

Feasibility of patchless proximal profundoplasty and common femoral endarterectomy

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Background: Typical repair of common femoral artery (CFA) occlusive disease involves surgical endarterectomy followed by patch closure; however, prosthetic materials may become infected. In addition, in our institution, we have experienced an increased incidence of severe patch-related restenosis. We describe a technique for CFA endarterectomy and patchless proximal profundoplasty, and evaluate its feasibility.

Methods: We performed a single-centre retrospective cohort study of patients who, between July 1, 2020, and June 30, 2021, underwent a procedure that consisted of transection of the superficial femoral artery (SFA) off the femoral bifurcation in a bevelled manner, eversion endarterectomy of the SFA, remote-type endarterectomy of the CFA, direct visualization of the end point in the profunda femoris artery (PFA) with a longitudinal arteriotomy extension if needed and reimplantation of the SFA “hood” as a patch. We collected clinical information and outcomes from the patients’ charts.

Results: Ten patients who underwent a patchless profundoplasty procedure during the study period were identified. Indications for repair included tissue loss (3 patients), rest pain (2 patients), claudication (3 patients) and establishing access for other procedures (2 patients). Profunda femoris artery arteriotomy extensions were used in 5 cases. Six cases included simultaneous iliac or infrainguinal revascularization. All cases were technically successful. There was 1 intraoperative complication of remote tibial balloon angioplasty tear. The mean follow-up time was 199 (range 29–381) days. There were no surgical site infections. All patients were asymptomatic, with patent CFAs, at last follow-up. There was 1 case of surgical site restenosis and 1 reintervention for remote stenosis. The average increase in ankle and toe brachial indices was 44% and 75%, respectively. One patient was readmitted for gastrointestinal bleeding. One patient died from an acute myocardial infarction, on postoperative day 34.

Conclusion: The patchless profundoplasty technique is feasible and results in autologous anatomic repair of CFA disease without the need for vein, and allows direct visualization and tacking sutures of the proximal PFA. This technique may replace the ubiquitous vascular procedure of patch arterioplasty of the CFA, depending on the anatomic configuration.

Contexte : La réparation de l’occlusion de l’artère fémorale commune (AFC) repose généralement sur l’endartériectomie chirurgicale avec fermeture par patch, mais les matériaux des patchs prothétiques peuvent s’infecter. De plus, dans notre établissement, nous avons observé une incidence accrue de grave resténose liée aux patchs. Nous décrivons ici une technique d’endartériectomie de l’AFC et de profundoplastie proximale sans patch, et nous en évaluons la faisabilité.

Méthodes : Nous avons procédé à une étude de cohorte rétrospective monocentrique regroupant des patients qui, entre le 1^{er} juillet 2020 et le 30 juin 2021, ont subi une intervention décrite comme suit : transection en biseau de l’artère fémorale superficielle (AFS) à partir de la bifurcation fémorale, endartériectomie en éversion de l’AFS, endartériectomie distale de l’AFC, visualisation directe du point terminal dans l’artère fémorale profonde (AFP) avec extension longitudinale de l’artériotomie au besoin et réimplantation du « biseau » de l’AFS comme patch. Nous avons recueilli les données et les résultats cliniques à partir des dossiers des malades.

Résultats : Dix patients ayant subi une profundoplastie sans patch durant la période de l’étude ont été identifiés. Les indications de ces réparations incluaient perte tissulaire (3 patients), douleur au repos (2 patients), claudication (3 patients) et établissement d’un accès en vue d’une autre intervention (2 patients). Une extension de l’artériotomie de l’AFP a été utilisée dans 5 cas. Six cas incluaient une revascularization iliaque et infra-inguinale concomitante. Tous les cas ont été des réussites au plan technique. Une complication est survenue sous la forme d’une déchirure due au

ballonnet d'angioplastie tibiale distale. La durée moyenne du suivi a été de 199 jours (entre 29 et 381). On n'a recensé aucune infection du site chirurgical. Tous les patients étaient asymptomatiques, et les AFC étaient perméables au moment du dernier suivi. On a noté un cas de resténose du site opéré et une réintervention pour sténose à distance. L'augmentation moyenne des indices cheville-bras et orteil-bras a été de 44 % et 75 %, respectivement. Un patient a été réadmis pour hémorragie digestive, 1 autre est décédé d'un infarctus aigu du myocarde au 34^e jour postopératoire.

Conclusion : La technique de profondoplastie sans patch est faisable; elle permet une réparation anatomique autologue de l'occlusion de l'AFC, sans recours à une veine, une visualisation directe et l'utilisation d'agrafes pour suturer l'AFP proximale. Cette technique pourrait remplacer l'artérioplastie par patch de l'AFC généralement utilisée à l'heure actuelle, selon la configuration anatomique.

