



Penn Medicine

Staging in Circumferential Spinal Fusion in Adult Spinal Deformity: Systematic Review and Meta-Analysis

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Disclosure

I have no disclosures to report

Adult Spinal Deformity (ASD)

Affects up to 68%
of the elderly
population

Complex
spectrum of
spinal pathologies

Presented in
patients >60 years

Treatment Modalities

Non-Operative

- Pain Management and Physical Therapy

Operative

- Circumferential Spinal Fusion

Surgical Intervention

Circumferential Spinal Fusion

- Indications of Surgery: progressive curvature of spine with sagittal or coronal imbalance, significant loss of pulmonary function caused by the misalignment and deformity, loss of function due to pain associated with spinal curvature
- Increases stability granted by both anterior and posterior fixation of the spinal column
- Attempts to remedy the limitations of lateral approaches, such as the need for an intraoperative patient repositioning, which increases operative time and puts the patient at risk for complication due to longer time under anesthesia

Staged vs Same-Day Fusion

Staged

- Occurs two distinct operative days
- Determined by surgeon's preference and case complexity

Same-Day

- Occurs within a single session

Purpose

This study aimed to investigate the differences in outcome between staged and un-staged circumferential spinal fusion for ASD correction.

Methodology

Protocol Registration



Eligibility and PICO Framework



Search Strategy



Data Selection and Extraction



Data Synthesis

Protocol Registration

Design and reporting were supported by Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) and Preferred Reporting Items for Systematic review and Meta-Analysis Protocols (PRISMA-P)

Registered on Prospero (CRD42022339764) and published on JMIR Research Protocols (PRR1-10.2196/42331)

