Appendix 1. Detailed search strategy.

A comprehensive and reproducible search strategy was applied across multiple electronic databases.

PubMed/MEDLINE

The following search string was used:

("varicose veins"[MeSH Terms] OR "chronic venous disease" OR "venous insufficiency"[MeSH Terms])

AND

("endovenous laser ablation" OR "EVLA" OR "radiofrequency ablation" OR "RFA" OR "mechanochemical ablation" OR "MOCA")

AND

("phlebectomy" OR "sclerotherapy" OR "concomitant" OR "simultaneous" OR "hybrid" OR "staged")

Filters applied: Humans; Adults; English language.

Time frame: database inception to December 1, 2025.

EMBASE

An equivalent search strategy was applied using Emtree terms and free-text keywords related to chronic venous disease, endovenous ablation techniques, and management of tributary varicose veins, adapted to the EMBASE search syntax.

Cochrane Central Register of Controlled Trials (CENTRAL)

Search terms focused on randomized and controlled clinical trials evaluating endovenous ablation techniques with or without concomitant treatment of tributary varicose veins.

In addition, reference lists of all included studies and relevant reviews were manually screened to identify additional eligible studies.

Supplementary Table 1. PRISMA 2020 checklist.

The present systematic review and meta-analysis was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement. All relevant items of the PRISMA 2020 checklist were addressed, including eligibility criteria, information sources, search strategy, study selection, risk of bias assessment, data synthesis, and reporting of results.

Table S1. PRISMA 2020 checklist

Section	Item	PRISMA 2020 item	Location in manuscript
Title	1	Identify the report as a systematic review and/or meta-analysis	Title
Abstract	2	Structured summary	Abstract
Introduction	3	Rationale for the review	Introduction
Methods	4	Objectives	Introduction, section 2.5
Methods	5	Eligibility criteria	Methods, section 3.2
Methods	6	Information sources	Methods, section 3.1
Methods	7	Search strategy	Methods 3.1; Supplementary Appendix 2
Methods	8	Selection process	Methods, section 3.3
Methods	9	Data collection process	Methods, section 3.3
Methods	10	Data items	Methods, section 3.4; Table S2-S3
Methods	11	Risk of bias assessment	Methods, section 3.4; Table S2-S3
Methods	12	Effect measures	Methods, section 3.5
Results	13	Synthesis methods	Methods, section 3.5
Results	14	Reporting bias assessment	Supplementary Figure S1
Results	15	Study selection	Results, section 4.1
Results	16	Study characteristeics	Results, section 4.1; Table 1
Results	17	Risk of bias in studies	Results, section 4.2; Table S2-S3
Discussion	19	Results of individual studies	Results, section 4.3; Table 2

Supplementary Table 2. Risk of bias assessment – randomized controlled trials (RoB 2).

Supplementary Table 3. Risk of bias assessment – observational studies (ROBINS-I).

Table S2. Risk of bias assessment – randomized controlled trials (RoB 2)

Study	Randomization process	Deviations from intended interventions	Missing outcome data	Measurement of outcome	Selection of reported results	Overall risk
Theivacumar et. 2008	Some concerns	Low	Low	Low	Low	Some concerns
Kim et.al, 2009	Some concerns	Low	Low	Low	Low	Some concerns
Lane et al, 2015	Low	Low	Low	Low	Low	Low
El-Sheikha et.al., 2014	Low	Low	Low	Low	Low	Low
Rahman et.al, 2025	Low	Low	Low	Low	Low	Low

Interpretation: Early randomized trials showed some concerns mainly related to incomplete reporting of allocation concealment and blinding, whereas more recent trials demonstrated overall low risk of bias.

Table S3. Risk of bias assessment - observational studies (ROBINS-I)

