Skeletonized versus pedicled internal thoracic artery and risk of sternal wound infection after coronary bypass surgery: meta-analysis and meta-regression of 4817 patients

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Abstract

It is suggested that the internal thoracic artery (ITA) harvesting technique influences the incidence of sternal wound infection (SWI) after coronary artery bypass graft (CABG). To determine if there is any real difference between skeletonized vs pedicled ITA, we performed a meta-analysis to determine if there is any real difference between these two established techniques in terms of SWI. We performed a systematic review using MEDLINE, EMBASE, CENTRAL/CCTR, SciELO, LILACS, Google Scholar and reference lists of relevant articles to search for studies that compared the incidence of SWI after CABG between skeletonized vs pedicled ITA until June 2012. The principal summary measures were odds ratio (OR) with 95% confidence interval (CI) and P values (statistically significant when <0.05). The ORs were combined across studies using the weighted DerSimonian–Laird random effects model and weighted Mantel–Haenszel fixed effects. Meta-analysis, sensitivity analysis and meta-regression were completed using the software Comprehensive Meta-Analysis version 2 (Biostat, Inc., Englewood, NJ, USA). Twenty-two studies involving 4817 patients (2424 skeletonized; 2393 pedicled) met the eligibility criteria. There was no evidence for important heterogeneity of effects among the studies. The overall OR (95% CI) of SWI showed a statistically significant difference in favour of skeletonized ITA (fixed effect model: OR 0.443, 95% CI 0.323–0.608, $P < 0.001$; random effect model: OR 0.443, 95% CI 0.323–0.608, $P < 0.001$). In the sensitivity analysis, the difference in favour of skeletonized ITA was also observed in subgroups such as diabetic, bilateral ITA and diabetic with bilateral ITA; we also observed that there was a difference in the type of study, since non-randomized studies together demonstrated the benefit of skeletonized ITA in comparison with pedicled ITA, but the randomized studies together did not show this difference (although close to statistical significance and with the tendency to favour the skeletonized group). In meta-regression, we observed a statistically significant coefficient for SWI and proportion of diabetic patients (coefficient −0.02, 95% CI −0.03 to −0.01, $P = 0.016$). In conclusion, skeletonized ITA appears to reduce the incidence of postoperative SWI in comparison with pedicled ITA after CABG, with this effect being modulated by the presence of diabetes.

Keywords: Meta-analysis • Coronary artery bypass • Mammary arteries • Surgical wound infection

INTRODUCTION

Rationale

Sternal wound infection (SWI) is a recognized and important complication of coronary artery bypass graft (CABG) surgery [1]. The most serious manifestation of an SWI is mediastinitis, which extends the previous anatomical classification to the risk of sepsis. It is well known that an infection of the mediastinum can be severe and potentially lethal [2].

It is suggested that the method of internal thoracic artery (ITA) harvesting influences the incidence of postoperative SWI [3–5]. There are two established harvesting techniques: pedicled and skeletonized ITAs. Whereas the pedicled technique dissects the artery away from the sternum with its accompanying veins, fascia, adipose tissue and lymphatics, generating a pedicled graft, skeletonization requires the ITA to be dissected free of all surrounding tissue, solely yielding the artery [3].

Our meta-analysis attempts to determine if there is any real difference between skeletonized and pedicled ITA in terms of SWI.

Objectives

We performed a meta-analysis and meta-regression of studies to compare skeletonized vs pedicled ITA during CABG, according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [6].

METHODS

Eligibility criteria

Using the PICOS (Population, Intervention, Comparison, Outcome, Study design) strategy, studies were considered if: (i) the population comprised patients undergoing CABG; (ii) they compared outcomes between skeletonized vs pedicled ITA; (iii) outcomes studied included any situations considered as SWI—superficial, deep and/or mediastinitis; (iv) they were prospective or retrospective or non-randomized studies or randomized controlled trials.

Information sources

The following databases were used (until June 2012): MEDLINE, EMBASE, Cochrane Central Register of Controlled Trials (CENTRAL/CCTR), ClinicalTrials.gov, Scientific Electronic Library Online (SciELO), Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS)—The Latin American and Caribbean Health Sciences), Google Scholar and reference lists of relevant articles.

Search

We conducted the search using Medical Subject Heading (MeSH) terms ('skeletonized' OR 'skeletonization') AND ('pedicled' OR 'pedunculated' OR 'in situ') AND ('arteries, mammary' OR 'artery, mammary' OR 'mammary artery' OR 'internal mammary artery' OR 'arteries, internal mammary' OR 'artery, internal mammary' OR 'internal mammary arteries' OR 'mammary arteries' OR 'mammary arteries, internal' OR 'mammary artery, internal' OR 'internal thoracic artery' OR 'arteries, internal thoracic' OR 'artery, internal thoracic' OR 'internal thoracic arteries' OR 'thoracic arteries, internal' OR 'thoracic artery, internal') AND ('coronary artery bypass graft' OR 'coronary artery bypass grafting' OR 'coronary artery bypass surgery' OR 'coronary bypass surgery' OR 'coronary artery bypass graft surgery' OR 'coronary artery bypass' OR 'coronary bypass').

Study selection

The following steps were done: (i) identification of titles of records through searching of databases; (ii) removal of duplicates; (iii) screening and selection of abstracts; (iv) assessment for eligibility through full-text articles and (v) final inclusion in the study.

One reviewer followed steps 1–3. Two independent reviewers followed step 4 and selected studies. Inclusion or exclusion of studies was decided unanimously. When there was disagreement, a third reviewer took the final decision.