Eligibility and PICO Framework

Population

- Adults with adult spinal deformity

Intervention

- Staged CF Surgery

Comparison

- Same-Day Surgery

Outcomes

- Perioperative outcomes

Data Extraction and Synthesis

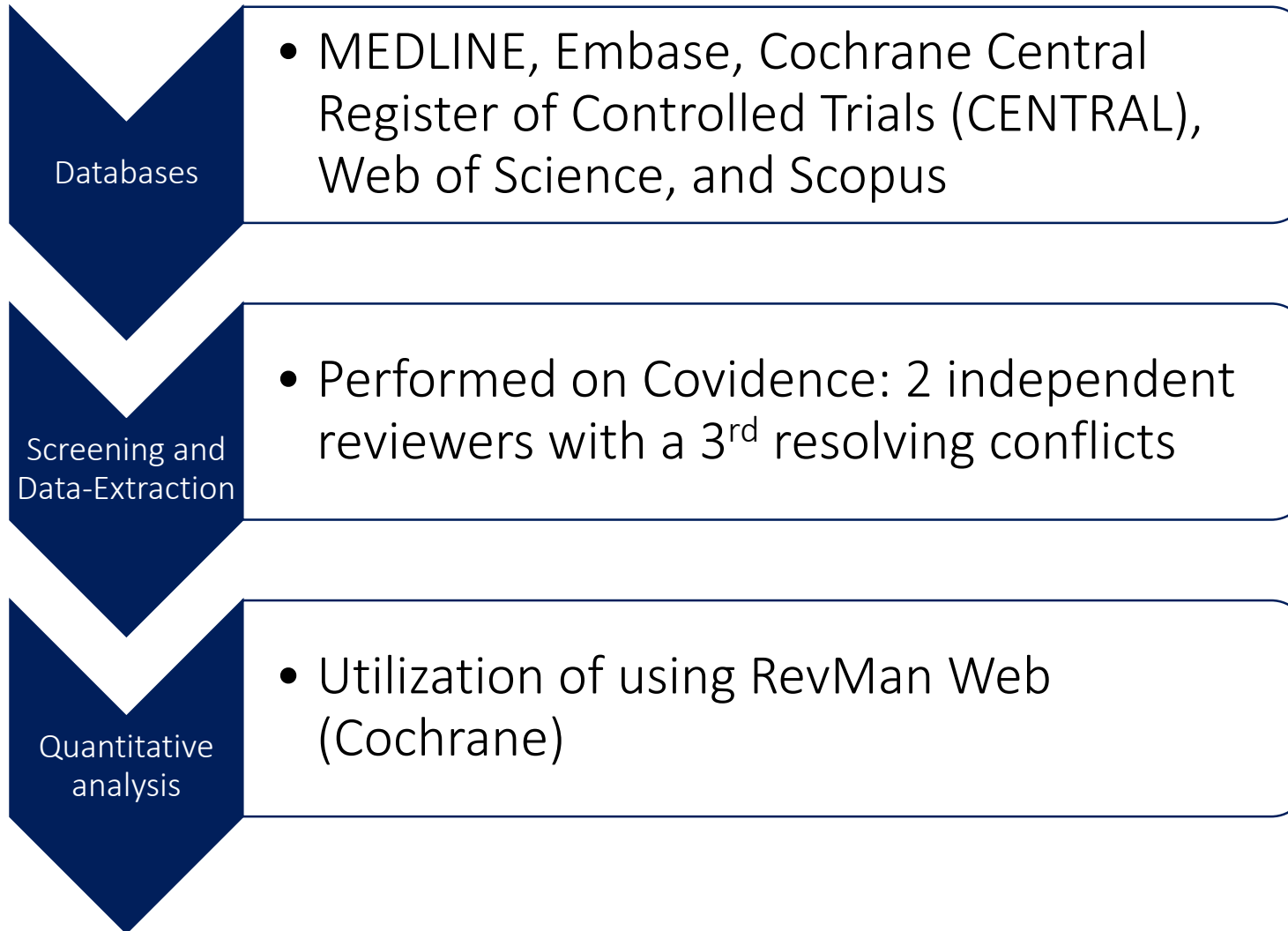


Figure 1. Study Selection

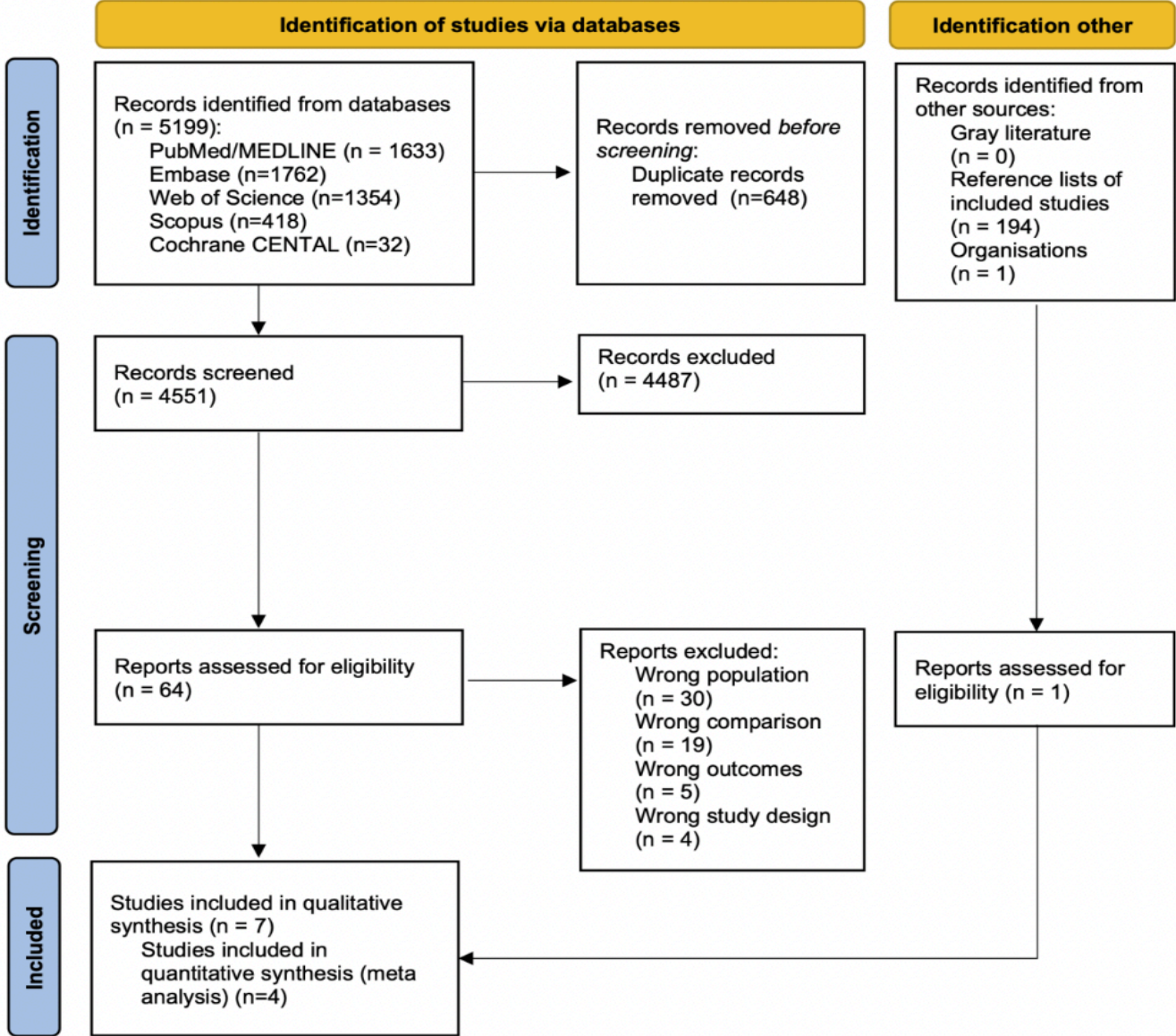


Table 1. Study characteristics and comparative results between Staged and Same-Day CF

