Meta-analysis of posterior versus medial approach for popliteal artery aneurysm repair

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ABSTRACT

Background: Popliteal artery aneurysm is an uncommon vascular disease but one that can cause significant morbidity, the most severe being limb loss reported in 20% to 59% of cases. Two approaches to repair are described in the literature, the posterior and the medial; however, the "gold standard" method of repair remains controversial.

Methods: A systematic review of electronic information sources was undertaken to identify papers comparing outcomes of posterior repair vs medial repair. The methodologic quality of the papers was assessed using the Newcastle-Ottawa Scale. Fixed-effect or random-effects models were applied to synthesize data.

Results: The search yielded seven articles eligible for inclusion. The total population comprised 1427 patients; 338 had posterior repair and 1089 had medial repair. There was no difference in the two groups in terms of postoperative nerve damage (odds ratio [OR], 1.01; 95% confidence interval [CI], 0.24-4.2) and 30-day postoperative complications (OR, 0.87; 95% CI, 0.43-1.77). Limb loss at 30 days occurred more frequently in the medial approach group, but the difference was not statistically significant (risk difference [RD], 0.02; 95% CI, −0.04 to 0.00). Thirty-day primary patency was not statistically different between groups (RD, −0.01; 95% CI, −0.04 to 0.02), but the 30-day secondary patency suggested superiority of the posterior approach (RD, 0.05; 95% CI, 0.02-0.07). Long-term primary and secondary patency both favored the posterior approach (OR, 1.61 [95% CI, 1.06-2.43] and OR, 1.73 [95% CI, 0.91-3.30], respectively). Aneurysm exclusion was also superior with the posterior approach (OR, 4.20; 95% CI, 1.40-12.60). The rate of reoperation favored the posterior approach (OR, 0.26; 95% CI, 0.09-0.72). Long-term risk of limb loss favored posterior repair, but no statistically significant difference was found (OR, 0.32; 95% CI, 0.43-1.77).

Conclusions: High-level comparative data comparing posterior and medial repair for popliteal artery aneurysms are not available. Within the parameters of this review, however, superiority of the posterior approach for primary and secondary patency, aneurysm exclusion, and need for reoperation was noted. High-level evidence from randomized clinical trials is required to define the relative benefits of the posterior approach over the medial approach in selected patients. (J Vasc Surg 2016;■:1-10.)

Popliteal artery aneurysms (PAAs) are uncommon but cause a significant morbidity and mortality. Their incidence is stated at <0.1%.[1] However, the popliteal artery is the second most frequent location of arterial aneurysm, and many affected have concomitant abdominal aortic aneurysms (33%) and contralateral PAA disease (50%).[2] PAAs >2 cm in diameter and those that are symptomatic should be considered for interventional treatment.[2]

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Complications of PAA are limb loss, through either thrombosis or embolic occlusion of the distal runoff vessels, and, more rarely, rupture. The overall risk of limb loss is 20% to 59%, and the risk of death is up to 11%.[3,4] It has been reported that surgical outcomes are superior if the PAA is asymptomatic compared with those presenting acutely with symptoms.[5]

Two approaches to open surgical repair are described in the literature, posterior and medial; however, the "gold standard" method of repair remains controversial. The medial approach to PAA repair involves bypassing the aneurysmal segment with end-to-side anastomosis, using either vein or prosthetic graft, and ligating the PAA at the proximal and distal boundaries of the aneurysm. The posterior approach entails a curved incision in the popliteal fossa and resection of the PAA with interposition (end-to-end anastomosis) vein or prosthetic grafting in a similar technique to that employed in abdominal aortic aneurysm repair.[6,7]

With medial repair, as not all of the side branches feeding the sac are ligated, there is said to be ongoing risk of sac expansion, leading to compressive symptoms from the PAA and the risk of future rupture. In posterior

repair, as the sac is laid open, patent branches can be oversewn, reducing the risk of future sac expansion.[4] However, reports on posterior repair have commented on higher rates of nerve damage complicating this method.[5]

To some degree, the morphology of the aneurysm can predispose to one type of repair; for example, if an aneurysm is extending upward to the adductor canal, it is generally accepted that the medial approach provides the best access for proximal extension and the posterior approach may not allow full access to proximal healthy artery. However, in cases in which the anatomy does not dictate one repair over the other, definitive evidence as to which is the best method of surgical repair is not published. To date, there is no review publication comparing the two methods. This meta-analysis aimed to collate all relevant studies comparing posterior and medial repair and to establish which provides the best rates of limb salvage, graft patency, and minimum postoperative complications.

METHODS

Design. The objectives, inclusion criteria, investigated outcomes, and methods of analysis were prespecified and documented in a protocol. The protocol was registered at the International Prospective Register of Systematic Reviews (PROSPERO registration number: CRD42015027532). The review conformed to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement standards.[8]

Eligibility criteria. We considered randomized clinical trials and observational studies comparing different approaches for surgical repair of PAAs. Male or female participants of any age diagnosed with a PAA requiring treatment were selected for analysis. We defined the posterior approach for surgical repair as the experimental intervention, whereas a standard medial approach was the comparator intervention. Major perioperative complications, primary and secondary patency, and limb loss were defined as the primary outcome parameters. Major perioperative complications were those requiring further surgical intervention or having a significant impact on the patient's postoperative course and functional capacity; they included surgical site infection, bleeding/hematoma, deep venous thrombosis, and respiratory and cardiac complications. We defined nerve damage, 30-day limb loss, 30-day primary and secondary patency, aneurysm exclusion, and reoperation as secondary outcome end points.