Data items

The endpoints were odds ratio (OR) for SWI after CABG using skeletonized vs pedicled ITA.

Data collection process

Two independent reviewers extracted the data. When there was disagreement about data, a third reviewer (the first author) checked the data and took the final decision about it. From each study, we extracted patient characteristics, study design and outcomes (number of events and number of total groups).

Risk of bias in individual studies

Included studies were assessed for the following characteristics: (i) sequence generation; (ii) allocation concealment; (iii) blinding; (iv) incomplete outcome data; (v) selective outcome reporting and (6) other sources of bias. Taking these characteristics into account, the papers were classified into A (low risk of bias), B (moderate risk of bias) or C (high risk of bias).

Two independent reviewers assessed risk of bias. Agreement between the 2 reviewers was assessed using kappa statistics for full-text screening, and rating of relevance and risk of bias. When there was a disagreement about risk of bias, a third reviewer (the first author) checked the data and took the final decision on it.

Summary measures

The principal summary measures were ORs with 95% confidence interval (CI) and P values (considered statistically significant when <0.05). The meta-analysis was completed using the software Comprehensive Meta-Analysis version 2 (Biostat, Inc., Englewood, NJ, USA).

Synthesis of results

Forest plots were generated for graphical presentations for clinical outcomes, and we performed the I^2 test and χ^2 test for the assessment of heterogeneity across the studies [7]. Each study was summarized by the OR for skeletonized ITA compared with pedicled ITA. The ORs were combined across studies using weighted DerSimonian–Laird random effects model [8] and weighted fixed effects model using the Mantel–Haenszel model [9]. The models were weighted by the number of events in each study to show how much each study contributed in the analysis.

Risk of bias across studies

To assess publication bias, a funnel plot was generated, which was statistically assessed by Begg and Mazumdar's test [10] and Egger's test [11].

Sensitivity analysis

Since the medical literature demonstrates that the use of BITA grafts has been shown to have the potential to increase the incidence of SWI, and this effect is believed to be amplified in diabetic patients [12, 13], we performed subgroup analysis involving patients presenting diabetes or use of bilateral ITA or both. We also performed a subgroup analysis taking into consideration the type of study (randomized or non-randomized).

Meta-regression analysis

Meta-regression analyses were performed to determine whether the effects of skeletonized ITA were modulated by prespecified factors. Meta-regression graphs describe the effect of skeletonized ITA on the outcome (plotted as a log OR on the *y*-axis) as a function of a given factor (plotted as a mean or proportion of that factor on the *x*-axis). Meta-regression coefficients show the estimated increase in log OR per unit increase in the covariate. Since log OR > 0 corresponds to OR > 1 and log OR < 0 corresponds to OR < 1, a negative coefficient would indicate that as a given factor increases, the OR decreases.

The predetermined modulating factors to be examined were: sex, age, diabetes and use of bilateral ITA. Sex was represented as the proportion of females in the study. Age was represented as the mean age of the patients participating in the study. Diabetes was represented as the proportion of diabetics (insulin dependent or non-insulin dependent) in the study. Bilateral ITA was represented as the proportion of patients that used left and right ITA during CABG.

RESULTS

Study selection

A total of 542 citations were identified, of which 82 studies were potentially relevant and retrieved as full text. Twenty-two [3, 12–32] publications fulfilled our eligibility criteria. Interobserver reliability of study relevance was excellent ($\kappa = 0.85$). Agreement for decisions related to study validity was very good ($\kappa = 0.81$). The search strategy can be seen in Fig. 1.

Study characteristics

The characteristics of each study are shown in Table 1. A total of 4817 patients were studied, with 2424 using skeletonized ITA and 2393 using pedicled ITA, including the years 1999–2011; 13 were prospective (59.1%), 8 randomized (36.4%), and 2 multicenter (9.1%). Most studies (77.3%) used a multivariable adjustment for possible confounders. Information not shown in Table 1, but noteworthy, is that most studies consisted of patients whose mean age was around the sixth decade of life, mostly male, and more than half of the studies with more than one third of the population consisted of diabetic patients. The overall internal validity was considered to be a moderate risk of bias.

Synthesis of results

The OR of SWI in the skeletonized ITA group compared with the pedicled ITA group in each study is reported in Fig. 2. There was no evidence for important heterogeneity of treatment effect among the studies for SWI. The overall OR (95% CI) of SWI showed a statistically significant difference in favour of skeletonized ITA (fixed effect model: OR 0.443, 95% CI 0.323–0.608, *P* < 0.001; random effect model: OR 0.443, 95% CI 0.323–0.608, *P* < 0.001).

Risk of bias across studies

Funnel plot analysis (Fig. 3) disclosed symmetry around the axis for the treatment effect in the SWI outcome, which means we probably do not have a publication bias related to this endpoint.

Sensitivity analysis

The OR of SWI for diabetic patients in the skeletonized ITA group compared with the pedicled ITA group in each study is reported in Fig. 4A. There was no evidence for important heterogeneity of treatment effect among the studies for SWI in this subgroup. The overall OR (95% CI) of SWI showed a statistically significant difference in favour of skeletonized ITA (fixed effect model: OR 0.195, 95% CI 0.118–0.322, *P* < 0.001; random effect model: OR 0.195, 95% CI 0.118–0.322, *P* < 0.001).

The OR of SWI for patients submitted to bilateral ITA harvesting in the skeletonized ITA group compared with the pedicled ITA group in each study is reported in Fig. 4B. There was evidence for important heterogeneity of treatment effect among the studies for SWI in this subgroup. The overall OR (95% CI) of SWI showed a statistically significant difference in favour of skeletonized ITA (fixed effect model: OR 0.381, 95% CI 0.257–0.565, *P* < 0.001; random effect model: OR 0.307, 95% CI 0.168–0.563, *P* < 0.001).

