± 0.81	2.16 ± 0.79	23.14 ± 2.69	5.07 ± 0.51	5.89 ± 0.29	35.54 ± 2.88
McGrath.Jr, LB. 2019	MIS	7.1 ± 0.4	6.3 ± 0.5	47.2 ± 3.1	4.2 ± 0.6	3.0 ± 0.5	35.9 ± 4.1	2.9 ± 0.2	3.3 ± 0	11.3 ± 1
	UBE	6.0 ± 0.4	6.2 ± 0.4	51.0 ± 1.9	2.6 ± 0.4	1.3 ± 0.3	20.7 ± 3.4	3.4 ± 0	4.9 ± 0.1	30.3 ± 1.5
Ito, Z. 2021	MIS	3.7 ± 1.1	4.5 ± 1.2	23.3 ± 9.8	1.5 ± 0.6	1.2 ± 0.5	12.5 ± 4.3	2.2 ± 0.5	3.3 ± 0.7	10.8 ± 5.5
	UBE	3.9 ± 1.2	3.9 ± 1.3	23.5 ± 9.2	1.3 ± 0.5	1.0 ± 0.4	11.3 ± 5.6	2.6 ± 0.7	2.9 ± 0.9	12.2 ± 3.6
Lee, CW. 2019	MIS	5.09 ± 2.84	6.47 ± 2.73	56..3 ± 6.1	2.83	3.24	45.3	2.26 ± 2.84	3.23 ± 2.73	11 ± 6.1
	UBE	5.97 ± 2.77	7.01 ± 2.31	69.8 ± 5.4	2.35	2.46	46.5	3.62 ± 2.77	4.55 ± 2.31	23.3 ± 5.4

Iwai, H. 2020	MIS	6.2 ± 2.4	N/A	N/A	2.2 ± 2.1	N/A	N/A	4.0 ± 0.3	N/A	N/A
	UBE	6.8 ± 1.8	N/A	N/A	2.4 ± 1.9	N/A	N/A	4.4 ± 0.1	N/A	N/A
Abdala, A. 2019	*Open*	N/A	8.6 ± 0.84	33.9 ± 9.02	N/A	1.8 ± 0.99	13.1 ± 4.58	N/A	6.8 ± 0.15	20.8 ± 4.44
	MIS	N/A	8.7 ± 0.95	30.9 ± 5.95	N/A	1.9 ± 0.99	11.3 ± 3.30	N/A	6.8 ± 0.04	19.6 ± 2.65

3.2. Oswestry Disability Index (Odi)

UBE showed a significantly better ODI at the final follow-up compared to MIS (p<0.05). MIS demonstrated a better ΔODI compared to UBE (p<0.05). There were no significant differences between MIS and open laminectomy for ODI scores (Table 4) (Figure 5) (Figure 6).

