Abstract

Introduction: Reconstructing the internal iliac artery (IIA) may help to prevent pelvic ischemia during open repair of abdominal aortic aneurysms (AAAs) with iliac arterial lesions. Composite grafts combined with Y-shaped and straight vascular grafts have previously been used to reconstruct the IIA. However, multifurcated vascular grafts have recently been used to treat AAAs with iliac arterial lesions. We, therefore, assessed the viability of multifurcated vascular grafts for AAAs with iliac arterial lesions.

Materials and Methods: We retrospectively reviewed 87 patients who underwent elective open repair with reconstruction of IIAs under infrarenal clamp for AAAs with iliac arterial lesions between April 2002 and August 2015. Forty-three patients received multifurcated vascular grafts including 23 patients who underwent reconstructed unilateral IIA, and 44 patients received composite grafts including forty patients with reconstructed unilateral IIA. We compared the multifurcated and composite graft groups among all patients and also compared among patients who underwent unilateral IIA reconstruction.

Results: There were no significant differences between the two groups among all patients in terms of intra- and post-operative data. There were no cases of hospital death or buttock claudication. In propensity score matching analysis among patients with unilateral IIA reconstruction, 22 patients were extracted each group. There were no significant differences in any preoperative or perioperative parameters between the groups.

Conclusions: We could not show the availability of open repair using multifurcated vascular grafts for AAA with iliac arterial lesions with comparable results compared to composite grafts.

Key Words: Abdominal aortic aneurysm, composite graft, iliac arterial lesions, multifurcated vascular graft

Introduction

Composite grafts combined with Y-shaped and straight vascular grafts have commonly been used for open repair of abdominal aortic aneurysms (AAAs) with iliac arterial lesions though multifurcated vascular grafts have also recently been used commercially to treat these lesions.[1-3] Multifurcated vascular grafts have already anastomosed branches resulted in reducing the number of anastomosis steps and preventing stenosis with a flexible stable graft joint. However, the usefulness of multifurcated vascular grafts compared with composite grafts remains unknown. In this study, we retrospectively assessed the usefulness of multifurcated vascular graft replacement for AAAs with iliac arterial lesions compared with composite graft replacement.

Materials and Methods

Patients

We performed elective open repair in 266 patients with AAAs from April 2002 to August 2015. Ninety-two patients underwent open repair with the reconstruction of the iliac arterial lesions; among whom five patients needed clamping of the suprarenal aorta. The remaining 87 were included in the present study. Forty-three patients underwent open repair using multifurcated vascular grafts including 23 patients who underwent reconstruction of the unilateral IIA and twenty who underwent reconstruction of bilateral IIA. Forty-four patients underwent open repair using composite grafts combined with Y-shaped and straight vascular grafts, including forty patients with unilateral and four with bilateral IIA reconstruction. We compared the multifurcated vascular graft (M) and composite graft (C) groups among all patients, and also compared the multifurcated vascular graft (MU) and composite graft (CU) groups among patients who underwent unilateral IIA reconstruction.
groups among patients who underwent unilateral IIA reconstruction.

We reviewed all clinical data retrospectively. Preoperative renal disease was defined as creatinine level >2.0 mg/dL or nephropathy. Preoperative pulmonary disease comprised chronic obstructive pulmonary disease including emphysema and bronchial asthma treated with steroids. Postoperative renal failure was defined as new creatinine level >2.0 mg/dL or >1.5-fold higher than the preoperative level and requiring hemodialysis. Individual consent for later retrospective studies was obtained at the same time as consent for vascular surgery. This retrospective study was approved by the Institutional Review Board of Osaka City Medical School Hospital and complied with the current ethical guidelines according to the standards of the Helsinki Declaration.

**Treatment for aneurysms**

Surgical indications were iliac artery aneurysm >3 cm and AAA >5 cm or a dilatation rate of >5 mm/½ year. All patients were assessed by computed tomography (CT) angiography. The indication for IIA reconstruction at our institution was as follows: (1) common iliac artery aneurysm or stenosis associated with difficulty in anastomosis to iliac bifurcation; (2) IIA aneurysm located in relatively shallow pelvic floor, allowing reconstruction of distal IIA; and (3) external iliac artery stenosis or aneurysm. Patients with an IIA aneurysm located in the deep pelvic floor associated with difficulty in internal iliac or gluteal artery reconstruction underwent coil embolization for IIA aneurysm under local anesthesia in the fluoroscopy room before open repair. The common femoral artery approach was frequently used with the Seldinger technique. Draining arteries of the IIA aneurysm were occluded as proximally as possible with coils (Tornado or MReye embolization coil; Cook Medical, Bloomington, IN, USA) or vascular plugs (Amplatzer™ Vascular Plug II, St. Jude Medical, St. Paul, MN, USA).