The OR of SWI for diabetic patients submitted to bilateral ITA harvesting in the skeletonized ITA group compared with the pedicled ITA group in each study is reported in Fig. 4C. There was no evidence for important heterogeneity of treatment effect among the studies for SWI in this subgroup. The overall OR (95% CI) of SWI showed a statistically significant difference in favour of skeletonized ITA (fixed effect model: OR 0.188, 95% CI 0.098–0.360, *P* < 0.001; random effect model: OR 0.188, 95% CI 0.098–0.360, *P* < 0.001).

The OR of SWI in the skeletonized ITA group compared with the pedicled ITA group in non-randomized studies is reported in Fig. 5. There was evidence for moderate heterogeneity of treatment effect among the non-randomized studies for SWI. The overall OR (95% CI) of SWI showed a statistically significant difference in favour of skeletonized ITA (fixed effect model: OR 0.438, 95% CI 0.312–0.616, *P* < 0.001; random effect model: OR 0.423, 95% CI 0.265–0.677, *P* < 0.001).

The OR of SWI in the skeletonized ITA group compared with the pedicled ITA group in randomized studies is reported in Fig. 5. There was no evidence for heterogeneity of treatment effect among the randomized studies for SWI. The overall OR (95% CI) of SWI showed no statistically significant difference
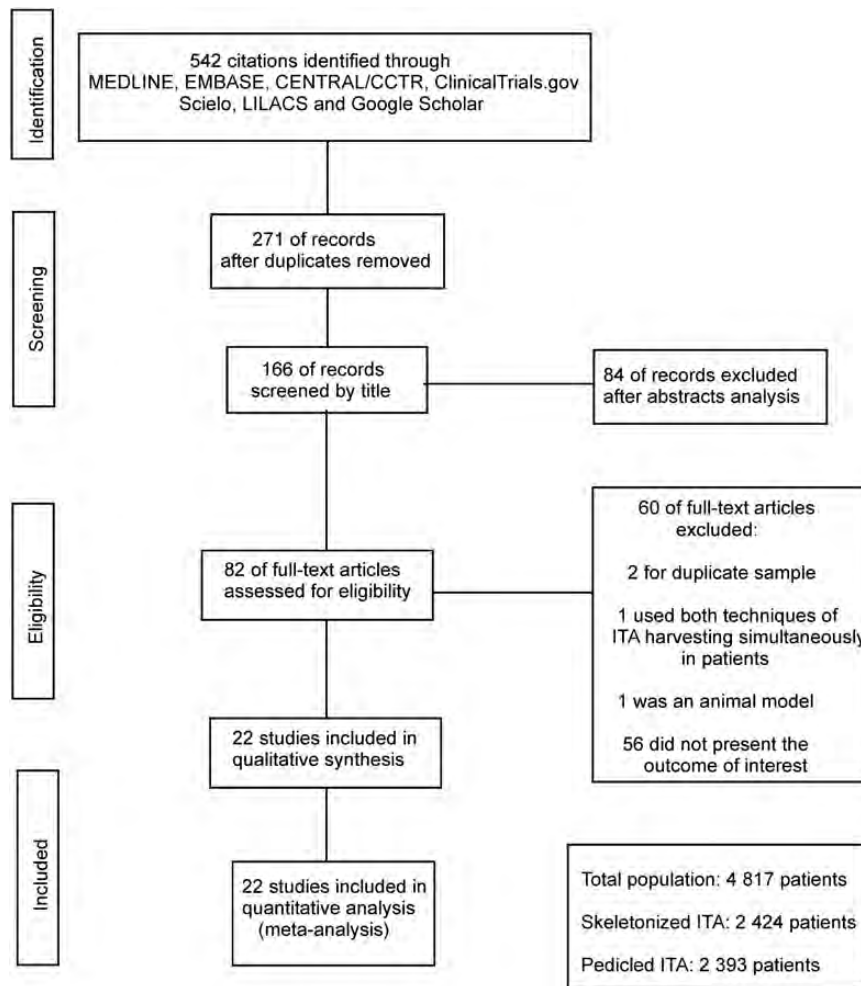
Figure 1: Flow diagram of studies included in data search.

(fixed effect model: OR 0.476, 95% CI 0.201–1.131, $P = 0.093$; random effect model: OR 0.476, 95% CI 0.201–1.131, $P = 0.093$).

Meta-regression analysis

Meta-regression coefficients were not statistically significant for SWI and proportion of females, proportion of use of bilateral ITA and mean age, which means that they do not modulate the effect of skeletonized ITA. However, we observed a statistically significant coefficient for SWI and proportion of diabetic patients (coefficient –0.02, 95% CI –0.03 to –0.01, $P = 0.016$), which means that the greater the proportion of diabetic patients in a population undergoing CABG, the lower the OR for SWI in the skeletonized ITA group, i.e. the greater the protective effect of skeletonized ITA for diabetic patients in relation to the incidence of SWI, (Fig. 6).

DISCUSSION

Summary of evidence

The results of this meta-analysis demonstrate that there was a statistically significant difference in favour of skeletonized ITA

compared with pedicled ITA in the risk for SWI, the summary measures being free from the influence of heterogeneity of the effects (except for bilateral ITA subgroup) or publication bias. In the sensitivity analysis, the difference in favour of skeletonized ITA was also observed in subgroups such as diabetic, bilateral ITA and diabetic with bilateral ITA. Also, in the sensitivity analysis, we observed that there was a difference in the type of study, since non-randomized studies together demonstrated the benefit of skeletonized ITA in comparison with pedicled ITA, but the randomized studies together did not show this difference. Meta-regression did not demonstrate any influence of female gender, age or use of bilateral ITA on SWI, but showed a modulation influence of diabetes.