Information sources and literature search strategy. The literature search strategy and protocol were designed with a clinical information specialist. Studies were identified by searching electronic bibliographic databases and scanning reference lists of articles. The following electronic bibliographic sources were searched: the U.S. National Library of Medicine's database (MEDLINE), the Excerpta Medica database (Embase), the Cumulative Index to Nursing and Allied Health Literature (CINHAL), and the Cochrane Central Register of Controlled Trials (CENTRAL). We selected relevant terms to identify eligible reports. Thesaurus headings, search operators, and limits in each of the databases were adapted accordingly. The last search was run in November 2015. No language constraints were applied, and we planned to translate articles published in the non-English language. The literature search strategy is outlined in the Supplementary Table (online only).

Study selection and data management. Eligibility assessment of identified studies was performed independently in an unblinded standardized manner by two reviewers (A.P., S.H.). A third review author (G.A.A.) acted as an arbitrator in the event of disagreement. We developed a data extraction sheet, pilot tested it on randomly selected included studies, and refined it accordingly. One review author (A.P.) extracted relevant information from included studies, and a second author (S.H.) checked the extracted data. Disagreements were resolved by discussion between the two review authors. We collected study-related information, such as study design and year of publication; baseline demographics and clinical characteristics of the study populations, such as elective or urgent/emergency surgery and type of bypass graft used (autologous vein or prosthetic); and outcome data. The outcome measures were organized into a two-by-two table to permit calculation of effect sizes for PAA repair using the posterior approach in comparison with the medial approach with regard to each dichotomous outcome.

Risk of bias assessment. The methodologic quality of observational cohort or case-control studies was assessed with the Newcastle-Ottawa Scale (NOS).[9] With use of the tool, each study was judged on eight items, categorized into three groups: the selection of the study groups; the comparability of the groups; and the ascertainment of either the exposure or outcome of interest for case-control or cohort studies, respectively. Stars awarded for each quality item served as a quick visual assessment. Stars were awarded such that the highest quality studies were awarded up to nine stars. We planned to use the Cochrane Collaboration's tool for the assessment of the risk of bias of randomized controlled trials.[10]

Methods of analysis. Dichotomous outcome measures, such as the perioperative complications, were calculated using odds ratio (OR) or risk difference (RD) and 95% confidence interval (CI) to reflect the uncertainty of point estimate of effects. The unit of analysis was the individual patient or the treated limb.

Summary estimates of ORs or RDs were determined using the Mantel-Haenszel fixed-effect model, unless

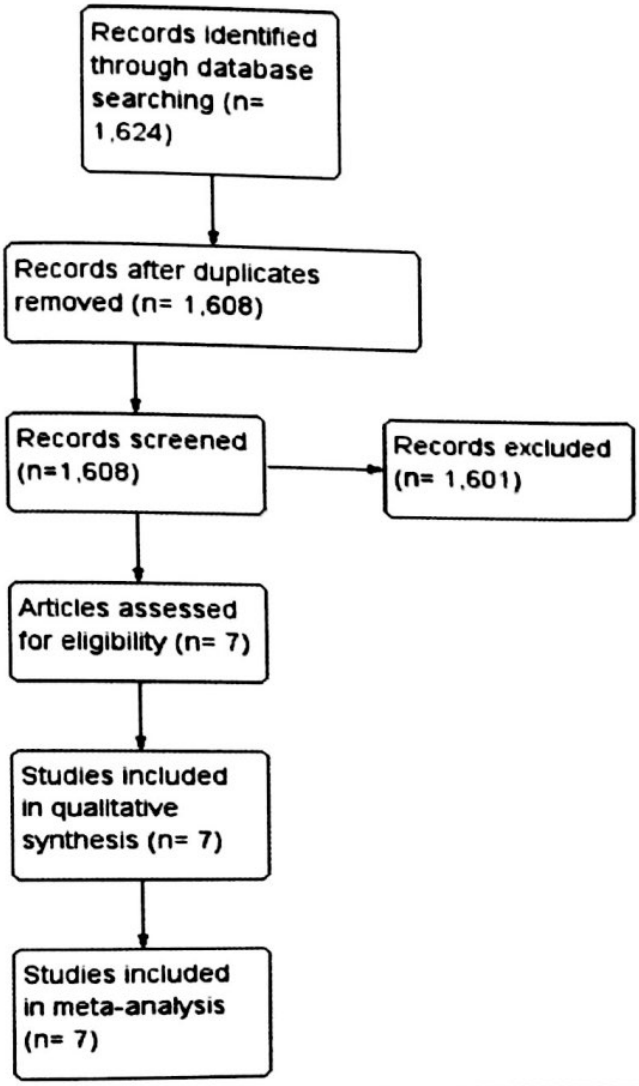


Fig 1. Study flow diagram.

evidence of between-study heterogeneity was identified (defined as Cochran's Q [χ^2] test P value < .05 and I^2 value > 75%), in which case the random-effects model of DerSimonian and Laird was applied. We created a forest plot for each treatment effect.

Interstudy heterogeneity was initially assessed visually using the forest plots. Furthermore, we examined heterogeneity with the combination of the Cochran Q (χ^2) test and the I^2 statistic. P values < .05 were considered significant for heterogeneity. Moreover, we considered I^2 values <50% indicative of low heterogeneity, I^2 values between 50% and 75% indicative of moderate heterogeneity, and I^2 values >75% indicative of significant heterogeneity.[10]

We planned to assess potential publication bias using the Egger test and to represent it graphically with Begg funnel plots of the natural log of the OR vs its standard error, if sufficient studies in any single meta-analysis were available (>10 studies).[10]

If available data permitted, we planned to perform subgroup analyses by the type of graft (autogenous vein or prosthetic) and elective or urgent/emergency repair. Additional sensitivity analyses were performed to evaluate the potential effect of key assumptions and study-level factors on the overall results. We used the Review Manager (RevMan) computer program (version 5.3; The Nordic Cochrane Center, The Cochrane Collaboration, Copenhagen, Denmark).