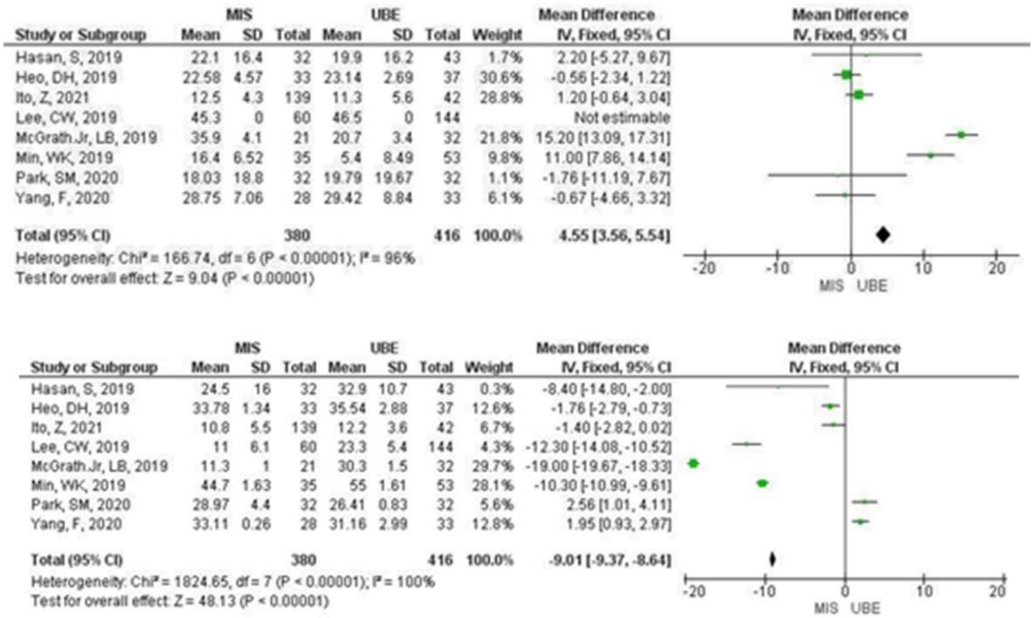

Figure 7.
Forest Plot ODI score MIS vs. UBE; a) Final follow up; b) ΔODI.

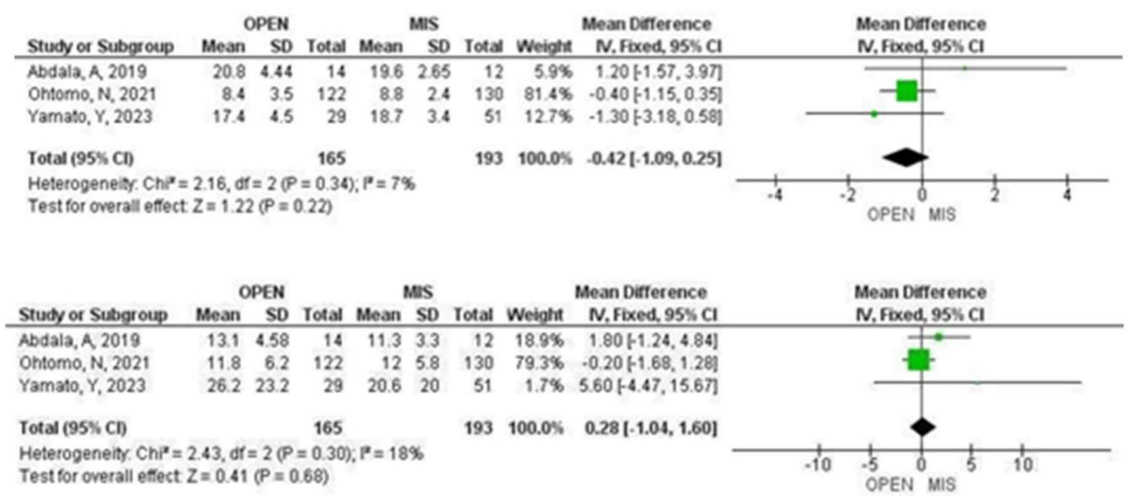

Figure 8.
Forest Plot ODI score Open vs. MIS; a) Final follow up; b) ΔODI

Table 4.
Blood Loss, Hospital Stay, Operative Duration, Failure Rate, and Complications.