Considerations about this meta-analysis

To our knowledge, this is the largest meta-analysis of studies performed to date, providing incremental value by demonstrating that skeleletonized ITA reduces the incidence of SWI compared with pedicled ITA. These results were found probably as a result of better sternal perfusion after ITA skeletonization compared with the pedicled ITA [15, 33]. Kamiya *et al.* [15] showed that the oxygen saturation and blood flow in the microcirculation of the sternum tissue were better when using the

Table 1:   Study characteristics and risk of bias (internal validity)

Study	Total incidence of SWI (%)	SKT/PED (*n*)	Study design	Selection bias	Performance bias	Attrition bias	Detection bias	Multivariable adjustment for possible confounders
Sá *et al.* [3]	5.0	186/226	NP, NR, NM	B	B	A	B	Probably adequate
Nishi *et al.* [12]	2.2	23/23	P, NR, M	B	B	A	B	Probably adequate
Mannacio *et al.* [13]	1.0	100/100	P, R, NM	A	B	A	B	Probably adequate
Markman *et al.* [14]	4.9	21/20	P, R, NM	A	B	A	A	Probably adequate
Kamiya *et al.* [15]	8.3	12/12	P, R, NM	A	B	A	B	Probably adequate
Milani *et al.* [16]	4.3	35/35	NP, NR, NM	C	B	C	C	Probably inadequate
Gideon *et al.* [17]	5.0	68/68	NP, NR, NM	B	B	A	B	Probably adequate
Kai *et al.* [18]	2.2	162/23	NP, NR, NM	B	B	A	B	Probably adequate
Belov *et al.* [19]	2.6	69/82	NP, NR, NM	B	B	A	B	Probably adequate
De Paulis *et al.* [20]	14.9	150/300	P, NR, NM	B	B	A	B	Probably adequate
Castro *et al.* [21]	4.0	25/25	P, R, NM	A	B	A	B	Probably adequate
Hirose *et al.* [22]	9.3	115/99	P, NR, M	B	B	A	B	Probably adequate
Peterson *et al.* [23]	10.4	79/36	P, NR, NM	B	B	A	B	Probable adequate
Takami and Ina [24]	1.5	45/20	P, R, NM	C	B	B	C	Probably inadequate
Cartier *et al.* [25]	1.1	200/440	NP, NR, NM	B	B	A	B	Probably inadequate
Lorberboym *et al.* [26]	13.0	11/12	P, R, NM	B	B	A	B	Probably adequate
Bonnachi *et al.* [27]	4.2	110/179	P, R, NM	B	B	A	B	Probably adequate
Huang *et al.* [28]	2.0	50/50	NP, NR, NM	B	B	A	B	Probably adequate
Cohen *et al.* [29]	17.4	11/12	P, R, NM	B	B	A	B	Probably adequate
Calafiore *et al.* [30]	2.4	842/304	NP, NR, NM	B	B	A	B	Probably adequate
Wendler *et al.* [31]	2.5	40/40	NP, NR, NM	C	B	C	B	Probably inadequate
Deja *et al.* [32]	1.4	70/287	P, NR, NM	C	B	C	B	Probably inadequate

This was performed by 2 independent reviewers. The overall bias of the combined studies was considered moderate.
A: risk of bias is low; B: risk of bias is moderate; C: risk of bias is high; D: incomplete reporting; P: prospective; NP: non-prospective; R: randomized; NR: non-randomized; M: multicenter; NM: non-multicenter; SKT/PED: skeletonized grafts/pedicled grafts.

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skeletonized ITA compared with pedicled ITA. Boodhwani *et al.* [33] conducted a study with 48 patients, in which each individual was subjected to CABG using bilateral ITA, and all ITAs were dissected skeletonized on the left side and pedicled on the right side (this study was not included in our meta-analysis since all patients were submitted to both harvesting techniques, making comparison non-feasible). Patients were then evaluated for sternal perfusion through scintigraphy (radionuclear image). The authors found that sternal perfusion was increased in the skeletonized side compared with the pedicle side (increase of 17.6%, $P = 0.03$).

According to some authors [34, 35], females, the elderly and patients submitted to bilateral ITA harvesting are thought to face higher risks associated with pedicled ITA and therefore benefit more from skeletonized ITA. The meta-regression analysis in this study refutes the hypothesis that differences related to gender, age or use of bilateral ITA in the study population are responsible for the treatment effects observed across studies. Interestingly, we observed a modulation of the effect of the skeletonized ITA by the variable diabetes. The negative coefficient observed indicates that there is an inverse relationship in modulation, i.e. the more diabetic patients we have in a study group, the smaller is the OR of SWI risk in the group treated with skeletonized ITA. This demonstrates that skeletonization is beneficial in general, and even more so in the diabetic group—something confirmed by analysis of the subgroup of diabetics.