RESULTS

Literature search results

The literature search of the electronic information sources identified seven relevant articles, the full texts of which were examined in detail. There were no duplicate articles. The studies were all retrospective observational studies. The literature search results are presented in Fig 1.

The total meta-analysis population comprised 1427 patients. The patient numbers in the available studies varied greatly from the smallest with a total of 26 repairs to the largest with 681 PAA repairs. Overall, 338 had a posterior surgical approach and 1089 had a medial repair. The reports were all recently published, the oldest being published in 2007.

Study characteristics

The study characteristics and methodologic assessment (NOS scores) are outlined in Table I. The seven papers ranged from that awarded six stars to those awarded nine stars; hence, there was variation in the quality of studies with associated variations in risk of bias, those of poorer methodologic quality being more likely to present skewed or biased results.

In one study, the patients in the two groups were case matched in terms of demographics, aneurysm morphology, and distal runoff to reduce the variation between the groups and to attempt to ensure that the type of repair was the only variable.[11] However, this was done retrospectively, and the type of repair was still at the surgeon's discretion. In the rest of the studies, where reported, the demographics were similar between the groups but not specifically matched. This information is displayed in Tables II and III. In terms of age, the patients in each paper were well matched. The male preponderance was also maintained across all studies in which it was reported. Major cardiovascular risk factors were also reported in similar rates across the studies, as is displayed in Table II.

The symptoms of the patients operated on were reported by all papers. In most of the papers, the posterior repair and medial repair groups were similar in terms of the symptoms they presented with; however, there were differences among the studies. For example, rates of acute ischemia ranged from 0% to 30%.[6,11-14] One paper had much higher rates of acute presentation, with 36% in the posterior group and 67% in the medial group.[15] Another study had just 13% in the posterior

Table I. Study characteristics for the selected papers

Author	Country	NOS score	Study type	Total patients	Posterior group	Medial group
Kropman,[11] 2007	Netherlands	9	Observational retrospective	66	33	33
Zaraca,[16] 2010	Italy	7	Observational retrospective	49	38	11
Ravn,[12] 2007	Sweden	6	Observational retrospective	681	60	621
Mazzaccaro,[6] 2015	Italy	8	Observational retrospective	77	43	34
Bisdas,[13] 2010	Germany	7	Observational retrospective	58	29	29
Bracale,[15] 2011	Italy	9	Observational retrospective	26	14	12
Cervin,[14] 2015	Sweden	8	Observational retrospective	470	121	349

NOS, Newcastle-Ottawa Scale.

Table II. Demographic details of study participants

Author	Age, years	Male sex, %	Heart disease, %	Hypertension, %	Smoking, %	Diabetes,%	Hyperlipidemia, %
Kropman,[11] 2007	65 ± 9 vs 65 ± 10	94[a]	30 vs 30	45 vs 48	52 vs 39	12 vs 9	30 vs 24
Zaraca,[16] 2010	66.3 vs 69.4	97[a]	29 vs 36	47 vs 55	50 vs 55	21 vs 18	42 vs 55
Ravn,[12] 2007	NR	NR	NR	NR	NR	NR	NR
Mazzaccaro,[6] 2015	64.7 vs 75.1	99[a]	23 vs 20	56 vs 53	84 vs 59	26 vs 12	26 vs 24
Bisdas,[13] 2010	59 (49-84)[a]	88[a]	36[a]	80[a]	64[a]	14[a]	66[a]
Bracale,[15] 2011	69.93 vs 69.25	NR	43 vs 17	79 vs 67	86 vs 58	14 vs 0	57 vs 17
Cervin,[14] 2015	NR	NR	NR	NR	NR	NR	NR

NR, Not reported.
Displayed as posterior vs medial approach unless otherwise stated.
[a]The figure is combined for the two groups as they are not presented separately.

Table III. Popliteal artery aneurysm (PAA) diameter and presenting symptoms of the study participants

Author	Diameter, mm	Asymptomatic, %	Acute ischemia, %	Chronic ischemia, %	Venous graft, %
Kropman,[11] 2007	32 ± 10 vs 32 ± 10	36 vs 39	21 vs 18	42 vs 42	73 vs 73
Zaraca,[16] 2010	30.2 vs 32.9	68 vs 27	13 vs 45	18 vs 27	84 vs 64
Ravn,[12] 2007	30 vs 30	NR	20 vs 29	80 vs 71	63 vs 80
Mazzaccaro,[6] 2015	28 ± 10	44 vs 47	21 vs 26	26 vs 20	9 vs 35
Bisdas,[13] 2010	NR	17[a]	0[a]	83[a]	84[a]
Bracale,[15] 2011	28.7 vs 35.1	64 vs 16	36 vs 67	0 vs 17	50 vs 75
Cervin,[14] 2015	NR	66 vs 47	20 vs 32	14 vs 21	83 vs 90

NR, Not reported.
Displayed as posterior vs medial approach unless otherwise stated.
[a]The figure is provided for the whole study group as it is not provided for the two groups separately.

group treated in an acute setting but 45% in the medial group.[16]