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Author Information	No. of Patients	Age (mean, range, median)	Study type	Population details and differences	Surgery details	Outcomes
Anand et al., 2014 United States	50	61 (20-85)	Retrospective cohort study	Patients with adult idiopathic scoliosis corrections undergoing cMIS, Cobb angle of greater than 30 but less than 75 degree	Staged DLIF and L5-S1 XLIF with PSF; mean vertebrae fused: 7 (range 4-15) Same Day DLIF and L5-S1 XLIF with PSF; mean vertebrae fused: 7 (range 4-15)	Staged: (n=37), EBL 763ml (25-2500), OR Time 482min (83-546) Same-Day: (n=13), EBL 613ml (150-1500), OR Time 351min (176-510)
Anand et al., 2013 United States	71	64	Retrospective cohort study	Adults with scoliosis undergoing cMIS, 2 or more levels	Staged DLIF and XLIF with PSF; mean vertebrae fused: 4.4 Same-Day DLIF and XLIF with PSF; mean vertebrae fused: 4.4	Staged: (n=36), EBL 671ml, OR Time 426min Same-Day: (n=35), EBL 412ml, OR Time 291min
Arzeno et al., 2019 United States	92	68 (61-78)	Retrospective cohort study	Patients with ASD, undergoing anterior (including lateral and anterolateral approaches) and PSF of at least 5 levels Groups differ in: approach, Ponte osteotomy, three-column osteotomy, O-arm, neuromonitoring, decompression, no. of posterior levels fused, no. of osteotomy levels, no. of decompression levels	Staged CF (ALIF, PSF), Ponte osteotomy n=39, three-column osteotomy n=7, Decompression n=34; mean vertebrae fused: 8 (95% CI 5-9) Same-Day CF (ALIF, PSF), Ponte osteotomy n=24, three-column osteotomy n=1, decompression n=16; mean vertebrae fused: 9 (95% CI 9-9)	Staged: (n=45), mean LOS 9d, REOP n=5, READ n=1, POI n=2, AAE n=12 Same day: (n=47), mean LOS 6d, REOP n=7, READ n=6, POI n=3, AAE n=7
Harris et al., 2021 United States	87	61 (11)	Retrospective cohort study	Patients with ASD who underwent long PSF (more than five levels fused, with fusion to the pelvis) Groups differ in: previous spine surgery, scoliosis/kyphosis, pseudarthrosis, pelvic incidence	Staged CF (ALIF, PSF); mean vertebrae fused: 8.7 (SD 0.48) Same-Day CF (ALIF, PSF); mean vertebrae fused: 7.4 (SD 2.4)	Staged: (n=41), ODI 45±17, SRS-22r 2.8±0.6 Same-Day: (n=46), ODI 48±15, SRS-22r 2.8±0.6
Masuda et al., 2023 Japan	287	72.3	Retrospective cohort study, Propensity score weighted	Patients with ASD, ≥four fused levels and at least one level using LLIF, and presence of at least one spinal deformity marker: scoliosis Cobb angle≥20°, sagittal vertical axis≥5 cm, pelvic tilt≥25°, pelvic incidence minus lumbar lordosis angle≥10°, and/or thoracic kyphosis≥60°	Staged CF (LLIF, PSF); mean vertebrae fused: 7.7 (SD 2.3) Same-Day CF (LLIF, PSF); mean vertebrae fused: 6.2 (SD 2.4)	Staged: (n=101), EBL 642.5ml (550.5), OR Time 541.3min (124.1), LOS 42d (25), IOAE n=11, POAE n=11, REOP n=11, POI n=4, AAE n=22 Same-Day: (n=186), EBL 722.2ml (612.6), OR Time 479.9min (128.5), LOS 34.1d (18.2), IOAE n=17, POAE n=23, REOP n=19, POI n=5, AAE n=40

Continuation of Table 1. Study characteristics and comparative results between Staged and Same-Day CF