We also observed a difference in summary results depending on the type of study analyzed. As we demonstrated, non-randomized studies support the idea of the benefit of skeletonized ITA in comparison with pedicled ITA, while randomized studies have failed to show this difference (although the result was close to statistical

significance and with the tendency to favour the skeletonized group). The main explanation for this phenomenon lies in the sample size for each type of study. While non-randomized studies have a total population of 4102 patients, randomized studies have only 715 patients. Considering that SWI is a complication with low incidence, a larger sample is needed to demonstrate a statistically significant difference between the two types of intervention for a particular outcome, and obviously the randomized studies totalled a small sample for this purpose. We argue that the maximum incidence of SWI in CABG surgery should be no larger than 5.0%. Among the studies included in our meta-analysis, six studies exceeded this cut-off [15, 20, 22, 23, 26, 29]. Of these, three studies had a very small sample size [15, 26, 29], <25 patients, which makes few events in this population simulate a high incidence (a merely aesthetic statistical effect), so that their incidences do not reflect the context of CABG in the general population. The other 3 studies [20, 22, 23] dealt with a special risk group—in this case, diabetic patients, exclusively—in which we would have expected a higher incidence of SWI, but being risk groups, these studies also do not reflect the context of CABG in the general population. Considering all the other 16 studies, which had larger sample sizes and dealt with populations that included all types of patients, we have established our argument, since none exceeded the cut-off of 5.0%. We simulated a calculation of the minimum sample size required to obtain a probabilistic sample for conducting a randomized study, considering a 95% CI, power of 80%, a proportion of 1 patient in the skeletonized group for each patient in the pedicled group, the maximum acceptable incidence for postoperative SWI reported in the literature being 5%, and we obtained a minimum total sample of 1526 individuals (763 patients in each arm). This could explain why the non-randomized studies have demonstrated a statistical
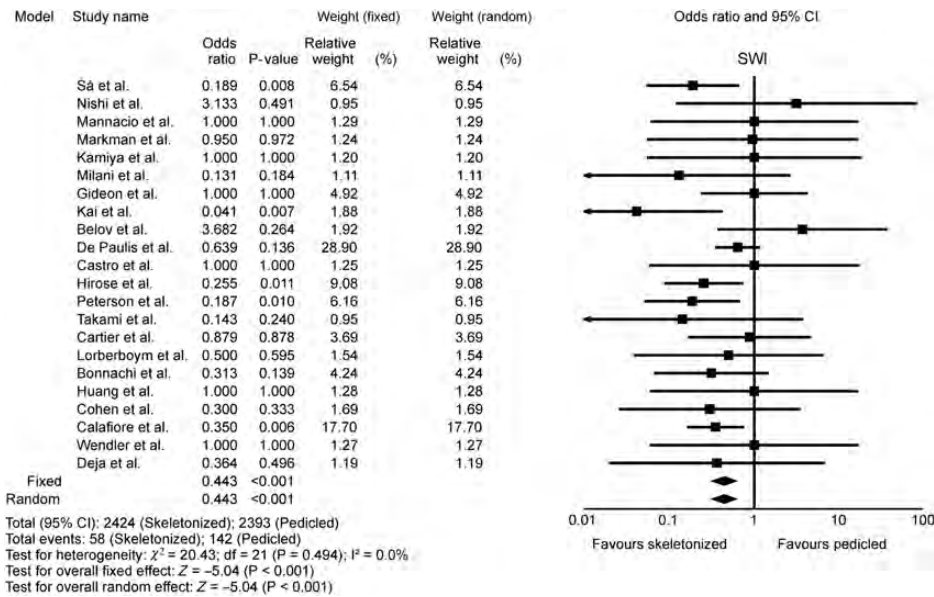
Figure 2: Odds ratio and conclusions plot of sternal wound infection associated with skeletonized versus pedicled internal thoracic artery.
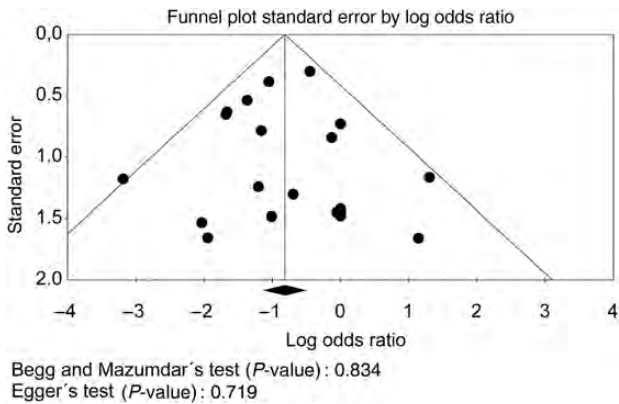

Figure 3: Publication bias analysis by funnel plot graphic for sternal wound infection.

difference (because they reached the minimum sample) while randomized trials have failed (because they did not reach the minimum sample.) This fact points to the need for a randomized study with a larger sample to confirm or refute the hypothesis of the benefit of skeletonized ITA in comparison with pedicled ITA.

What is different from the largest previous meta-analysis?

Although another meta-analysis from Saso et al. [36] has been published in this field, this analysis is important for certain reasons.

Our pooled sample size was 31.5% larger than the largest previously published meta-analysis [36]. This larger sample size translated into greater statistical power and precision, reducing the amount of uncertainty surrounding treatment effects. Nine published studies had not been included in the largest prior meta-analysis and were included in our analysis (contributing 1154 out of the 4817 patients).

Saso et al. [36] performed a publication bias analysis without the application of statistical analysis for this specific study. We performed a publication bias analysis applying two statistical tests for each analysis.

We also conducted an analysis of risk of bias of individual studies, something not done by our predecessor. They also showed no heterogeneity of effects in bilateral ITA subgroup analysis, but we claim this is not true, considering that we used the same studies and the same sample size for this subgroup analysis, and we identified an important heterogeneity of the effect of skeletonized ITA in this specific group.