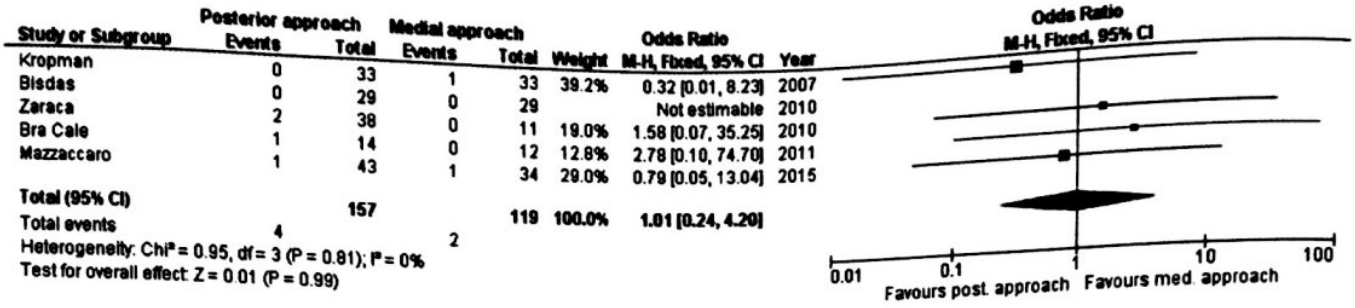
The use of preoperative or perioperative thrombolysis was not consistently reported by the papers, so it cannot be commented on any further in this review, but it was an adjunctive treatment used by some authors to improve acute symptoms before definitive surgical management.

In each paper, the surgeon used either a venous or prosthetic graft for the repair, the rates of which were consistently reported in papers. Rates of venous graft use ranged from 9% to 90%. One paper had particularly low use of a venous conduit, with only 9% in the posterior group and 35% in the medial group.[6] The other six papers had rates of venous conduit use between 50% and 90% and appeared to be well matched between the two groups in each study.

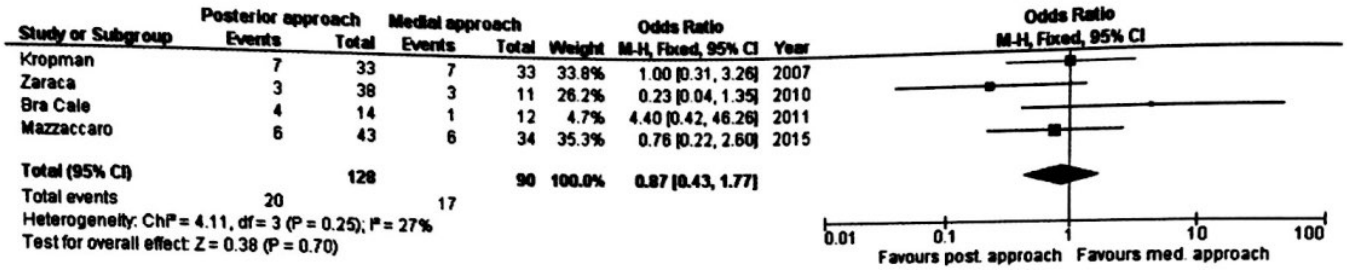
Early outcomes

The forest plots of comparison of posterior vs medial approach for PAA repair are presented in Fig 2.

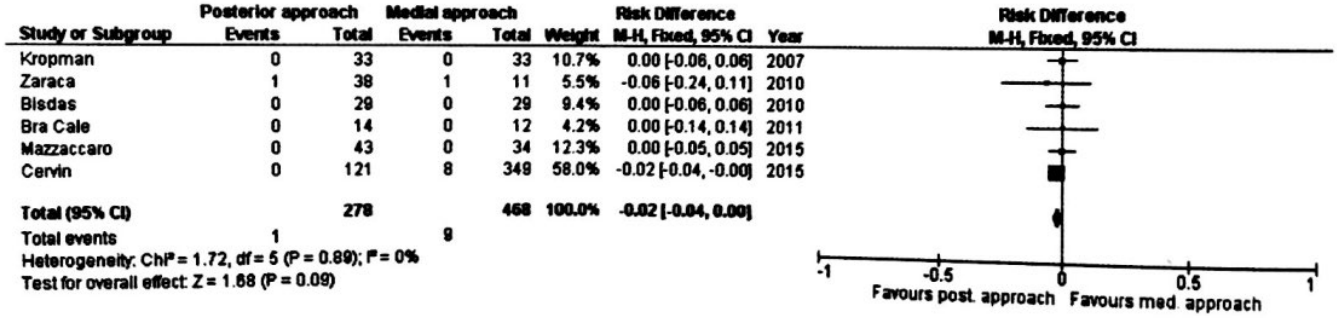
Nerve damage. Nerve damage was a reported outcome in five papers; the total population comprised 157 posterior PAA repairs and 119 medial repairs.[6,11,13,15,16] There were a total of six events of nerve damage, four in the posterior approach group and two in the medial