Open repair was carried out under general anesthesia. The day before the operation, patients with low risk of bleeding and no previous antplatelet therapy underwent insertion of an epidural tube under local anesthesia. Epidural anesthesia with ropivaaine hydrochloride hydrate was administered for 2 days following open repair. All patients underwent vascular graft replacement through laparotomy under systemic heparinization.

Until 2009, we used the composite grafts. From 2010, we used the multifurcated or composite grafts. In the M group, trifurcated or quadrifurcated InterGard vascular grafts (Maquet Holding B.V. and Co.) were used. Figure 1 shows the types of peripheral arterial anastomosis in the M group. Trifurcated and quadrifurcated vascular grafts are shown in Figure 1a-f, respectively. External iliac artery reconstruction involved two types of anastomoses: End-to-end anastomosis in the proximal external iliac artery [Figure 1a, b, d, and e] and end-to-side anastomosis in the distal external iliac artery when the proximal external iliac artery had severe atherosclerosis [Figure 1c and f]. In the case of IIA aneurysms that underwent preceding coil embolization, the IIA aneurysm was closed after confirming that there was no flow from the draining arteries. Reconstruction of the inferior mesenteric artery was performed first, and a composite graft was then established by side-to-end anastomosis between the Y-shaped vascular graft leg and the straight vascular graft leg by end-to-end anastomosis [Figure 1d]. In the C group, the surgeon decided which type of Y-shaped vascular prosthesis to use (Hemashield Platinum or InterGard; Maquet Holding B.V. and Co. KG, Rastatt, Germany). A straight expanded polytetrafluoroethylene or InterGard vascular graft was used for IIA reconstruction. Anastomosis of the IIA using a straight vascular graft was performed first, and a composite graft was then established by side-to-end anastomosis between the Y-shaped vascular graft leg and the straight vascular graft anastomosed to the IIA because of preventing kinking or stenosis of the anastomosis between the grafts. Figure 2 shows the types of peripheral arterial anastomosis in the C group.

After open repair, patients underwent CT or CT angiography before discharge, and physical examination at 1, 3, and 6 months, and 1 and 2 years after discharge. CT angiography was performed to identify the patency of the bypass grafts at 1 and 2 years after open repair in patients with no renal diseases or allergy to contrast agent.

**Statistical analysis**

Data were analyzed using the statistical software “EZR” (Easy R) based on R and R commander. Numerical variables were expressed as a mean ± standard deviation.
deviation and were analyzed using nonparametric Mann–Whitney U-test. Categorical variables were expressed as the numbers or percentages of patients and were compared using Chi-square or Fisher’s exact tests, as appropriate. Propensity score matching was used to compare the CU and MU groups in patients who underwent reconstruction of unilateral IIA, according to preoperative variables. Free from the occlusion of reconstructed IIA was generated with Kaplan–Meier method. The log-rank test was used to compare the differences in the graft patency rate of IIA between the groups. Significance was set at $P < 0.05$.

**Results**

**Comparison between C and M groups**

Table 1 summarizes the pre-, intra-, and post-operative data for all patients. Preoperatively, the M group included significantly more patients with hyperlipidemia and previous laparotomy compared with the C group, but there were no differences in other preoperative or in intra- or post-operative parameters. During hospitalization for open repair, four and two patients in the C and M groups, respectively, required additional interventions for vascular disease. Two patients in the C group underwent femorofemoral artery bypass or common iliac to femoral artery bypass because of external iliac artery dissection or occlusion by injury, one patient underwent thrombectomy for limb ischemia because of intraoperative thromboembolization, and one patient underwent percutaneous transluminal angioplasty for external iliac artery stenosis postoperatively. Two patients in the M group underwent femorofemoral artery bypass because of external iliac artery stenosis or occlusion by injury intra- or postoperatively. There were no hospital deaths in either group. Postoperative complications occurred in 13 (30%) and 11 (26%) patients in the C and M groups, respectively, with no significant difference between the groups. One

