

From the Western Vascular Society

Long-term durability of Oakes salvage procedure to preserve Brescia-Cimino arteriovenous fistula

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ABSTRACT

Background: In 2002, Oakes et al described a novel procedure designed to salvage the distal cephalic venous outflow of a Brescia-Cimino fistula by placing a prosthetic graft between the brachial artery in the antecubital space and the cephalic vein at the wrist. In this fashion, the more proximal veins were saved for future procedures. Their approach was reported and found to be successful in the short term, but the long-term durability of the Oakes procedure has not been described. This study aimed to determine the long-term primary, primary-assisted, and secondary patency rates of the brachial to distal cephalic vein Oakes procedure.

Methods: This is a retrospective review of a prospective database in a large, single institution. All patients who underwent the Oakes procedure from 1998 to 2012 were followed up to 2018. We reviewed the time to intervention, type of intervention, patency rates, and mortality of this patient population.

Results: Over the 5-year study period, 14 patients were identified who underwent the Oakes procedure, of whom seven (50%) were female. The average age was 55.7 years (range, 38-73 years). All patients had a previously placed Brescia-Cimino that was not suitable for dialysis but was patent. The average number of days to placement of an Oakes brachial to distal cephalic graft was 396 (range, 119-1167) days. A total of 71% (10) of patients underwent an intervention to maintain the graft, of whom 50% (5) underwent an angioplasty and 50% (5) had a thrombectomy/revision procedure. The average number of days to first intervention was 367.3 (range, 21-1048) days from Oakes placement. Of this cohort, 30% (3) of patients had a second intervention, of whom 1 (33%) underwent an angioplasty and 2 (66%) had revisions. One patient had a third and a fourth intervention at 39 days and 74 days, respectively, that were both angioplasties. The overall number of days the Oakes procedure remained usable from placement was 843.6 (range, 21-3790) days or 2.3 years.

Conclusions: This study concluded that the Oakes procedure may extend the use of the distal dialysis access site by 2.3 years without increasing infection and is hence a durable solution that should be considered in patients requiring dialysis access. (*J Vasc Surg* 2019;■:1-5.)

Keywords: Hemodialysis; Oakes procedure; Maturation of cephalic vein

The Brescia-Cimino fistula is considered the initial access of choice for chronic hemodialysis.^{1,2} Once mature, these distal forearm fistulas are durable, easy to use, and have a low complication rate.^{3,4} However, early failure rates can be high,³ particularly in the age of the Fistula First Initiative with aggressive attempts at distal, autologous arteriovenous fistula (AVF) formation

as the initial attempt. In cases of failure, these fistulas are typically abandoned for more proximal access. Fistulas may fail for a variety of reasons revolving around lack of adequate outflow or inflow. Why a fistula is failing forms the basis for possible intervention that may lead to salvage of the access site. A number of salvage procedures have been described.⁵⁻⁷

The radiocephalic fistula is an ideal initial autologous option; however, the Brescia-Cimino fistula has a high failure rate due to thrombosis or failure to mature. In the latter cohort, the fistula may remain patent but have inadequate placement or size to be able to successfully cannulate for dialysis. Historically in this situation, these access sites were abandoned and more proximal access was obtained. In 2002, we described a novel salvage procedure that places a graft from the antecubital brachial artery to the most distal dilated segment of the cephalic vein at the wrist.⁸

This Oakes procedure was designed to salvage the distal cephalic venous outflow of a Brescia-Cimino fistula by placing a prosthetic graft between the brachial artery in the antecubital space and the cephalic vein at the wrist. In this fashion, the more proximal veins were saved

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for future procedures. The initial series was successful but limited by follow-up duration. We now describe our long-term results with this cohort regarding primary, primary-assisted, and secondary patency rates.

METHODS

The Oakes procedure involves placement of a prosthetic graft (polytetrafluoroethylene [PTFE] or bovine arterial heterograft) from the brachial artery in the antecubital space to the most distal dilated segment of the cephalic vein at the wrist. An anastomosis is created with the beveled end of the graft to the cephalic vein. The cephalic vein is ligated distally to prevent competing arterial inflow from the original radial anastomosis. Once the brachial artery is exposed in a transverse fashion, the graft is tunneled in an arc, from the ulnar side of the forearm to the distal radial site of the original radiocephalic anastomosis. This placement aims to allow easier conversion to a loop configuration when the venous segment ultimately fails. Both the Oakes graft and the newly matured vein can be cannulated for dialysis access allowing for a wider area for needle placement.