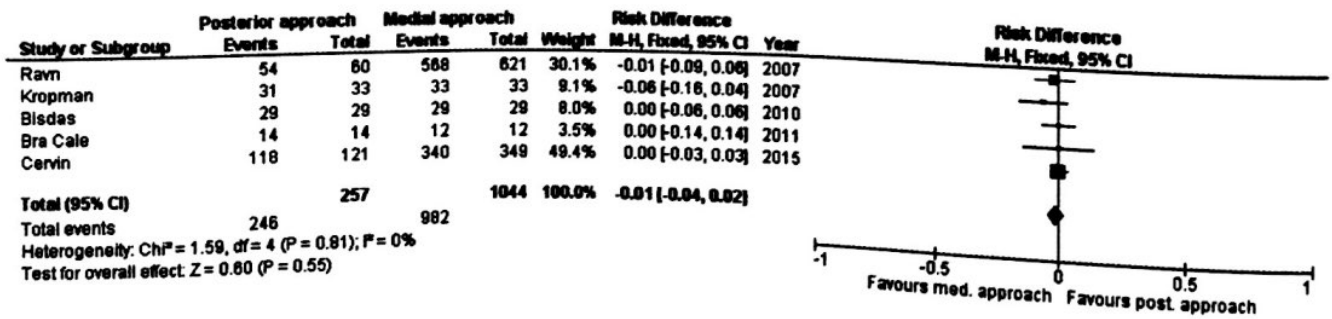
a Nerve damage



b 30-day complications



c 30-day limb loss

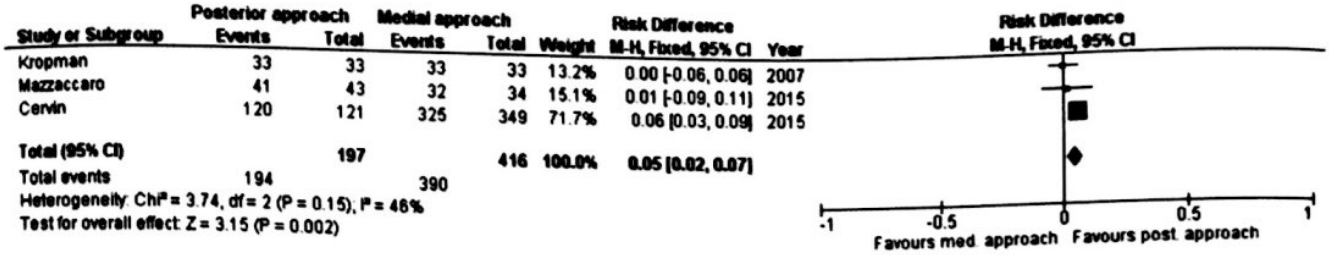


d 30-day primary patency

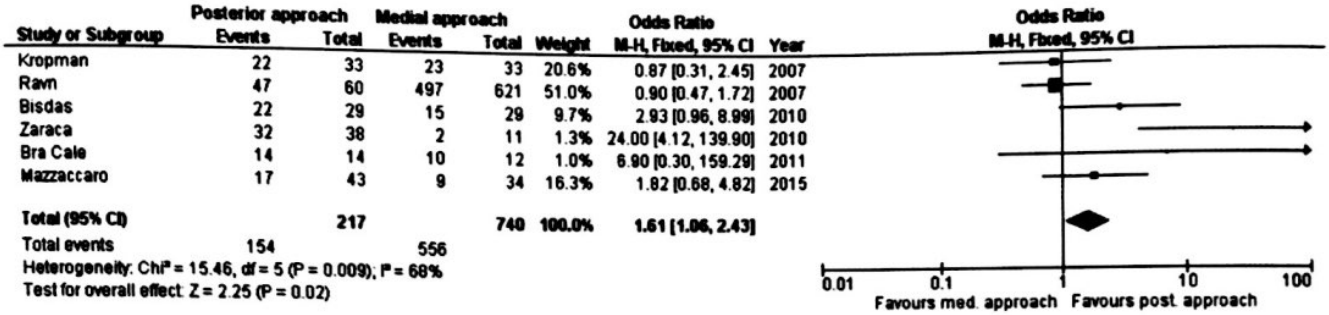
Fig 2. a-j, Individual forest plot for each treatment effect. Forest plots of comparison of posterior vs medial approach for popliteal artery aneurysm (PAA) repair. The *solid squares* denote the odds ratios (ORs) or risk differences (RDs), the *horizontal lines* represent the 95% confidence intervals (*CIs*), and the *diamond* denotes the pooled OR. *M-H,* Mantel-Haenszel test.

approach group. There was no statistical difference in the two groups (OR, 1.01; 95% CI, 0.24-4.20). The study heterogeneity calculated was low at $I^2 = 0\%$.

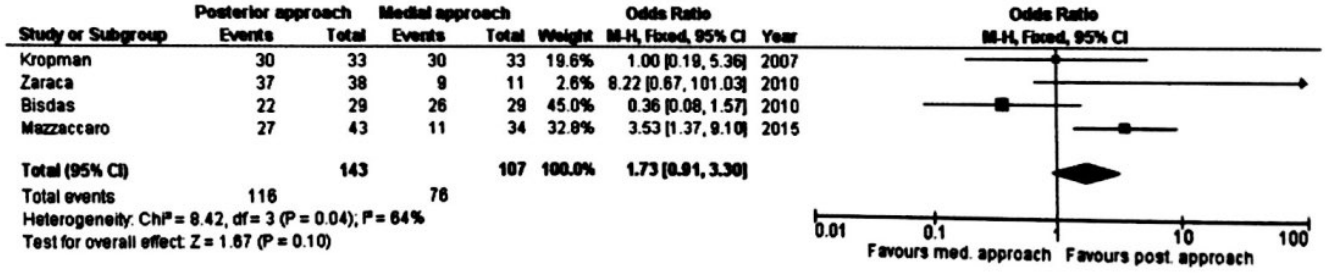
Thirty-day complications. Thirty day complications were reported in four studies with a total of 37 events (20 posterior and 17 medial).[6,11,15,16] The total population was 128 posterior approaches and 90 medial approaches. These events ranged from surgical wound infections and hematomas to general complications like pneumonia and heart failure. There was statistical