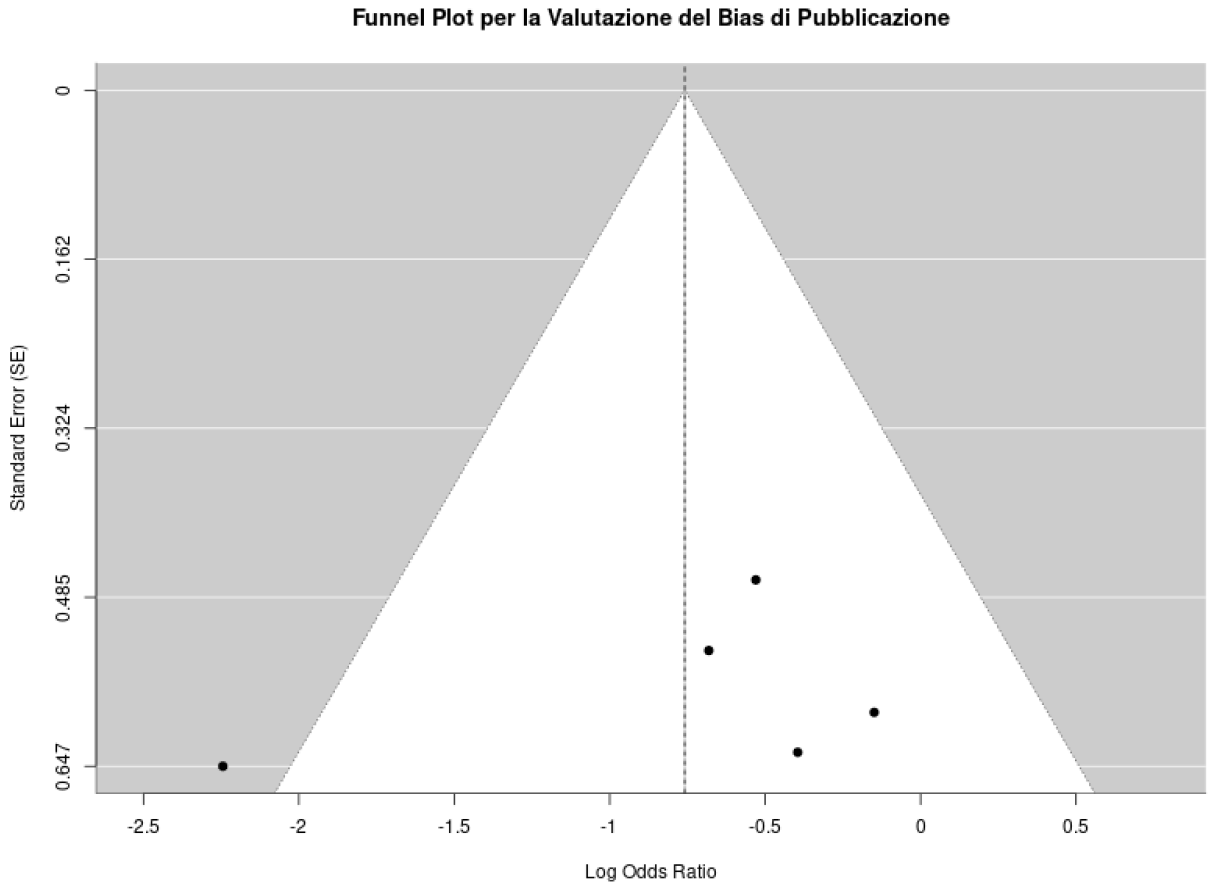
Study	Confounding	Selection of participants	Classification of interventions	Deviations from intended interventions	Missing data	Outcome measurement	Overall risk
Dexter et.al, 2012	Moderate	Low	Low	Low	Low	Low	Moderate
Harlander-Locke et.al., al., 2013	Moderate	Low	Low	Low	Low	Low	Moderate
Almeida et al., 2018	Moderate	Low	Low	Low	Low	Low	Moderate
Rahman et.al, 2025	Moderate	Low	Low	Low	Low	Low	Moderate

Interpretation: All observational studies were judged to have a moderate risk of bias, primarily due to residual confounding and lack of blinded outcome assessment, which is intrinsic to non-randomized designs.

Randomized controlled trials were evaluated using the Cochrane Risk of Bias tool version 2 (RoB 2), assessing bias arising from the randomization process, deviations from intended interventions, missing outcome data, outcome measurement, and selection of reported results.

Non-randomized observational studies were assessed using the Risk of Bias In Non-randomized Studies of Interventions (ROBINS-I) tool, considering bias due to confounding, participant selection, classification of interventions, deviations from intended interventions, missing data, outcome measurement, and selection of the reported result.

Overall, randomized controlled trials demonstrated a low to moderate risk of bias, whereas observational studies were judged to have a moderate risk of bias, mainly due to residual confounding inherent to non-randomized study designs.



Supplementary Figure 1. Funnel plot for publication bias.

A funnel plot was generated to visually assess potential publication bias for the primary outcome (need for re-intervention). Given the limited number of included studies, formal statistical testing for funnel plot asymmetry was not performed, and the results should be interpreted with caution.