All these characteristics may give readers a more detailed view and a better critical analysis of the medical literature on this issue. Our meta-analysis summarized the results of studies on medical literature regarding SWI outcomes, strengthening the concept of ITA skeletonization for CABG. Furthermore, the meta-regression enhances the consistency of pooled results and reveals the importance of skeletonization for diabetic patients.

Risk of bias and limitations

This meta-analysis included data from non-randomized and/or observational studies, which reflects the real world, but they are limited by treatment bias, confounders and a tendency to overestimate treatment effects. Patient selection alters outcome and thus makes non-randomized studies obviously less robust.

Although important statistical heterogeneity among studies was not observed (except when we analysed bilateral ITA subgroup), the differences in terms of operative technique and volume may have led to an influence of clinical heterogeneity not picked up by the meta-analysis. Other factors that would have influenced the results but were not well reported and thus not taken into consideration were the prevalence of obesity, chronic pulmonary obstructive disease, excessive use of bone wax or diathermy, quality of operative antisepsis prophylaxis, multiple transfusions, glycemic control in diabetics and the way

Figure 4: Odds ratio and conclusions plot of sternal wound infection associated with skeletonized vs pedicled internal thoracic artery in sensitivity analysis. (**A**) Diabetic; (**B**) Bilateral ITA; (**C**) Diabetic with bilateral internal thoracic artery harvesting.

the patient is prepared for surgery (shaving, cleaning and timing of both before the operation), bacterial flora of each centre, etc.

There are inherent limitations with meta-analyses, including the use of cumulative data from summary estimates. Patient data were gathered from published data, not from individual patient follow-up. Access to individual patient data would have enabled us to conduct further subgroup analysis and propensity analysis to account for differences between the treatment groups.

Future perspectives

Because the findings support a potential benefit from a specific harvesting method and as part of the regular curriculum in cardiovascular surgery, we recommend that the skeletonization technique should become a mandatory part of the training of cardiovascular surgery residents. The results of this study suggest the need for large-scale (with a calculated probabilistic sample

Model	Type of study	Study name	Odds ratio	P-Value	Weight (Fixed) Relative weight (%)	Weight (Random) Relative weight (%)
	Non-Randomized	Sá et al.	0.189	0.008	7.55	9.58
	Non-Randomized	Nishi et al.	3.133	0.491	1.10	1.94
	Non-Randomized	Milani et al.	0.131	0.184	1.29	2.26
	Non-Randomized	Gideon et al.	1.000	1.000	5.68	7.85
	Non-Randomized	Kai et al.	0.041	0.007	2.17	3.61
	Non-Randomized	Belov et al.	3.682	0.264	2.22	3.68
	Non-Randomized	De Paulis et al.	0.639	0.136	33.38	19.76
	Non-Randomized	Hirose et al.	0.255	0.011	10.48	11.77
	Non-Randomized	Peterson et al.	0.187	0.010	7.11	9.20
	Non-Randomized	Cartier et al.	0.879	0.878	4.26	6.33
	Non-Randomized	Huang et al.	1.000	1.000	1.48	2.56
	Non-Randomized	Calafiore et al.	0.350	0.006	20.44	16.51
	Non-Randomized	Wendler et al.	1.000	1.000	1.47	2.55
	Non-Randomized	Deja et al.	0.364	0.496	1.37	2.39
Fixed			0.438	<0.001		
Random			0.423	<0.001		
	Randomized	Mannacio et al.	1.000	1.000	9.64	9.64
	Randomized	Markman et al.	0.950	0.972	9.26	9.26
	Randomized	Kamiya et al.	1.000	1.000	8.93	8.93
	Randomized	Castro et al.	1.000	1.000	9.35	9.35
	Randomized	Takami et al.	0.143	0.240	7.11	7.11
	Randomized	Lorberboym et al.	0.500	0.595	11.46	11.46
	Randomized	Bonnachi et al.	0.313	0.139	31.66	31.66
	Randomized	Cohen et al.	0.300	0.333	12.61	12.61
Fixed			0.476	0.093		
Random			0.476	0.093		

Non-Randomized Studies
Total (95% CI): 1964 (Skeletonized); 1738 (Pedicled)
Total events: 37 (Skeletonized); 76 (Pedicled)
Test for heterogeneity: Chi² = 18.43; df = 13 (P = 0.142); I² = 29.5%
Test for overall fixed effect: Z = -4.76 (P < 0.001)
Test for overall random effect: Z = -3.59 (P < 0.001)