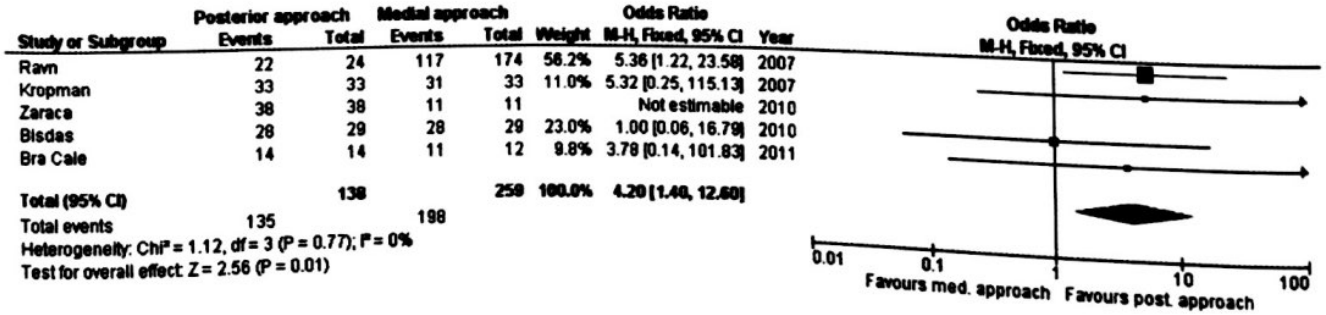
e 30-day secondary patency



f Long-term primary patency



g Long-term secondary patency



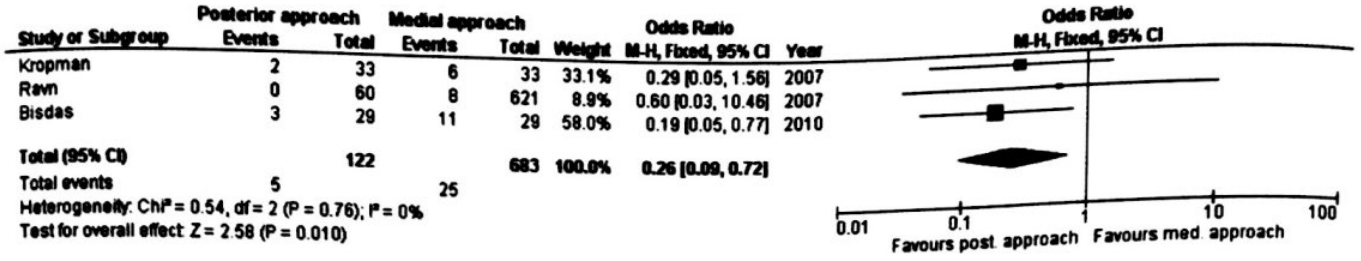
h Aneurysm exclusion

Fig 2. Continued.

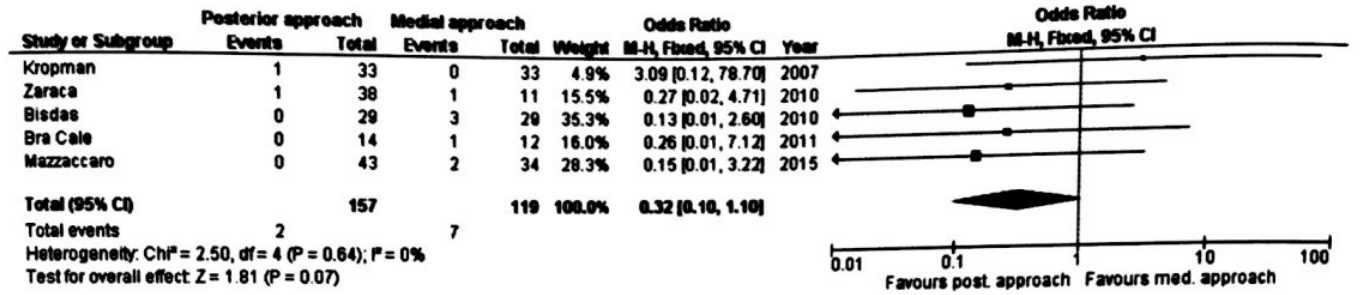
difference identified between the two groups (OR, 0.87; 95% CI, 0.43-1.77; $P = .70$). The between-study heterogeneity was low at $I^2 = 27\%$.

Thirty-day limb loss. Thirty-day limb loss was reported by six studies with a total population of 278 posterior approaches and 468 medial approaches.[6,11,13-16] These studies had a total of 10 instances of amputation, 9 in the medial approach group, and only 1 in the posterior group. Despite the numeric difference, the RD for the two approaches failed to reach significance (RD, −0.02; 95% CI, −0.04 to 0.00; $P = .09$). The study heterogeneity was low at $I^2 = 0\%$.

Thirty-day patency rate. Thirty-day primary patency was reported by five studies.[11-15] The total population



i Reoperation



j Limb loss

Fig 2. Continued.

analyzed was 246 posterior approaches and 1044 medial approaches. Overall analysis of the data retrieved showed no difference between posterior and medial repair with an RD of −0.01 (95% CI, −0.04 to 0.02; $P = .55$). Between-study heterogeneity was low at $I^2 = 0\%$.

Considering 30-day secondary patency, three studies reported this outcome with a total population of 197 posterior and 416 medial repairs.[6,11,14] The calculated RD was 0.05 (95% CI, 0.02-0.07), suggesting superiority of the posterior approach with $P = .002$. A low between-study heterogeneity was found ($I^2 = 46\%$).