Although most segments of the arterial tree are amenable to endovascular interventions, the common femoral arterial segment (CFA) is not as well suited for conventional percutaneous techniques. Typical repair of CFA occlusive disease involves surgical endarterectomy followed by patch closure. The materials typically used for the patch include bovine pericardium, polyethylene terephthalate (e.g., Dacron [DuPont]) and expanded polytetrafluoroethylene. However, these prosthetic materials have the potential for prosthetic infection, which can be difficult to manage. In addition, in our institution, we experienced an increased incidence of severe patch-related restenosis. Use of autologous vein may mitigate these 2 problems and can be incorporated by either harvesting great saphenous vein or using the “hood” of a vein bypass. However, if one wishes to use an all-autologous repair without sacrificing the saphenous vein or superficial femoral artery (SFA), there is a limited number of techniques, especially if direct visualization and management (e.g., tacking sutures) of the proximal profunda femoris artery (PFA) is required.

We describe a technique that we believe is simpler and more versatile than those that have been described previously.¹⁻⁵ It is very similar to carotid repair by eversion endarterectomy of the carotid artery: the SFA is transected off the femoral bifurcation in a bevelled manner. Eversion endarterectomy is carried out on the SFA, and remote-type endarterectomy is performed on the CFA. The end point in the PFA is directly visualized (with a longitudinal arteriotomy extension, if needed), and then the SFA hood is reimplanted as a patch.

The purpose of this single-centre retrospective cohort study was to evaluate the feasibility of this patchless profundoplasty technique.

METHODS

All patients who underwent a patchless profundoplasty procedure performed by L.W.H.T. or V.K. between July 1, 2020, and June 30, 2021 were identified. The information collected from the patients' charts included clinical indication; preoperative ankle brachial index (ABI) and toe

brachial index (TBI); lesion anatomy; operative adjuncts (i.e., iliac or infrainguinal interventions); technical success; intraoperative and postoperative complications; number of days between the procedure and last follow-up visit; patency, stenosis and symptoms at last follow-up visit; any need for reintervention; last ABI and TBI; cardiovascular risk factors; and medication use.

The Research Ethics Board of the William Osler Health System approved the study protocol. All patients (or, if deceased, their estate) provided informed consent.

Surgical technique

The surgical technique is shown in Figure 1, Figure 2 and Figure 3. Depending on the need for adjunctive iliac or infrainguinal interventions, the procedures were performed in the hybrid suite or conventional operative suite. Cases were performed under regional anesthesia (spinal or epidural, or both) with sedation.

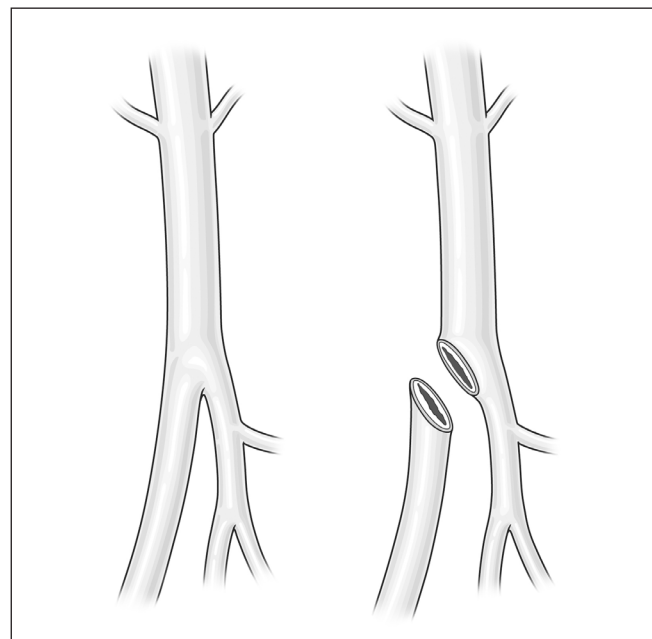


Fig. 1. Left: common femoral artery, superficial femoral artery (SFA) and profunda femoris artery. Right: oblique transection of SFA origin. Illustration by M. Gail Rudakewich.