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**Table 1: Pre-, intra, and post-operative parameters in all patients**

| Preoperative data          | C group (n=44) | M group (n=43) | $P$  |
|----------------------------|---------------|---------------|-----|
| Age, years                 | 73.3±9.0      | 73.5±7.9      | 0.92|
| Sex, male                  | 41            | 35            | 0.12|
| BMI                        | 22.9±2.6      | 22.6±2.9      | 0.66|
| Hypertension               | 34            | 31            | 0.63|
| Hyperlipidemia             | 9             | 18            | 0.038|
| Diabetes mellitus          | 6             | 8             | 0.57|
| Smoking                    | 34            | 33            | >0.99|
| Pulmonary diseases         | 9             | 10            | 0.80|
| Renal diseases             | 9             | 5             | 0.38|
| Hemodialysis               | 1             | 2             | 0.62|
| Cardiac diseases           | 17            | 15            | 0.83|
| ASO                        | 4             | 0             | >0.99|
| Cerebral diseases          | 8             | 7             | >0.99|
| Previous laparotomy        | 5             | 15            | 0.011|
| Previous laparoscopic surgery | 5         | 5             | >0.99|
| Use of steroids            | 3             | 5             | 0.48|
| Platelet count, $\times 10^4/\mu$L | 19.5±6.3 | 17.9±4.5      | 0.30|
| FDP, $\mu$g/mL             | 16.3±21.4     | 11.5±11.2     | 0.73|

| Intra- and post-operative data | | |
| Operation time, min          | 267±72        | 268±71        | 0.75|
| Operative blood loss, mL     | 845±620       | 872±694       | 0.97|
| Transfusion volume (U)       | RBC           | 4.5±4.0       | 3.7±3.2       | 0.40|
|                               | FFP           | 2.5±3.4       | 2.8±3.2       | 0.53|
|                               | Platelet transfusion | 4     | 4           | >0.99|
|                               | IMA reconstruction | 4     | 6           | 0.52|
|                               | Intraoperative additional vascular surgery | 4 | 2 | 0.68|
| Hospital stay, days          | 19.0±9.8      | 24.6±21.1     | 0.34|
| Mortality                   | 0             | 0             | NS|
| Complications               | 13            | 11            | 0.81|
| Arterial injury             | 2             | 4             | 0.43|
| Ischemic heart disease      | 0             | 1             | 0.49|
| Renal failure               | 3             | 3             | >0.99|
| New hemodialysis            | 0             | 1             | 0.49|
| Hydronephrosis              | 1             | 0             | >0.99|
| Sepsis                      | 0             | 1             | 0.49|
| Pneumonia                   | 1             | 2             | 0.62|
| Tracheotomy                 | 0             | 1             | 0.49|
| Ischemic colitis            | 1             | 1             | >0.99|

Contd...
patient in each group had ischemic colitis with diarrhea and bloody stools, treated conservatively although there was no IIA occlusion by CT angiography and the cause remained unclear. No patients in either group had buttok claudication. After discharge, one patient in each group required femorofemoral artery bypass for vascular leg occlusion as a result of injury to the external iliac artery or peripheral anastomosis site. We underwent follow-up CT angiography in 25 and 24 patients in the C group, and 24 and 23 in the M group, at 1 and 2 years after open repair, respectively. Follow-up CT angiography showed no occlusion of the bypass graft between the groups. Kaplan–Meier curve shows the graft patency rate of IIA between the two groups [Figure 3].