Reference	Operation Approach	Blood Loss (ml)	Hospital Stay (days)	Operative duration (hours)	Failure Rate (n)	Complication (n)
Min, WK. 2019	MIS	N/A	7.45 ± 2.63	58.85 ± 7.48	1	*Dural tear (1); Epidural Hematoma (1)*
	UBE	N/A	4.31 ± 1.17	53.68 ± 6.75	1	*Dural tear (2); Epidural Hematoma (1)*
Park, SM. 2020	MIS	N/A	2,44 ± 1,4	58.4 ± 33.9	1	*Dural tear (2)*
	UBE	N/A	1,9 ± 0,68	45.6 ± 16.2	0	*Dural tear (2)*
Yamato, Y. 2023	Open	56.9 ± 54.4	16.0 ± 5.3	94.8 ± 37.3	N/A	*Dural tear (3); Hemostatic Agent Use (6); Surgical Site Infection (1)*
	MIS	34.2 ± 65.5	8.0 ± 3.7	85.2 ± 34.8	N/A	*Dural tear (3); Hemostatic Agent Use (10)*
Ohtomo, N. 2021	Open	144.2 (75-700)	16.5	100.9 (47-274)	2	*Dural tear (3); Urinary tract infection (1); Surgical Site Infection (4); Stroke (1)*
	MIS	30.4 (5-250)	9.7	76.8 (40-169)	1	*Dural tear (8); Hematoma (1); Surgical Site Infection (1)*
Table 4. Blood Loss, Hospital Stay, Operative Duration, Failure Rate, and Complications (continue)						
Yang, F. 2020	MIS	N/A	7.13 (6.08 - 8.11)	72.00 (68.75 - 74.80)	0	*Dural tear (1); Urinary tract infection (2); transient delirium (2)*
	UBE	N/A	3.65 (2.90 - 4.50)	90.33 (87.13 - 94.75)	0	*Dural tear (2); Urinary tract infection (2); acute exacerbation of chronic bronchitis (1); acute left heart failure (1)*
Kim, JH. 2023	*Open*	N/A	4.8 ± 1.5	N/A	0	*Acute embolic cerebral infarction (1); Asymptomatic synovial cysts (1)*
	UBE	N/A	3.8 ± 1.9	N/A	1	*Operation level mismatch (1); Asymptomatic hematoma (1)*
Hasan, S. 2019	MIS	30.0 ± 18.9	1.7 ± 1.2	N/A	2	*Dural tear (2)*
	UBE	3.1 ± 5.0	0.9 ± 0.8	N/A	2	*Dural tear (2)*
Choi, DJ. 2019	MIS	N/A	N/A	N/A	N/A	*Dural tear (2)*
	UBE	N/A	N/A	N/A	N/A	*Dural tear (2); Root injury (1)*
Heo, DH. 2019	MIS	N/A	N/A	56.4 ± 4.7	N/A	*Dural tear (2); Transient weakness (1);*

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						Hematoma (2)
	UBE	N/A	N/A	62.4 ± 5.7	N/A	*Dural tear (1); Hematoma (1)*
McGrath.Jr, LB. 2019	MIS	51.8 ± 11.0	2.4 ± 0.5	154.1 ± 6.2	2	*Dural tear (3); Epidural hematoma (2); Urinary retention (6); Parasthesia (1)*
	UBE	6.5 ± 0.6	0.7 ± 0.1	210.8 ± 9.7	1	*Dural tear (1); Parasthesia (3); Disc herniation (1)*
Ito, Z. 2021	MIS	N/A	N/A	51.0 ± 12.2	2	*Dural tear (8); Hematoma (5)*
	UBE	N/A	N/A	57.0 ± 10.3	0	*Dural tear (2)*
Lee, CW. 2019	MIS	134.3 ± 35.34	4.85 ± 1.86	52.22 ± 19.07	1	*Dural tear (1); Hematoma (1)*
	UBE	35.34 ± 28.87	2.12 ± 1.68	84.17 ± 34.70	0	*Dural tear (4)*
Iwai, H. 2020	MIS	N/A	4.7 ± 1.67	54.6 ± 17.6	N/A	*Dural tear (3); Hematoma (2)*
	UBE	N/A	2.1 ± 1.8	77.8 ± 18.8	N/A	*Dural tear (1); Hematoma (7)*
Abdala, A. 2019	*Open*	152 ± 50.95	2.4 ± 0.7	85.5 ± 17.07	N/A	*Dural tear (2)*
	MIS	127 ± 37.43	1.8 ± 0.42	73.5 ± 14.54	N/A	*Dural tear (1)*

3.3. Blood Loss

UBE had significantly lower blood loss compared to MIS ($p<0.05$), and MIS had significantly lower blood loss compared to open laminectomy ($p<0.05$) (Figure 7) (Figure 8).