The Oakes procedure was performed on 14 patients at a large volume, single institution between December 1998 and November 2012. This procedure was performed in any patients with a radiocephalic fistula at the wrist that was not adequate for use due to inadequate dilation of the outflow vein. All patients underwent a duplex and fistulogram before being offered the Oakes salvage procedure. The initial patient cohort collected between 1998 and 2012 were followed up through 2018 (5-year follow-up period).

Data points included demographics, postoperative days to intervention, intervention type, the number of interventions, patency, and infection rates. Oakes access length of duration was identified by noting the date of new dialysis access use and subtracting that from the date of the Oakes procedure.

Consent was not obtained or required from patients as this was deidentified data. This study was reviewed and approved by the institutional review board at Stanford University.

RESULTS

Over the 5-year follow-up study period, 14 patients had Brescia-Cimino fistulas who underwent an Oakes procedure. All initial radiocephalic fistulas were patent but not suitable for dialysis due to the inadequacy of the outflow vein based on duplex and fistulogram. Of the 14 patients, 7 (50%) were women, and ages ranged from 38 to 73 years (median, 57.5 years). Five patients were Asian, 4 Hispanic, 3 white, and 2 black. The causes of end-stage renal disease were diabetic nephropathy (7), hypertension (5), polycystic kidney disease (1), and unknown (1).

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective cohort study
- **Key Findings:** A total of 14 patients underwent placement of a prosthetic graft between the antecubital brachial artery and the most distal dilated portion of the cephalic vein, to salvage venous outflow of a nonfunctioning Cimino-Brescia shunt (Oakes procedure). The distal access site was used for dialysis for 2.3 years (range, 21-3790 days). There was no graft infection.
- **Take Home Message:** The Oakes procedure successfully salvaged the distal cephalic vein in this study for durable access in patients with failed Brescia-Cimino shunt.

The average number of days to the placement of an Oakes brachial to distal cephalic graft after an initial fistula was 396 days (range, 119-1167 days). A total of 71% (10) of patients underwent an intervention to maintain the graft, of whom 50% (5) underwent an angioplasty and 50% (5) had a thrombectomy/revision procedure. The average number of days to first intervention was 367.3 (range, 21-1048) days from Oakes placement. Of this cohort, 30% (3) of patients had a second intervention, of whom one (33%) underwent an angioplasty and two (66%) had revisions. One patient had a third and a fourth intervention at 39 days and 74 days, respectively, that were both angioplasties (Fig 1). The majority of angioplasties were performed adjacent to the anastomosis. The overall number of days the Oakes procedure remained usable from placement was 843.6 (range, 21-3790) days or 2.3 years. There were no deaths attributable to the fistula procedure nor were there any infections reported in this cohort. No patients were lost to follow-up; the mean follow-up time was 3.6 years.

DISCUSSION

In this study, we describe our long-term patency and outcomes with the Oakes procedure as a method to salvage and prolong Brescia-Cimino fistula access in patients on chronic hemodialysis. The initial study reviewed short-term data; however, our study evaluated the Oakes procedure performed in patients as early as 1998 and followed to 2018.

For patients on chronic hemodialysis, vascular access preservation is essential. The Brescia-Cimino fistula (radiocephalic) is still considered the first choice for initial dialysis access.^{1,2,9} Because of its distal nature and therefore ability to preserve future access site options, the Brescia-Cimino fistula also has a lower rate of steal syndrome,³ longer patency,^{3,10} and lower complication rates including infection risk.^{3,4,11} However, there are also drawbacks as Brescia-Cimino fistulas often fail to mature.^{3,12} In