Comparison between CU and MU groups

Table 2 summarizes the pre-, intra-, and post-operative data for patients who underwent unilateral IIA reconstruction. There were significant differences in sex and previous laparotomy between the two groups, but no differences in intraoperative parameters between the groups. During hospitalization for open repair, three patients in the CU group required additional interventions for vascular disease, compared with none in the MU group though the difference was not significant. Two patients in the CU group underwent femorofemoral artery bypass or common iliac to femoral artery bypass because of external iliac artery dissection or occlusion by injury, and one patient underwent thrombectomy for limb ischemia because of intraoperative thromboembolization. Postoperative complications occurred in ten (25%) and six (26%) patients in the CU and MU groups, respectively, with no significant difference between them. In terms of postoperative data, hospital stay was significantly longer in the MU compared with the CU group because MU group had a patient who developed severe complications consisted of tracheotomy by pneumonia and shower embolization, which required the long hospital stay. After discharge, one patient in each group required femorofemoral artery bypass for vascular leg occlusion as a result of injury to the external iliac artery or anastomosis site. Follow-up CT angiography after open repair showed no occlusion of the bypass graft to the IIA in 23 patients in the CU group and 14 in the MU group. Preoperative and perioperative data after propensity score matching are summarized in Table 2. In propensity score matching analysis among patients according to preoperative variables, 22 patients were extracted each group. Operation time and hospital stay were similar in both groups. Postoperative complications occurred in nine (41%) and five (23%) patients in the CU and MU groups, respectively. Postoperative complications occurred in nine (41%) and five (23%) patients in the CU and MU groups, respectively, with no significant difference between them. After discharge, one patient in MU group required femorofemoral artery bypass for vascular leg occlusion as a result of injury to the external iliac artery. Follow-up CT angiography after open repair showed no occlusion of the bypass graft to the IIA in 12 patients in the CU group and 11 in the MU group.

Discussion

AAA with iliac arterial lesions is not rare, and approximately 20%–25% of patients with AAA have associated common iliac artery aneurysms. Open repair for AAA with iliac arterial lesions is thus performed in a relatively large number of patients, with expanding opportunities to undergo IIA reconstruction to prevent troublesome complications such as intestinal ischemia, buttock claudication, and spinal cord injury. Composite grafts have been used to reconstruct the IIA in open repair. Multifurcated vascular grafts have also been used recently, with favorable results, and are expected to have more opportunities in AAAs with iliac arterial lesions. However, the relative outcomes of multifurcated and composite grafts for open repair in patients with AAAs with iliac arterial lesions remain unclear. The present retrospective study, therefore, compared the outcomes of
Table 2: Pre-, intra-, and post-operative parameters in patients who underwent unilateral internal iliac artery reconstruction