Albayar et al., 2023	100	58.8 (9.0)	Retrospective cohort study, Inverse probability weighted	Patients >18 years at the time of surgery and diagnoses of ASD undergoing (ALIF), and open posterior lumbar or thoracolumbar (PSF)	Staged ALIF, and open posterior lumbar or thoracolumbar PSF; mean vertebrae fused: 10 (SD 3.9)	Staged: (n=44), 1351.7ml (869), LOS 10.5d (5), IOAE n=6, POAE n=30, REOP n=10, POI n=5, READ n=10
United States					Same-Day ALIF, and open posterior lumbar or thoracolumbar PSF; mean vertebrae fused: 7.3 (SD 3.1)	Same-Day: (n=56), EBL 1127.6ml (945.4), LOS 6.2d (3.1), IOAE n=2, POAE n=30, REOP n=8, POI n=1, READ n=8
Than et al., 2019	54	67.3	Retrospective cohort study	Patients with ASD, coronal Cobb angle >20 , SVA > 5 cm, PT> 20 , PI-LL> 10 , and/or	Staged MIS LLIF and/or MIS TLIF with PSF; mean vertebrae	Staged: (n=27) REOP n=4, POI n=0, AAE n=9
United States				thoracic kyphosis >60	fused: 5.4	
					Same-Day MIS LLIF and/or MIS TLIF with PSF; mean vertebrae fused: 5.3	Same-Day: (n=27) REOP n=7, READ n=1, POI n=1, AAE n=8

AAE = any adverse event; ALIF = anterior lumbar interbody fusion; ASD = adult spinal deformity; CF = circumferential fusion; DLIF = direct lumbar interbody fusion; EBL = estimated blood loss; IOAE = intraoperative adverse event; LLIF = lateral lumbar interbody fusion; LOS = length of stay; MIS = minimally invasive surgery; POAE = postoperative adverse event; POI = postoperative infection; PSF = posterior spinal fixation; READ = readmission; REOP = re-operation; TLIF = transforaminal lumbar interbody fusion; XLIF = extreme lumbar interbody fusion