Late outcomes

Long-term primary patency. Long-term primary patency was reported by six studies at the end of the defined study period.[6,11-13,15,16] The duration of follow-up ranged from 46 to 96 months, reported as the mean follow-up. The total analyzed population comprised 217 posterior repairs and 740 medial repairs. Long-term patency was superior in the posterior approach group (OR, 1.61; 95% CI, 1.06-2.43). Study heterogeneity was moderate at $I^2 = 68\%$.

Long-term secondary patency was an outcome reported in four studies.[6,11,13,16] It also appeared to favor the posterior approach; however, no statistical significance was reached (OR, 1.73; 95% CI, 0.91-3.30; $P = .10$). Study heterogeneity was moderate at $I^2 = 64\%$.

Aneurysm exclusion. Aneurysm exclusion was reported by five papers.[11-13,15,16] The population included 138 posterior approaches and 107 medial approaches. Exclusion was not achieved in 3 posterior approaches compared with 61 medial approaches. The superiority of the posterior approach was confirmed on statistical analysis (OR, 4.20; 95% CI, 1.40-12.60; $P = .01$), with low study heterogeneity at $I^2 = 0\%$.

Reoperation. Reoperation was reported in three studies with a total of 30 events from a population of 122 posterior and 683 medial repairs.[11-13] Five of these were in the posterior approach group and 25 in the medial group. With forest plot analysis, this was statistically significant, favoring the posterior approach (OR, 0.26; 95% CI, 0.09-0.72; $P = .01$). Overall, a low study heterogeneity was identified with $I^2 = 0\%$.

Limb loss. Limb loss at the study end point was reported in five papers, 157 posterior repairs and 119 medial repairs.[6,11,13,15,16] There were a total of nine amputations, two in the posterior approach group and seven in the medial approach group. The statistical analysis failed to reach significance with $P = .07$ (OR, 0.32; 95% CI, 0.10-1.10; $P = .07$), with low heterogeneity at $I^2 = 0\%$.

Sensitivity analysis

To check whether individual studies unduly influenced overall results, the analyses were repeated excluding each study one at a time. The following discrepancies in outcomes were identified: the significant difference for 30-day secondary patency was lost when the study of Cervin et al[14] was removed; the significant difference in long-term primary patency was lost when the study of Zaraca et al[16] was removed; the difference in long-term secondary patency became significant when the study of Bisdas et al[13] was excluded; the significant difference in aneurysm exclusion was lost when the study of Ravn et al[12] was removed; and the significant difference in reoperation was lost when the study of Bisdas et al[13] was removed from the analysis. Further, none of the

analyses were repeated excluding the study of Ravn et al,[12] which achieved the lowest methodologic quality score on the NOS; when this study was removed, the difference in aneurysm exclusion was lost, whereas the rest of the outcomes were not affected.

DISCUSSION

Summary of main results. Surgical repair of PAAs has been documented in the literature since early surgeons recognized the devastating consequences of not treating them.[2] With open surgical repair, good results have been obtained with both medial and posterior approaches. Unfortunately, because of the relative infrequency, high-level evidence regarding which approach is best is still needed. On literature review, both appear to have their merits and unique risks.

The posterior approach requires the patient to be positioned prone on the operating table[6]; this can provide the anesthetic team with some challenges, but it is usually technically possible with the usual efforts to protect the patient. The posterior approach becomes difficult if the aneurysm is extending outside of the popliteal fossa and may not be selected if this is the case. Access to suitable conduit for bypass can be an issue if the short saphenous vein is not suitable, as a separate incision for long saphenous vein harvest would be necessary,[2] the alternative being to accept the slightly inferior patency of a prosthetic graft, although some authors have published excellent patency rates using inlay prosthetic grafts with posterior repair.[17] The final issue is the risk of nerve damage, usually of the tibial or peroneal nerve, which can cause long-term neurologic deficit and disability.[2]

With medial repair, good access to healthy proximal and distal artery is ensured, but reported issues involve continued sac expansion.[2,11,17] This is said to happen through patent side branches that are not identified at the time of surgery, causing sac expansion and leading to either rupture or symptoms from the mass effect on adjacent structures.[17] These complications are usually severe enough to require further intervention.[12]

This review identified seven papers directly comparing the results of posterior and medial open surgical repair. The numbers in each study are generally small, limiting the power of the analysis. The largest study had 681 for comparison, the next largest had 470, but most had fewer than 100 cases in total. These were all observational studies, none of which were prospective or randomized.

Our results indicate that overall, more medial repairs are performed than posterior repairs. The reasons for this are unclear but could be anatomy based or surgeon preference based. It is perceivable that surgeons are less familiar with a posterior approach to PAAs and so may opt for medial repair more frequently.[6]

The meta-analysis of early outcomes included five domains, and overall assessed posterior repair was equivalent to medial repair in four areas: nerve damage, 30-day complications, 30-day limb loss, and 30-day primary patency. Posterior repair was superior in one domain, that of 30-day secondary patency. Within this subgroup, the important domain of nerve damage was analyzed, as it is said to be more frequent in posterior repair,[1] but no difference was found between the two approaches in the current review. Postoperative complication rates were low, with an overall rate of 17%, and showed no difference between the two cohorts.

Considering late outcomes, posterior repair was superior in four of five domains. These were long-term primary patency, aneurysm exclusion, limb loss, and reoperation. However, no difference was seen in terms of long-term secondary patency between the two groups. Length of follow-up was a number of years in each reporting paper, therefore of an adequate duration.