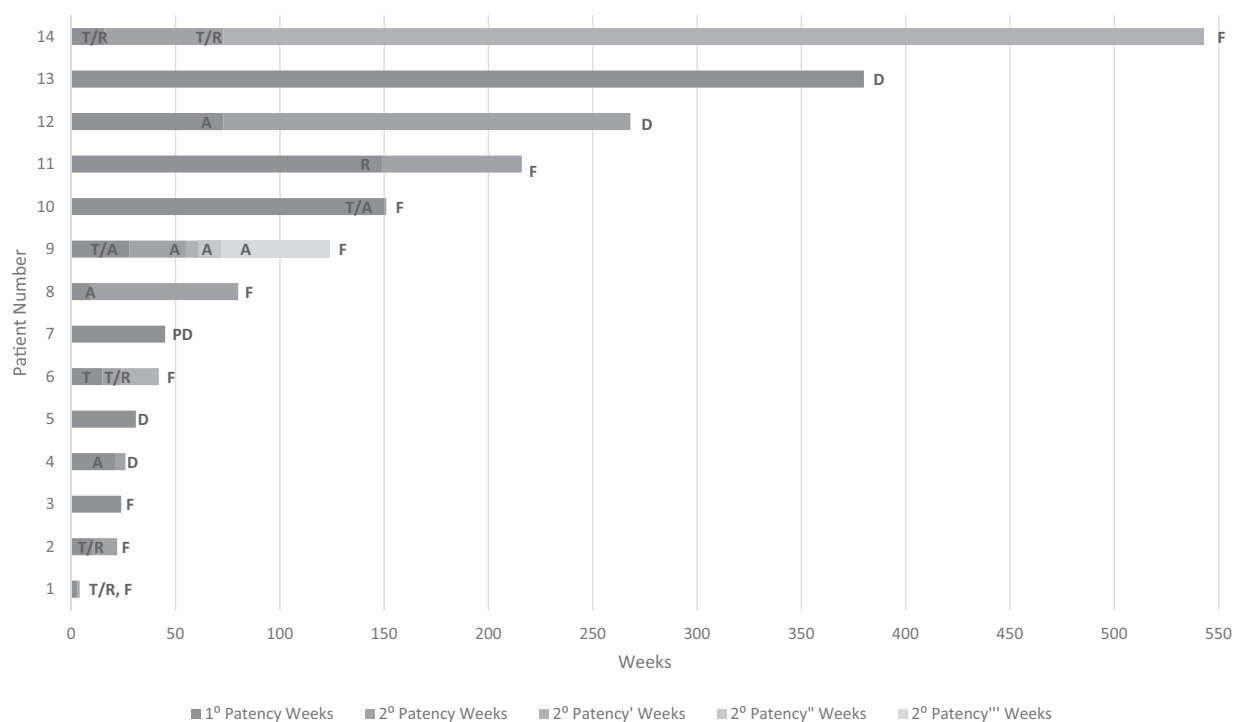


Fig 1. Overall patency results. Primary patency rate includes one case of primary-assisted patency at 14 weeks (patient 14 underwent prophylactic angioplasty for stenosis without thrombosis). 2° Patency', 2° Patency'', and 2° Patency''' refer to secondary-assisted patency. The reasons for intervention or access abandonment are noted at the end of each bar, and combined interventions are noted with a slash (eg, A/T, Angioplasty and thrombectomy); angioplasty (A), death (D), failure (F), revision (R), thrombectomy (T), and switched to peritoneal dialysis (PD).

addition, when these fistulas fail, most are abandoned for more proximal access.

Although the Society for Vascular Surgery recommends autogenous access above all prosthetic access, the one exception in the clinical practice guidelines is for access in the forearm. In the 2008 guidelines, the committee suggested that patients be given a choice between placing a forearm prosthetic or proceeding to the upper arm for autogenous access.² Although the infection risk can be higher with prosthetic use,¹³ this technique allows continued forearm use with preservation of the upper arm for the future. Also, the benefit of an autologous fistula over a prosthetic graft can be negligible when compared with prolonged catheter use,^{14,15} which might be necessary while waiting for autogenous access to mature.

We first described our experiences with the Oakes procedure in 2002, and showed that we could preserve forearm access in patients who otherwise would require proximal arm access.⁸ This procedure involves continued use of the cephalic vein at the wrist but with a new inflow source more proximally from the brachial artery (Figs 2-4). When the radiocephalic fistula is noted to be failing because of inflow issues related to a stenosed radial artery, this new connection allows for salvage of the distal cephalic segment saving anticubital fistula creation for a later date (Fig 5). If the radial artery is patent proximally, then proximalization of the cephalic vein may be



Fig 2. Incision sites and tract of graft for the Oakes procedure—brachial cutdown for inflow and cephalic vein at the wrist for outflow.

sufficient to allow for maturation and AVF use, but if inflow is a concern throughout the length of the radial artery, then the Oakes procedure is appropriate (Fig 6).