| Parameter                                                                 | CU group (n=40) | MU group (n=23) | P     | After PS matching | CU group (n=22) | MU group (n=22) | P     |
|---------------------------------------------------------------------------|-----------------|-----------------|-------|-------------------|-----------------|-----------------|-------|
| **Preoperative data**                                                     |                 |                 |       |                   |                 |                 |       |
| Age, years                                                                | 73.4±9.2        | 75.3±7.9        | 0.42  |                   | 74.3±7.1        | 75.2±8.1        | 0.63  |
| Sex, male                                                                 | 37              | 16              | 0.029 |                   | 21              | 16              | 0.095 |
| BMI                                                                       | 22.9±2.6        | 23.0±3.5        | 0.83  |                   | 23.1±2.7        | 22.8±3.5        | 0.83  |
| Hypertension                                                              | 31              | 17              | 0.77  |                   | 18              | 16              | 0.72  |
| Hyperlipidemia                                                            | 8               | 10              | 0.081 |                   | 8               | 9               | >0.99 |
| Diabetes mellitus                                                         | 5               | 5               | 0.48  |                   | 4               | 5               | >0.99 |
| Smoking                                                                   | 30              | 20              | 0.34  |                   | 15              | 19              | 0.28  |
| Pulmonary diseases                                                        | 8               | 4               | >0.99 |                   | 5               | 4               | >0.99 |
| Renal diseases                                                            | 7               | 4               | >0.99 |                   | 3               | 3               | >0.99 |
| Hemodialysis                                                              | 1               | 2               | 0.55  |                   | 0               | 1               | >0.99 |
| Cardiac diseases                                                          | 14              | 7               | 0.79  |                   | 9               | 7               | 0.76  |
| ASO                                                                       | 3               | 3               | 0.29  |                   | 0               | 0               | >0.99 |
| Cerebral diseases                                                         | 5               | 4               | 0.71  |                   | 4               | 4               | >0.99 |
| Previous laparotomy                                                       | 5               | 9               | 0.026 |                   | 5               | 9               | 0.54  |
| Previous laparoscopic surgery                                             | 5               | 2               | >0.99 |                   | 3               | 2               | >0.99 |
| Use of steroids                                                           | 3               | 2               | >0.99 |                   | 1               | 2               | >0.99 |
| Platelet count, ×10^4/µL                                                  | 19.7±6.2        | 17.9±4.7        | 0.38  | 17.6±4.8          | 18.2±4.7        | 0.62            |
| FDP, µg/mL                                                                | 15.9±21.6       | 13.2±14.1       | >0.99 | 20.0±27.2         | 13.4±14.4       | 0.79            |
| **Intra- and postoperative data**                                         |                 |                 |       |                   |                 |                 |       |
| Operation time, min                                                       | 266±75          | 279±81          | 0.32  | 282±79            | 276±82          | 0.87            |
| Operative blood loss, mL                                                  | 845±640         | 1008±842        | 0.59  | 980±707           | 982±853         | 0.83            |
| Transfusion volume (U)                                                    |                 |                 |       |                   |                 |                 |       |
| RBC                                                                       | 4.6±4.0         | 4.3±3.4         | 0.86  | 5.4±3.7           | 4.2±3.4         | 0.26            |
| FFP                                                                       | 2.4±3.5         | 3.2±3.8         | 0.35  | 2.9±3.8           | 3.4±3.8         | 0.62            |
| Platelet transfusion                                                      | 4               | 3               | 0.70  | 2                 | 2               | >0.99           |
| IMA reconstruction                                                        | 3               | 4               | 0.25  | 2                 | 3               | >0.99           |
| Intraoperative additional vascular surgery                                 | 3               | 0               | 0.29  | 2                 | 0               | 0.49            |
| Hospital stay, days                                                       | 18.9±9.7        | 32.1±26.1       | 0.002 | 20.8±10.5         | 29.2±22.6       | 0.16            |
| Mortality                                                                 | 0               | 0               | NS    | 0                 | 0               | NS              |
| Complications                                                             |                 |                 |       |                   |                 |                 |       |
| Arterial injury                                                           | 10              | 6               | 0.44  | 9                 | 5               | 0.32            |
| Ischemic heart disease                                                    | 2               | 1               | >0.99 | 1                 | 1               | >0.99           |
| Renal failure                                                             | 2               | 2               | 0.62  | 2                 | 2               | >0.99           |
| New hemodialysis                                                          | 0               | 1               | 0.37  | 0                 | 1               | >0.99           |
| Hydronephrosis                                                            | 1               | 0               | >0.99 | 1                 | 0               | >0.99           |
| Sepsis                                                                    | 0               | 1               | 0.37  | 0                 | 1               | >0.99           |
| Pneumonia                                                                 | 0               | 2               | 0.13  | 0                 | 2               | 0.49            |
| Tracheotomy                                                               | 0               | 1               | 0.37  | 0                 | 0               | NS              |
| Ischemic colitis                                                          | 1               | 1               | >0.99 | 1                 | 1               | >0.99           |
| Paralytic ileus                                                           | 1               | 2               | 0.55  | 0                 | 2               | 0.49            |
| Cholecystitis                                                             | 1               | 0               | >0.99 | 1                 | 0               | >0.99           |
| Arterial embolization                                                     | 3               | 1               | >0.99 | 0                 | 3               | 0.23            |
| Surgical site infection                                                   | 5               | 4               | 0.71  | 2                 | 4               | 0.66            |
| Postoperative maximum creatinine, mg/dL                                    | 1.20±0.43       | 1.88±2.09       | 0.83  | 1.22±0.43         | 1.61±1.69       | 0.85            |
| Abdominal incision hernia                                                 | 2               | 2               | 0.62  | 2                 | 2               | >0.99           |
| Postoperative additional vascular surgery                                  | 1               | 1               | >0.99 | 0                 | 1               | >0.99           |

ASO: Atherosclerosis obliterans, BMI: Body mass index, FDP: Fibrin degradation products, FFP: Fresh frozen plasma, IMA: Inferior mesenteric artery, NS: Not significant, PS: Propensity score, RBC: Red blood cell
multifurcated and composite graft replacement for AAAs with iliac arterial lesions.

The results of the present study showed similar outcomes of multifurcated and composite grafts in patients with AAAs and iliac arterial lesions, with no significant differences after propensity score matching. The actual anastomosis time between prosthetic grafts was approximately 10 min; however, operation time is affected by factors other than anastomosis time such as releasing tissues and stopping bleeding, and we were thus unable to determine the effect of multifurcated vascular grafts on operation time in the present study. However, multifurcated vascular grafts had some advantages including reducing the ischemic time of branch arteries by decreasing the number of anastomoses and sequential clamp release. Furthermore, the multifurcated vascular grafts also had flexibility with a stable joint, thus preventing stenosis between the grafts and enabling anastomosis of other branches such as the renal artery and inferior mesenteric artery, using the spare legs. Although there were no significant differences in outcomes between the multifurcated and composite vascular grafts in this study, multifurcated vascular grafts may thus provide decreased the number of steps.