Figure 2. Estimated Blood Loss

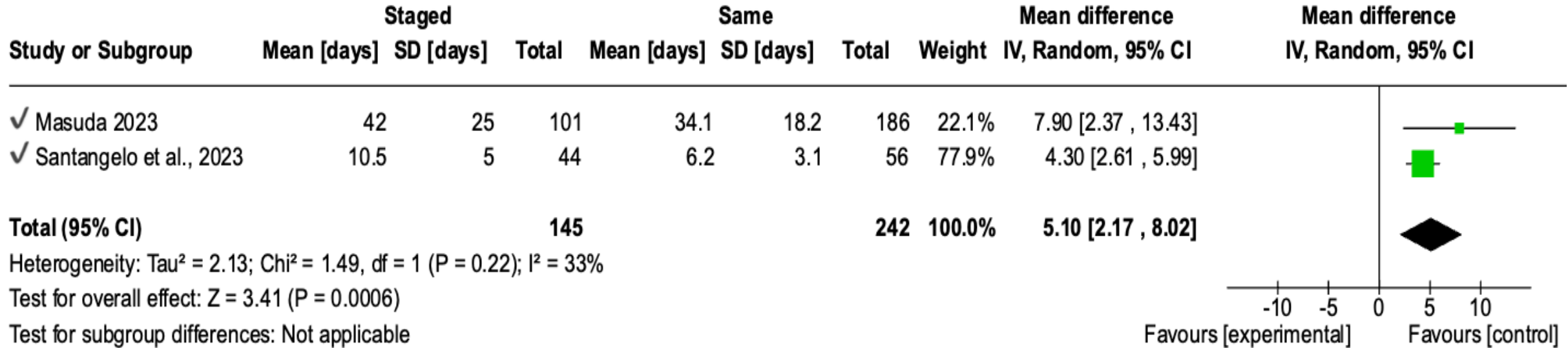


Figure 3. Intraoperative Complications

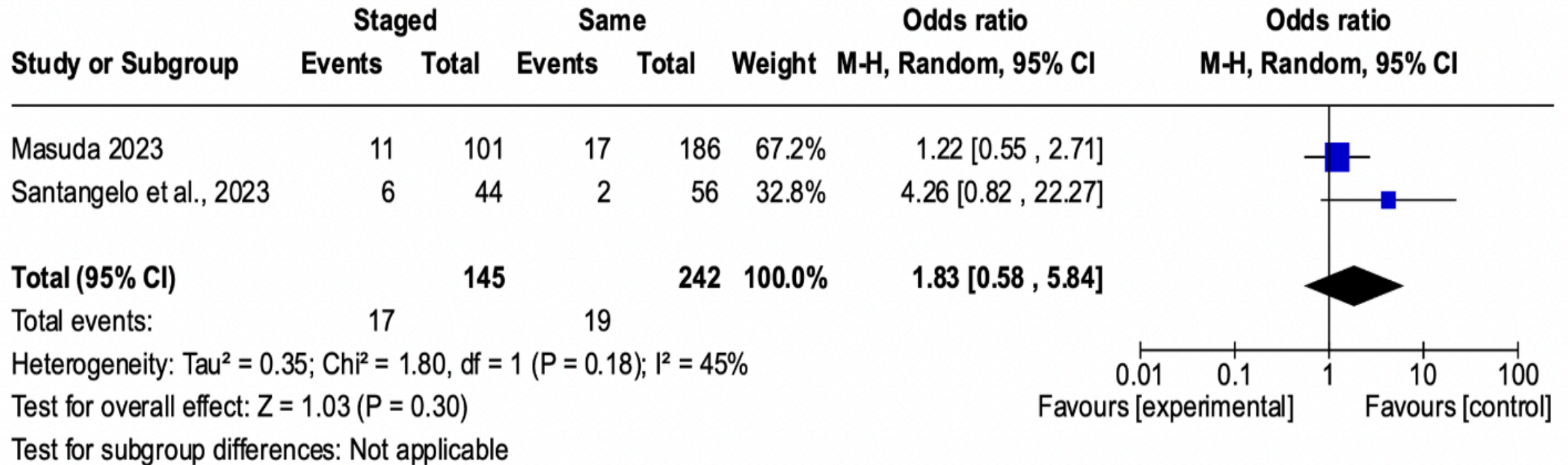


Figure 4. Operative Time

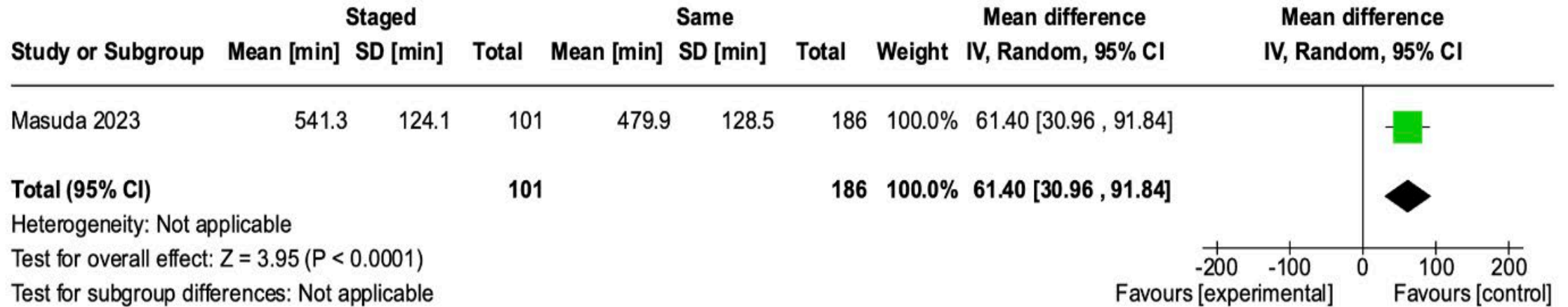


Figure 5. Post Operative Complications

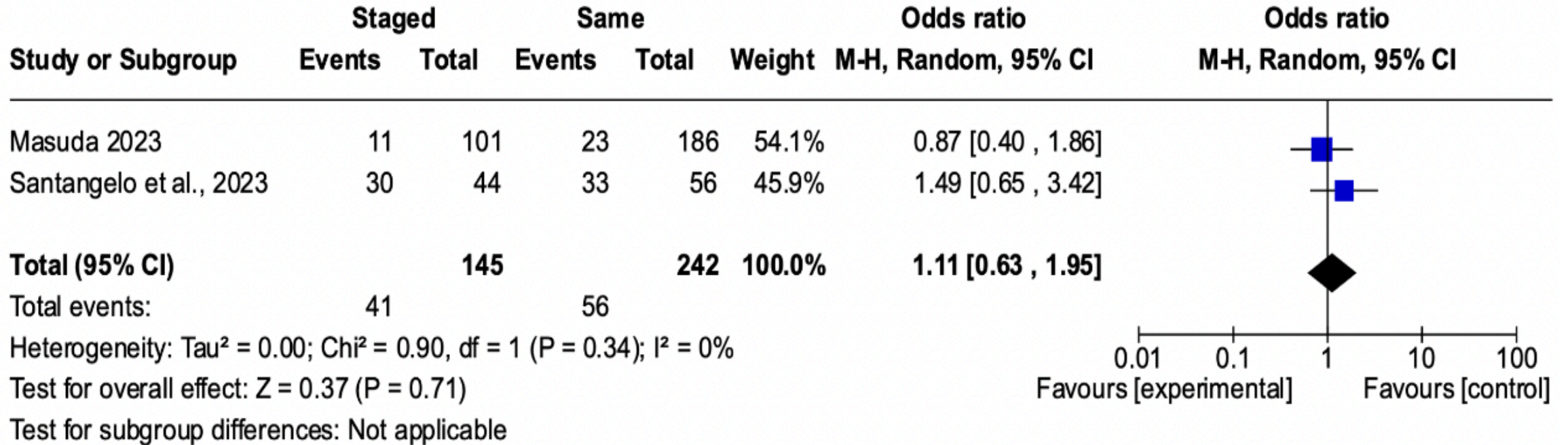