Randomized Studies
Total (95% CI): 460 (Skeletonized); 655 (Pedicled)
Total events: 21 (Skeletonized); 66 (Pedicled)
Test for heterogeneity: Chi² = 1.97; df = 7 (P = 0.961); I² = 0.0%
Test for overall fixed effect: Z = -1.68 (P = 0.093)
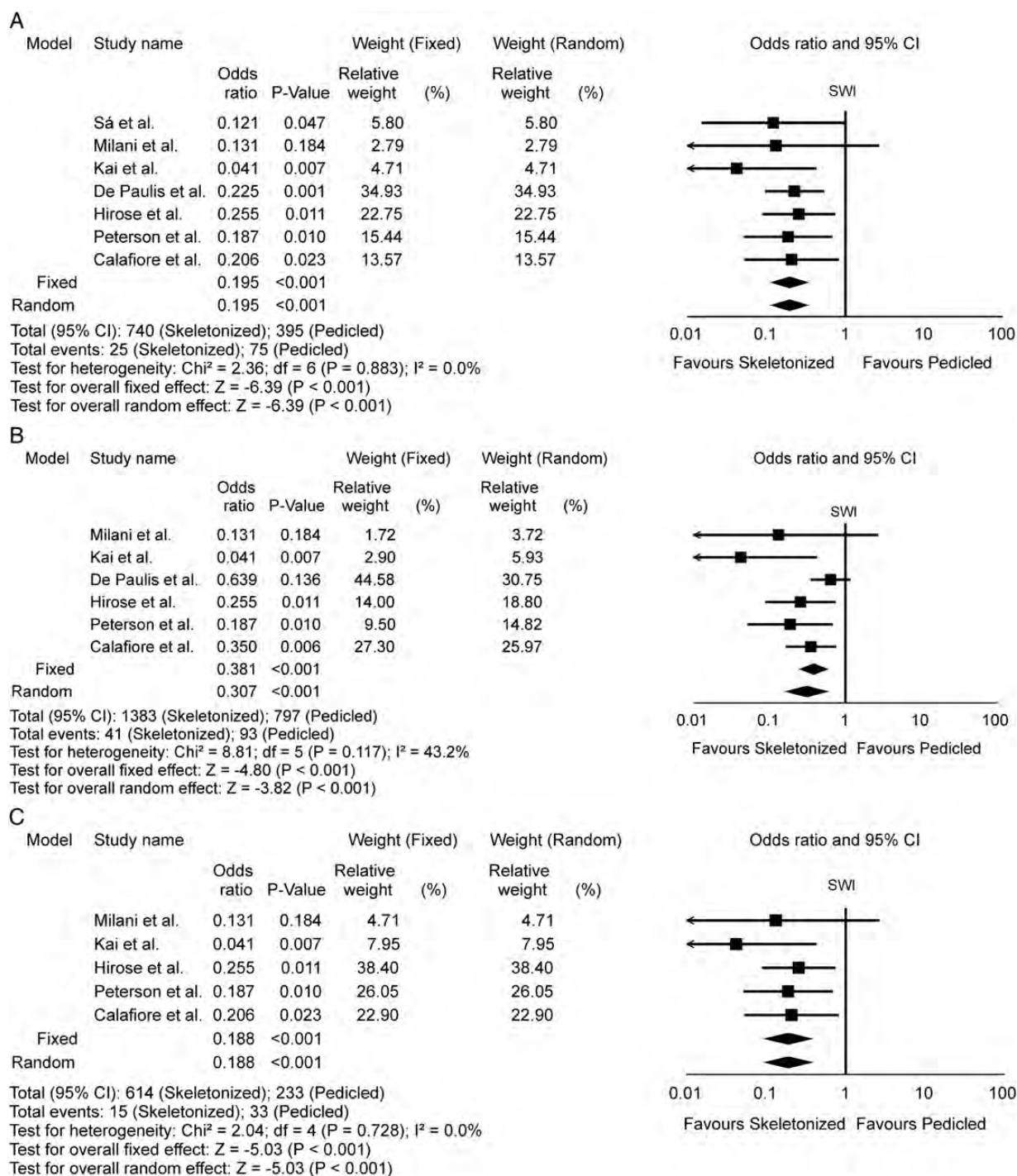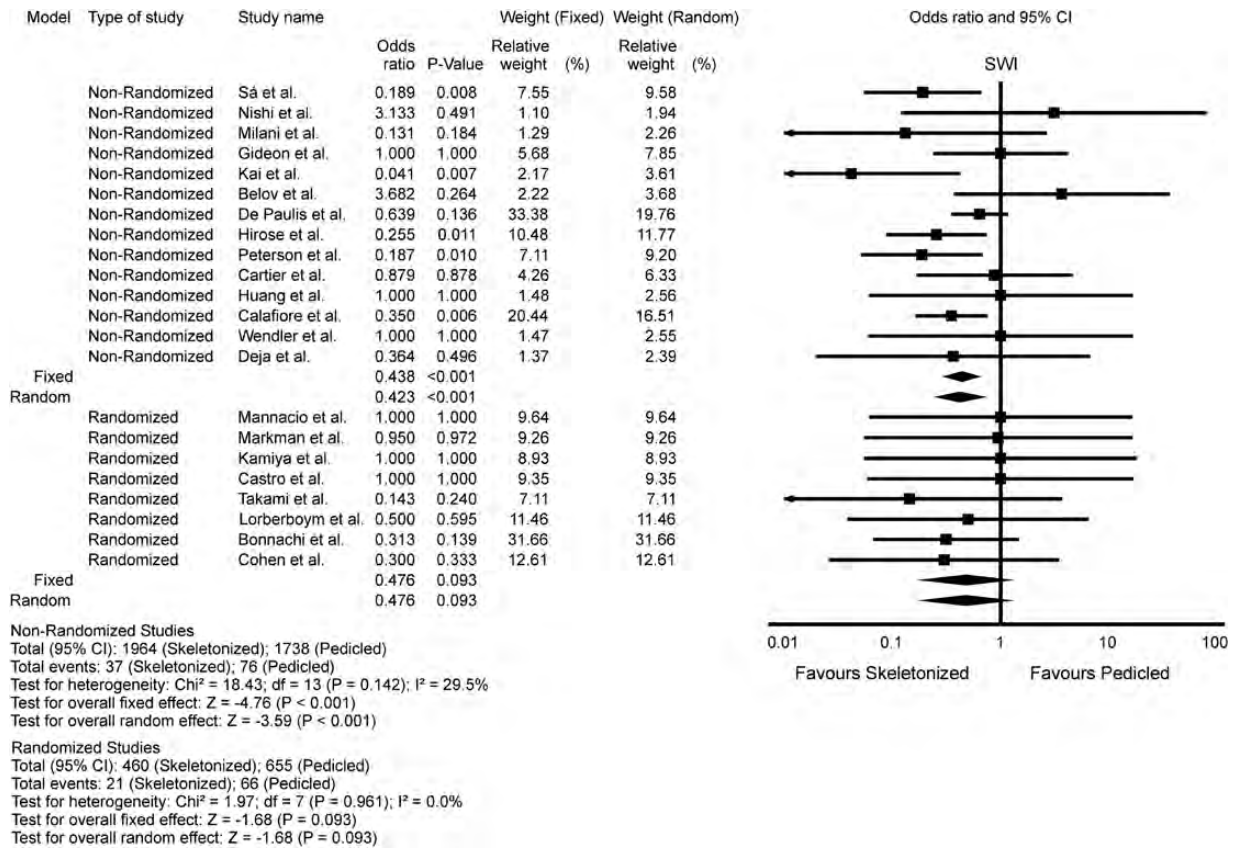Test for overall random effect: Z = -1.68 (P = 0.093)