Overall completeness and applicability of evidence. The study participants were retrospectively enrolled within a time frame and so were not preselected. However, it is unclear whether authors of selected studies excluded patients who were considered unfit for surgical intervention because of advanced age, comorbidity, or frailty.

Studies varied in the completeness of the data they delivered; in none of the meta-analyzed aspects were all seven papers' data represented. The absence of data from some studies does decrease the power of the analysis.

Within each study, information was not provided on the numbers of surgeons performing the repairs. The likelihood is that each study contained a number of different surgeons with varying levels of experience at each technique. In no paper was the skill of the operator controlled for, introducing a further aspect of bias on the results.

The relationship between the type of graft and the overall outcomes has been well documented in previous publications, with venous conduit usually being considered superior to prosthetic in improving patency rates and reducing risk of limb loss.[2,3,11,12] In this meta-analysis, the main study outcomes were not consistently linked to the type of conduit and so statistical analysis is not possible. However, rates of venous graft use were generally high. In five papers, rates >64% were seen in each group, but with variation between use in the posterior and medial repairs.[11-14,16] Most studies had higher rates with medial repairs, so improved patency might have been expected but was not found. One study had very low rates of vein graft use, just 9% posterior and 35% medial.[6] Inferior patency rates with medial repair despite the increased use of venous conduit could be due to the longer bypass or poorer flow dynamics in an end-to-side vs an end-to-end bypass.[6,15] Another postulated effect is the lower thrombogenicity in a shorter graft, leading to better patency rates.[17] Long-term patency rates may be affected by the postoperative anticoagulation regimen instigated. One paper detailed the

use of warfarin in all patients without a specific contraindication after PAA repair.[16] Another commented on the use of aspirin postoperatively,[11] but the rest failed to report the chosen method of anticoagulation employed postoperatively. This introduces a further potential area of bias in the results.

The indications for operation were similar in all studies, being either diameter >20 mm or symptomatic aneurysm; however, the relative numbers of asymptomatic to symptomatic patients varied among studies. This is of relevance as the symptoms of the patient at the time of the procedure have great bearing on the long-term outcomes.[1,4,5] It is generally accepted that patients with acute ischemia at presentation have inferior outcomes to those who are asymptomatic from their PAAs.[5,13] This is mostly due to the reduction in numbers of runoff vessels that has occurred secondary to the PAA, leading to the symptom and making any repair more likely to fail, with implications on patency rates and limb salvage rates.[1,2,5] Furthermore, those with chronic ischemia see better outcomes than those with acute ischemia.[5] Therefore, the relative numbers of each in each study matters with respect to its published outcomes. There was a large variation in the numbers with each presentation in each study. Five papers had rates of acute ischemia of <30%[6,11-14]; the final two had large differences in the rates of acute ischemia in the two groups. Both had more acutely ischemic limbs in the medial group, and both contributed data consistently to the long-term outcomes; this could have contributed to poorer outcomes in this group. The wide variation in the symptoms of the enrolled participants is a likely source of bias in the results.

In all studies, the selection of type of repair was at the discretion of the surgeons and may have been influenced by their experience in the two methods. It may also have been dictated by patient-related factors, such as aneurysm length. The percentage of aneurysms that are suitable for posterior repair has been reported at between 10% and 40%,[5,11,12] with one author suggesting that it could be 54%[15] and another up to 78%.[16] Inevitably, a proportion of aneurysms will be unsuitable for posterior repair because of proximal extent of the aneurysm. In our analysis, only one study controlled for this, albeit retrospectively, and excluded aneurysms that could not be repaired by both methods, so eliminating the effect that the length of bypass may have had on the results.[11]

Quality of the evidence. The studies were all level III evidence, from observational studies only. No randomized controlled trials were identified. In only one study were patients in each group matched in terms of demographics and anatomic factors of the repair. On the NOS scoring system, all papers scored in excess of six stars.

Potential biases in the review process. The "gray literature," including conference proceedings, dissertations and theses, and Google Scholar, was not searched. Furthermore, the methodologic quality of the selected studies was assessed by a single author (A.P.). None of the parameters reviewed included all papers, reducing the numbers analyzed and therefore the statistical power of the arguments.

Agreements and disagreements with other studies or reviews. This is the only review article written to date comparing posterior and medial surgical repair of PAAs; one of the papers in the review had called for a meta-analysis to increase the power of its study.[13]

In comparing these two methods of repair, it is important to take all factors into consideration. Primary graft patency rates in the long term were superior in this analysis with posterior repair. Posterior repair has been seen to offer acceptable rates of limb salvage and graft patency in two previous studies.[7,17] Furthermore, other groups have found that the posterior inlay technique gave improved rates of primary patency compared with the medial, ligation and bypass technique.[4,5]

The main reported drawback of posterior repair, nerve damage, was not statistically different in this analysis between medial and posterior repair.

The significant drawback of medial repair, continued sac expansion, has been seen to still be a contributing problem that can be mitigated by posterior repair.[17]

CONCLUSIONS

Implications for clinical practice and future research. It is clear that not all PAAs will be suitable for the posterior approach and that in some cases, operator expertise and willingness to position the patient prone may prove barriers to the use of this technique. However, the posterior approach should be considered the preferred surgical approach for PAAs not extending above the adductor hiatus because of the superior rates of patency in the long term and minimal short-term complications. Vascular specialists should be trained in the use of the posterior technique and employ it whenever aneurysm anatomy allows. High-level evidence from well-designed and adequately powered randomized clinical trials is required to draw solid conclusions with regard to the relative merits of the posterior approach and its short- and long-term benefits over medial surgical repair.

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AUTHOR CONTRIBUTIONS

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