Figure 6. Perioperative Complications

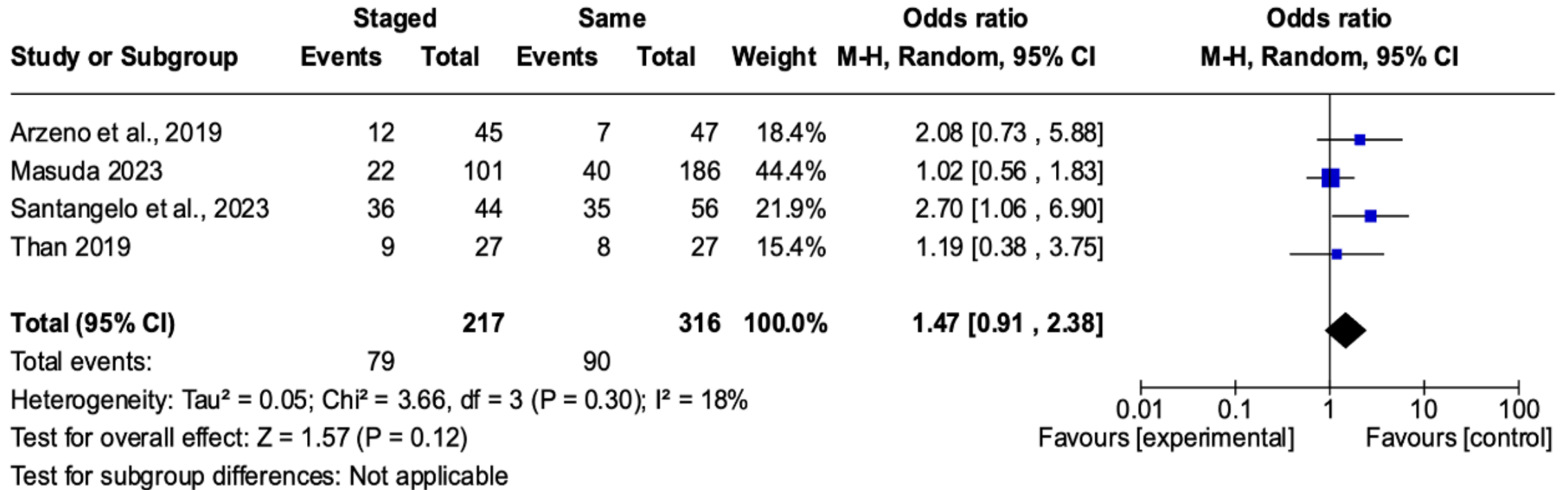


Figure 7. Hospital Length of Stay

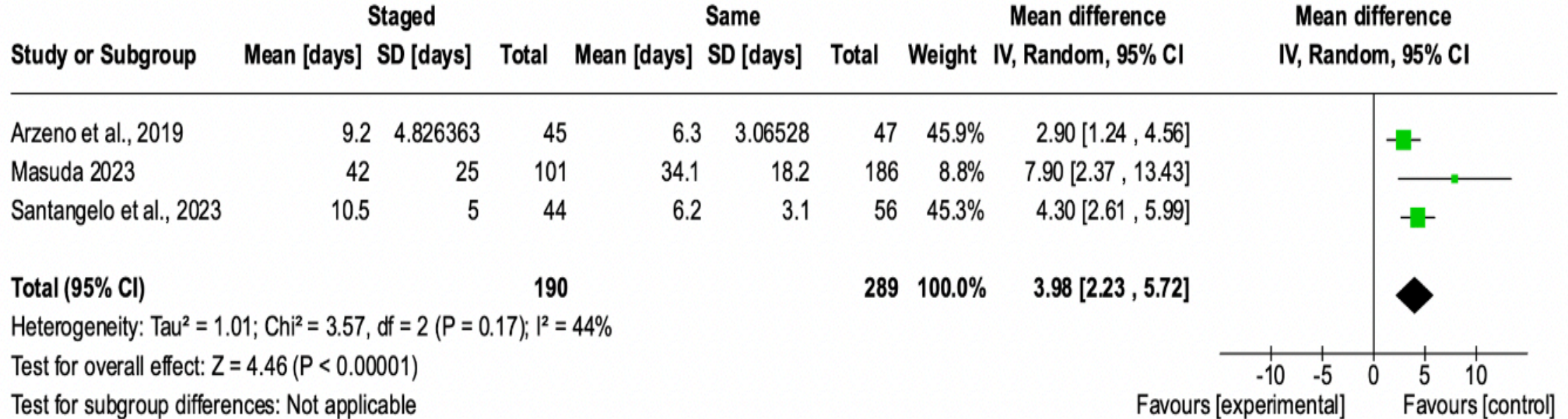


Figure 8. 30-day readmission

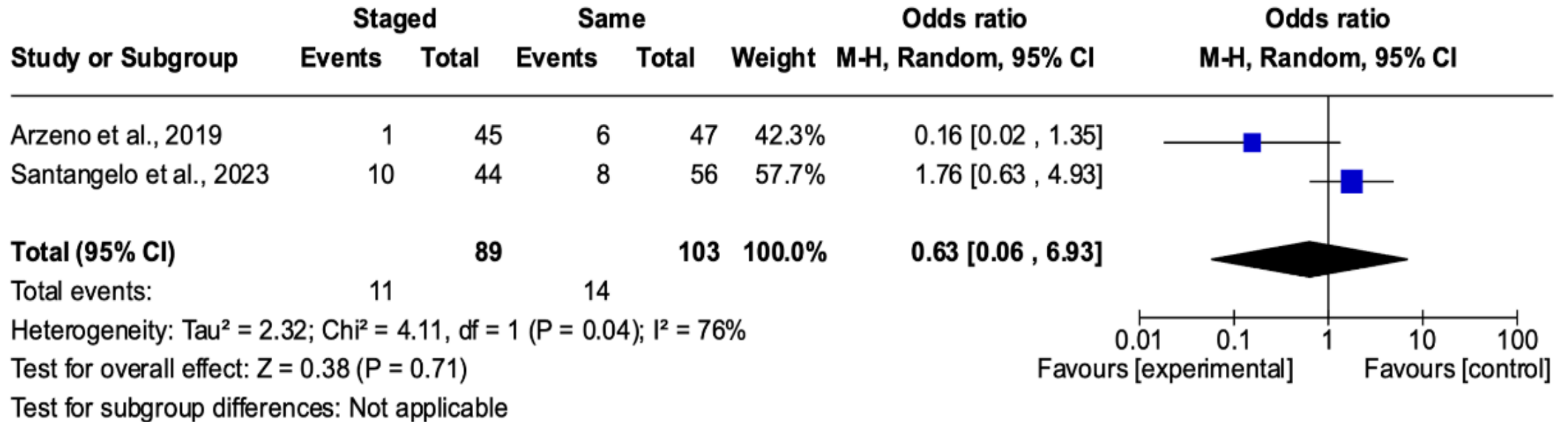
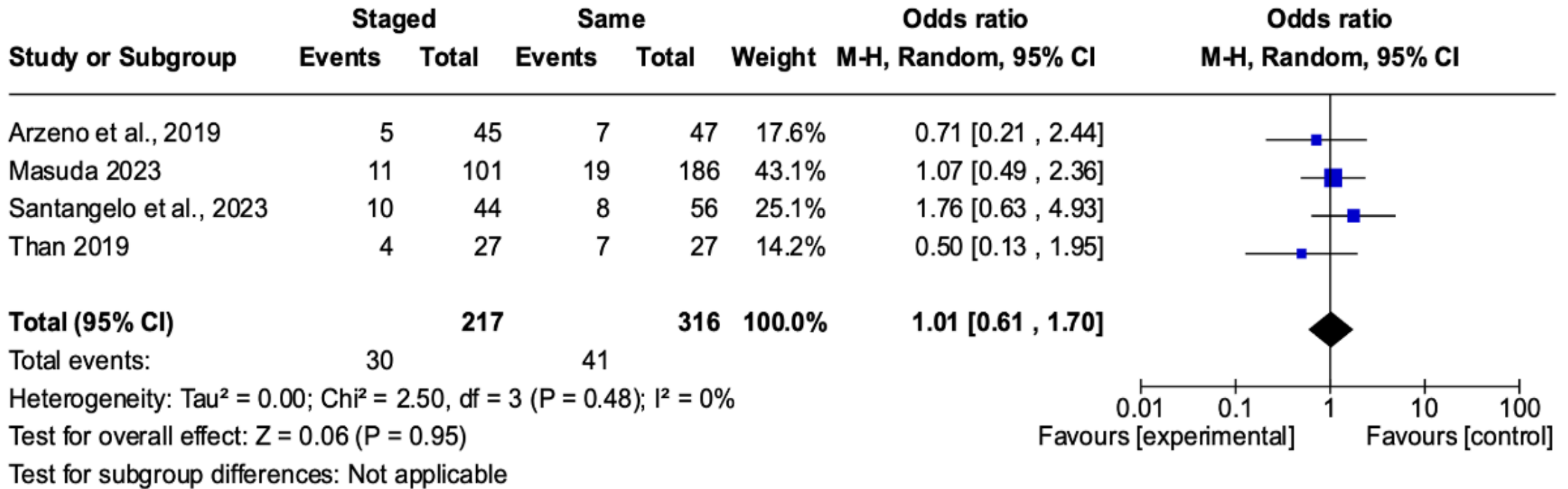