Reconstruction of the IIA is important to prevent pelvic ischemia caused by occlusion of the IIA. Notably, intestinal ischemia is a lethal complication as demonstrated by recent studies showing an incidence of 1.2%–4.5% in aortoiliac surgery and high mortality. Furthermore, buttock claudication is troublesome for some patients though its symptoms may gradually improve over time. Previously, endovascular aneurysm repair (EVAR) for AAA with iliac artery aneurysm required embolization of the IIA by coils or plugs to prevent endoleak though coil embolization was associated with a relatively higher risk of buttock claudication than preserving IIA flow. EVAR with iliac branch devices has recently been used in AAA with iliac arterial lesions and can resolve the pelvic ischemia caused by IIA occlusion. Furthermore, a recent study reported that EVAR provided favorable results of lower postoperative morbidity and mortality compared with open repair. EVAR with iliac branch devices may thus be a favorable option for AAA with iliac arterial lesions. However, EVAR is precluded in patients with anatomically difficult arteries such as severe angulated aorta, short landing zone, small access root, or shaggy aorta. Moreover, long-term complications associated with endoleaks after EVAR are a major concern. Therefore, open repair may be still needed as an alternative treatment for AAA with iliac arterial lesions.

Hospital complications after open repair for AAA have been reported in about 5%–25% of cases, with a relatively low mortality of 2%–3%. However, aneurysmal involvement of the iliac bifurcations is associated with increased mortality and morbidity after open repair because of technical challenges posed by the deep pelvic location associated with ureteric and iliac vein injuries. There was no mortality in the present study though the rate of postoperative complications was relatively high after open repair because of the inclusion of iliac arterial lesions. Although IIA reconstruction can reduce pelvic ischemia, two patients in the present study had ischemic colitis despite IIA reconstruction. Both patients had similar symptoms including diarrhea with bloody stools, treated conservatively, with no signs of IIA occlusion by CT angiography. A recent report suggested that a few patients develop ischemic colitis associated with microembolization from external manipulation of aneurysm or greater blood loss and a longer clamping time, after open repair of AAAs with iliac arterial lesions. The cases of mild ischemic colitis in the present study may have been associated with compensable transient ischemia caused by greater blood loss or a longer clamping time, rather than by microembolization. However, no other incidences of pelvic ischemia, such as spinal cord injury or buttck claudication, occurred in the present study. These results suggest that open repair with reconstruction of the IIA provided satisfactory results at our institution.

In IIA reconstruction surgery, good anastomosis between the graft and distal IIA before the anastomosis between the grafts helps to ensure a good graft anastomosis and course to prevent stenosis. However, multifurcated vascular grafts have preanastomosed legs, which may lead to difficulties in terms of the anastomosis between the graft and native artery. However, a stable joint between graft legs prevents graft stenosis and provides a stable anastomosis between the graft and native artery by coordinating the course of the graft. In the present study, we did not experience any difficulty in creating the anastomosis between the graft and IIA, and graft patency was similar for the multifurcated and composite grafts. Multifurcated vascular grafts may thus offer an alternative tool, with no significant technical problems.

There are some limitations to the present study. It is possible that other inherent factors may have influenced the compared outcomes between the two types of grafts. Open repair for AAA with iliac arterial lesions was performed by a few different surgeons, which may have affected the operation time and clinical course. However, technical operating procedures are standardized throughout our institution under consistent operating strategy, and propensity score matching would be expected to reduce the effects of inherent factors. After propensity score matching, there was no significant difference in outcomes between multifurcated and composite grafts. This suggests that multifurcated vascular grafts have the potential to ensure easy coordination of the course of the graft legs and good anastomosis without graft-joint issues, with opportunities and similar outcomes to composite grafts.

Conclusion

Multifurcated vascular grafts can produce similar outcomes to composite grafts for open repair of AAAs with iliac
arterial lesions. However, multifurcated vascular grafts may reduce the number of steps required that associated with the surgeon's burden although we failed to show the usefulness of multifurcated vascular grafts compared to composite grafts.

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**Conflicts of interest**
There are no conflicts of interest.

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