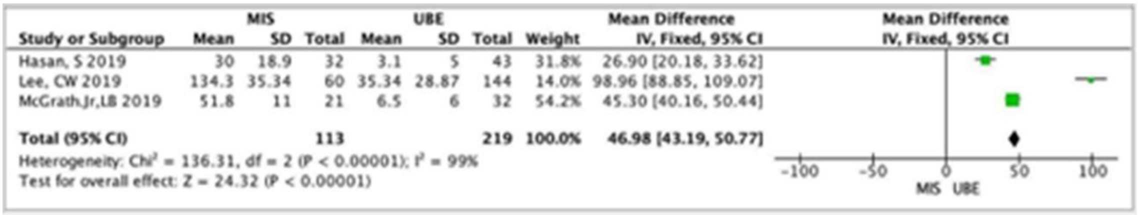

Figure 9.
Forest Plot Blood Loss MIS vs. UBE

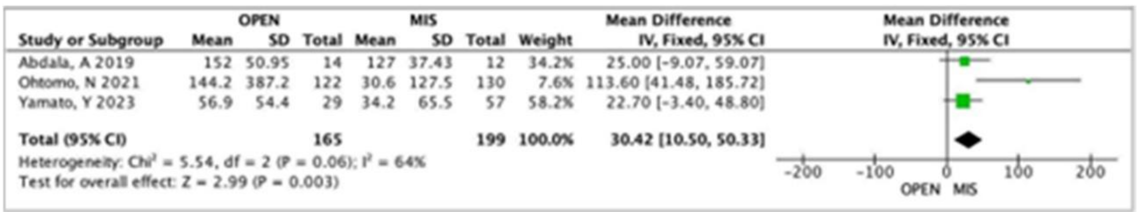

Figure 10.
Forest Plot Blood Loss Open vs. MIS

3.4. Hospital Stay

UBE demonstrated significantly shorter hospital stays compared to MIS ($p<0.05$), and MIS showed shorter hospital stays compared to open laminectomy ($p<0.05$) (Figure 9) (Figure 10).

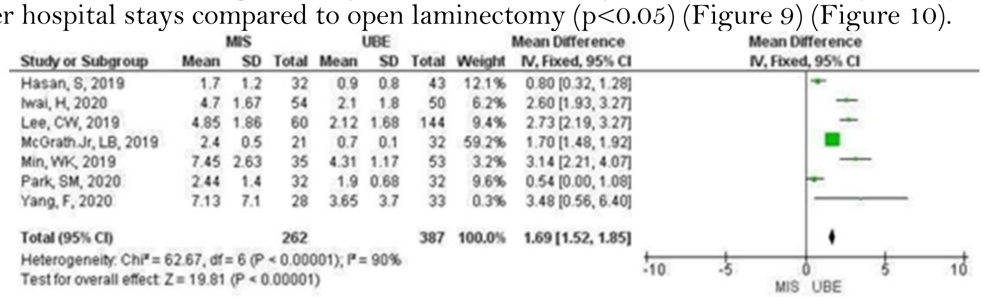

Figure 9.
Forest Plot Hospital Stay MIS vs. UBE

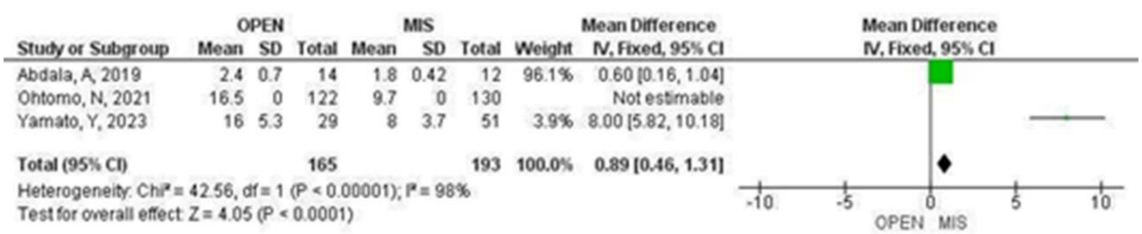

Figure 10.
Forest Plot Hospital Stay Open vs. MIS

3.5. Operative Time

MIS showed significantly shorter operative time compared to UBE and open laminectomy ($p<0.05$). The analysis revealed significant heterogeneity in operative times between the studies (Figure 11) (Figure 12).