Figure 5: Odds ratio and conclusions plot of sternal wound infection associated with skeletonized vs pedicled internal thoracic artery in sensitivity analysis (non-randomized vs randomized studies).
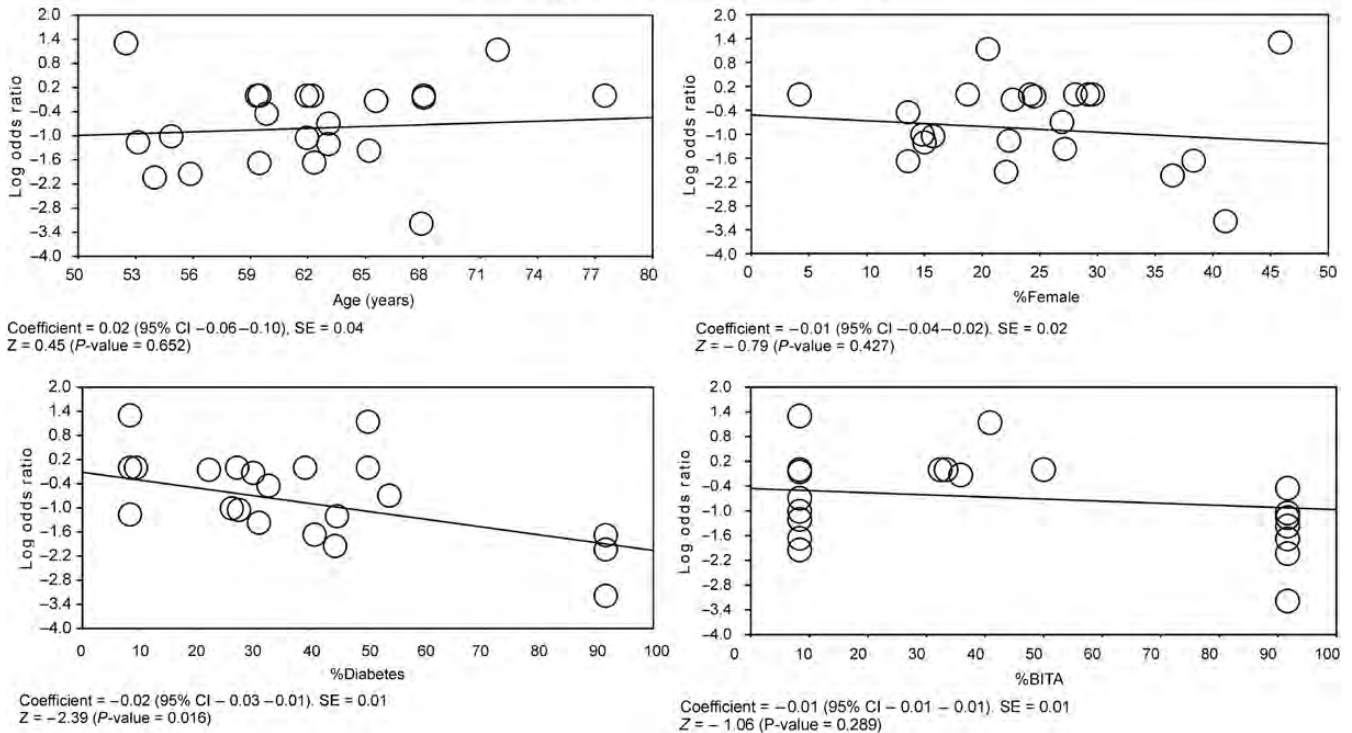

Meta-regression on log odds ratio

Coefficient = 0.02 (95% CI −0.06−0.10), SE = 0.04
Z = 0.45 (P-value = 0.652)

Coefficient = −0.01 (95% CI −0.04−0.02), SE = 0.02
Z = −0.79 (P-value = 0.427)

Coefficient = −0.02 (95% CI −0.03−0.01), SE = 0.01
Z = −2.39 (P-value = 0.016)

Coefficient = −0.01 (95% CI −0.01−0.01), SE = 0.01
Z = −1.06 (P-value = 0.289)

Figure 6: Meta-regression analysis by representative plots.

size), multicentre, prospective, randomized trials of skeletonized vs pedicled ITA grafts to verify that there is indeed a difference in the incidence of postoperative SWI.

CONCLUSIONS

Skeletonized ITA appears to reduce the incidence of postoperative SWI in comparison with pedicled ITA after CABG, with this effect being modulated by the presence of diabetes.

Conflict of interest: none declared.

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