Other techniques for salvage have been described as well.⁵⁻⁷ Won et al⁶ described the creation of an AVF with an expanded PTFE graft to the deep forearm veins for outflow. They reported 93% patency at 3 months

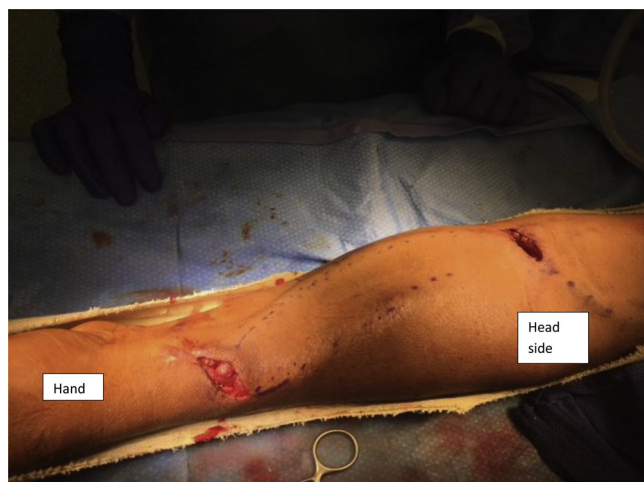


Fig 3. Oakes procedure—graft from brachial artery inflow to distal cephalic vein outflow in a gentle arc to allow for a large access segment.



Fig 4. Completion of the Oakes procedure at follow-up.

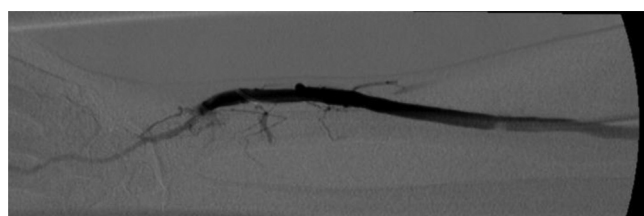


Fig 5. Fistulogram of stenosis at a radiocephalic fistula.

and 80% at 12 months.⁶ Similar to the Oakes procedure, Won et al⁶ used the brachial artery rather than the radial artery for inflow but created the anastomosis to the more proximal deep veins of the forearm. In comparison, the Oakes procedure remains more distal in the arm.⁶

Another salvage procedure, the NEO procedure, creates a more proximal neanastomosis on the radial artery using patent forearm vein.^{3,16} At 12 months, Mallik et al³ reported 87.3% secondary patency of the NEO procedure

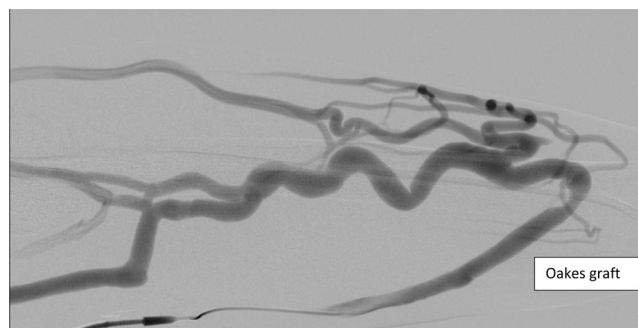


Fig 6. Fistulogram of the Oakes procedure.

when used to salvage a Brescia-Cimino fistula. Again, this procedure does not require moving more proximally on the forearm than the Oakes procedure; however, it only uses autologous tissue. Using autologous tissue in salvage procedures still requires time for the salvage procedure to mature. In addition, when used for salvage procedures, PTFE has compared favorably with purely autologous repairs with regard to patency and infection.¹⁷

In our patients, follow-up was every 6 months with a duplex for the first year and then as needed based on whether the dialysis center noticed fluctuations in the flow volume during cannulation. Indications for reintervention included reduced flow volumes, high pressures or low pressures during cannulation, difficulty in curtailing bleeding from cannulation sites, or pulsatility of the graft. Although all Oakes procedures ultimately fail requiring loop grafts or new AVF access at the antecubital region, the Oakes procedures allowed for use of the distal cephalic vein for an extended period.

Limitations. We are limited by our small cohort and the retrospective nature of this study. Despite the small number of patients, this method is likely applicable to most patients due to wide inclusion criteria used by the original surgeons. They aggressively approached Brescia-Cimino fistula placement regardless of patient demographics or preoperative studies. Our long-term follow-up also extends past the life of most fistulas.

CONCLUSIONS

The Oakes procedure extended the use of a forearm dialysis access site in our cohort by 2.3 years without increasing infection rates. The Oakes procedure appears to be a durable solution that should be considered in patients with patent but unusable Brescia-Cimino fistulas. By using the original venous outflow, this procedure preserves the more proximal veins for future access placement, and may therefore positively impact patient life.

AUTHOR CONTRIBUTIONS

Conception and design: AD, KR, KL, DO, ES, MG
Analysis and interpretation: DO, MG
Data collection: AD, KR, KL, ES, MG

Writing the article: AD, KR, KL, DO, ES, MG
 Critical revision of the article: AD, KR, KL, DO, ES, MG
 Final approval of the article: AD, KR, KL, DO, ES, MG
 Statistical analysis: Not applicable
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 Overall responsibility: MG

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