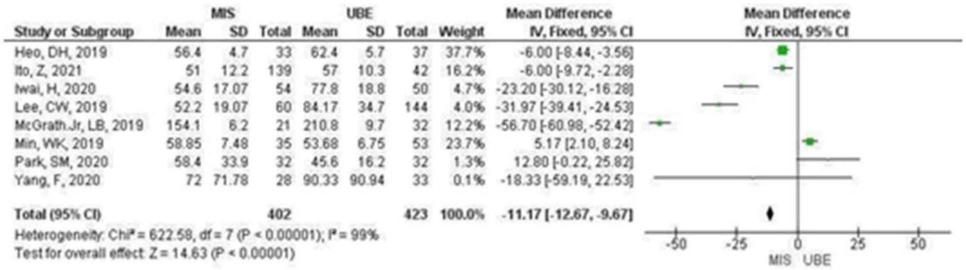

Figure 11.
Forest Plot Operative Time MIS vs. UBE

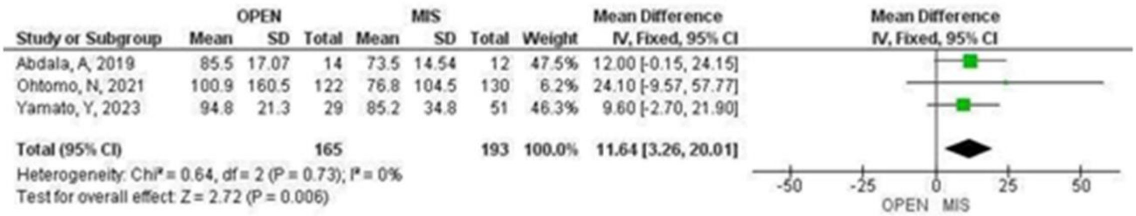

Figure 12.
Forest Plot Operative Time Open vs. MIS

3.6. Complications and Failure Rate

UBE was associated with lower complication and failure rates compared to both MIS and open laminectomy, although the results varied across different studies.

These results suggest that UBE may offer superior outcomes in terms of pain relief, functional recovery, and shorter hospital stays, while MIS provides the advantage of reduced operative time and blood loss.

4. Discussion

The success rate of open laminectomy for lumbar spinal stenosis (LSS) is around 62-70%, but it is often associated with risks such as local tissue trauma and postoperative spinal instability.[7] These complications are thought to arise due to the extensive retraction and muscle damage involved in the procedure, which leads to prolonged recovery times and poorer quality of life postoperatively. To address these challenges, minimally invasive surgery and unilateral biportal endoscopy were developed as alternatives to reduce tissue damage and improve outcomes.[8] MIS, using a tubular retractor, initially started as a solution for herniated discs but has since evolved to treat central canal stenosis. UBE, a newer technique, allows for better visualization with smaller incisions and has become the standard for many decompression procedures.[2,9–11]

The meta-analysis showed that patients treated with UBE had better final follow-up Visual Analogue Scale (VAS) scores for back and leg pain compared to those treated with MIS. However, MIS exhibited better changes in VAS scores from baseline, which could suggest a greater improvement for certain patients. MIS also had more complications, such as dural tears and hematomas, compared to UBE. MIS had a higher failure rate, with 10 patients requiring revision surgery compared to five in the UBE group.[12,13]

Although UBE offers superior outcomes in terms of pain relief, hospital stay, and lower complication rates, it does have its challenges. The technique requires a steep learning curve, and

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surgeons may face difficulties achieving complete decompression in the early stages of their experience. This learning curve can result in longer operative times for UBE compared to MIS, as seen in studies where UBE took significantly longer due to the complexity of the technique.[14,15]

5. Conclusion

UBE appears to be a safe and effective alternative for the decompression of LSS, especially when performed by experienced surgeons with the proper instrumentation. However, MIS still offers significant benefits for certain patient populations, particularly those with complex cases or higher body mass indexes (BMI), where the use of retractors may offer better visualization and access.

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