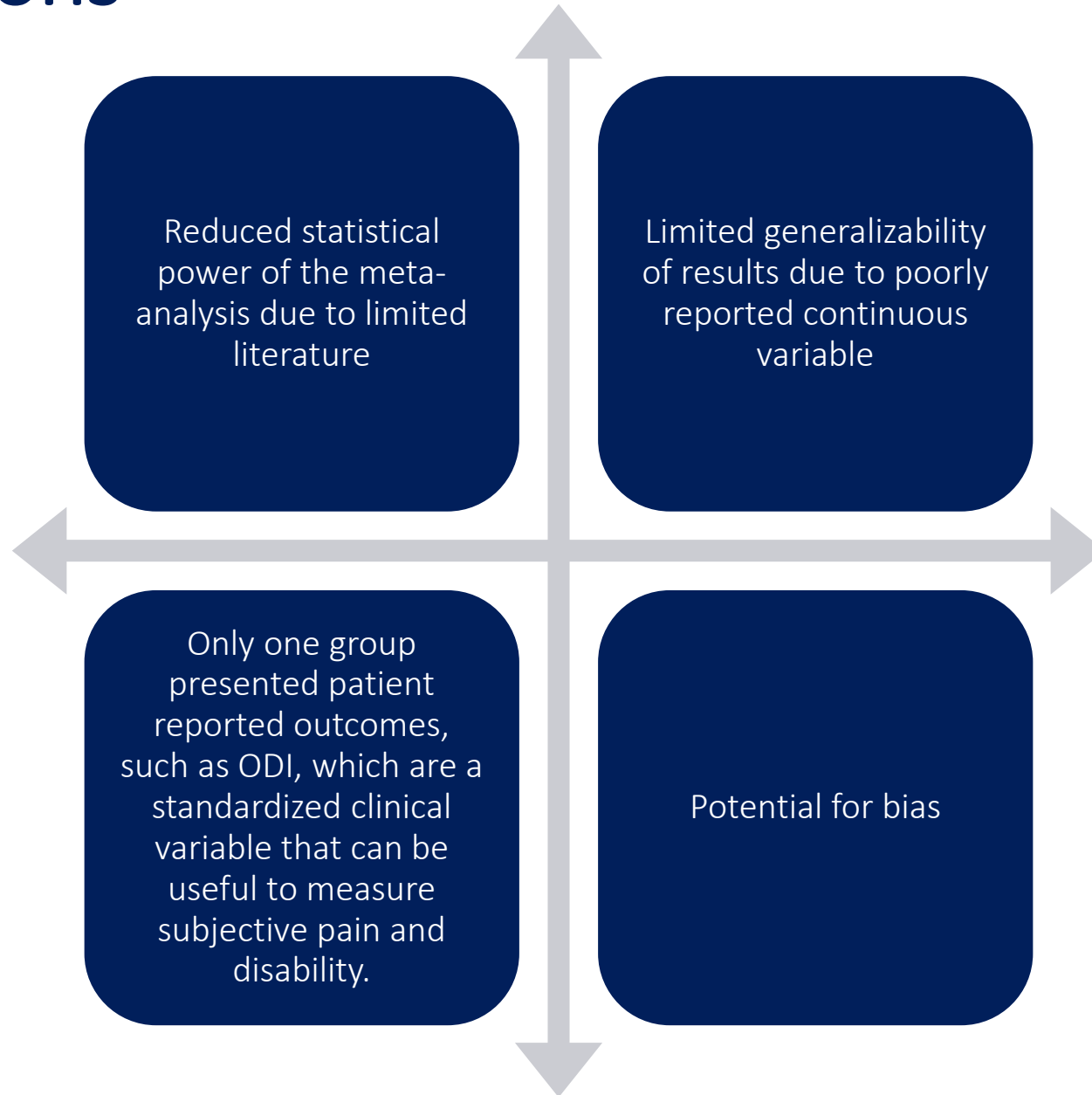


Figure 9. Reoperation



Study Limitations



Future Goals

Standardize the variables
being reported

Additional level I and II
Randomized Control Trials
should be conducted

Conclusion

OR Time and hospital LOS were significantly lower in Same-Day CF surgery

There are no differences in intra/postoperative, REOP, and READ

EBL and perioperative complications also trending towards significance.

Difficult to conclude whether either Same-Day or Staged CF provides a clinical advantage for patient outcomes.

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