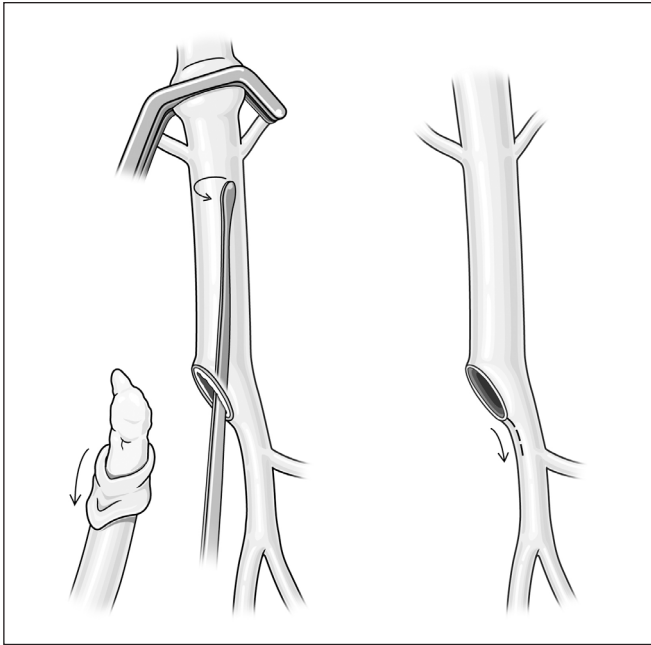


Fig. 2. Left: eversion endarterectomy of superficial femoral artery (SFA). Centre: Penfield dissector for remote-type endarterectomy of common femoral artery. A ring dissector may also be used. Care must be taken to avoid leaving residual disease or debris near the clamp. Right: longitudinal arteriotomy down profunda femoris artery (PFA) to visualize distal end of endarterectomy and secure with tacking sutures if needed (prn). Care must be taken to avoid extending too far down the PFA; otherwise, the SFA will become too distorted. Illustration by M. Gail Rudakewich.

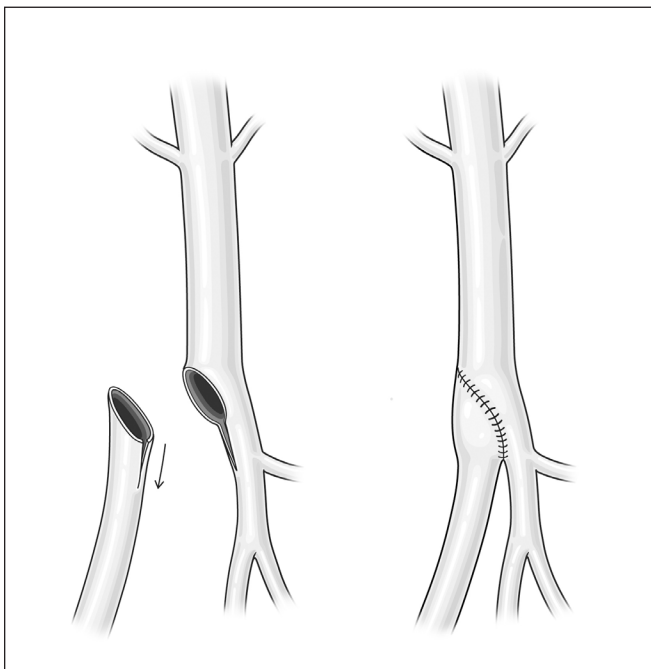


Fig. 3. Left: a matching arteriotomy can be created in the superficial femoral artery (SFA). If the profunda femoris artery (PFA) arteriotomy is not long, the SFA can be left without arteriotomy, and the rounded “heel” of the SFA can be used to splay open the PFA arteriotomy. Right: completion of the anastomosis between the “hood” of the SFA and the common femoral artery and PFA. Illustration by M. Gail Rudakewich.

Statistical analysis

No statistical analysis was performed given the small number of cases.

RESULTS

Ten patients who underwent a patchless profundoplasty procedure between July 1, 2020, and June 30, 2021 were identified. The patient demographic characteristics are summarized in Table 1. The main indications for repair were toe gangrene (in 2 patients), ulcer (1 patient), rest pain (2 patients) and disabling claudication (3 patients). One patient’s indication for repair was to establish access for endovascular aneurysm repair. In another patient, the indication for repair on the right side was to obtain access for bilateral kissing stents as part of contralateral left-sided multisegment revascularization for contralateral tissue loss and ipsilateral claudication. Seven patchless profundoplasty procedures were performed on the right side, and 3 were performed on the left side. Five of the operative reports mentioned use of a longitudinal arteriotomy extension on the PFA, with 3 of the 5 describing matching extensions on the SFA (if there was no matching extension, the rounded “heel” of the SFA was used to splay open the PFA arteriotomy). Isolated patchless profundoplasty was performed in 4 cases, 4 patients underwent simultaneous iliac revascularization, and 2 patients underwent simultaneous iliac and infra-inguinal revascularization.

Table 1. Demographic and clinical characteristics of patients who underwent a patchless profundoplasty procedure	
Characteristic	No. of patients* n = 10
Age, mean ± SD, yr	67.9 ± 6.9
Female gender	3
Smoking status	
Active smoker	4
Former smoker	6
Nonsmoker	0
Comorbidities	
Diabetes	3
Hypertension	9
History of cardiac disease	3
History of stroke or TIA	3
Preoperative medication use	
Acetylsalicylic acid	8
Clopidogrel	1
Low-dose rivaroxaban	2
Full-dose anticoagulation	1
Statin	9
ACE or ARB	7

ACE = angiotensin-converting enzyme; ARB = angiotensin receptor blocker; SD = standard deviation; TIA = transient ischemic attack.
*Except where noted otherwise.

All cases were successful technically. The only intraoperative complication was from adjunctive catheter balloon angioplasty of a remote posterior tibial artery, which resulted in a tibial artery tear; the tear was repaired without any issues. There were no immediate postoperative complications in any of the patients. One patient was readmitted with an upper gastrointestinal bleed. Another patient experienced postoperative delirium in the context of suspected preoperative dementia and aspiration pneumonia on postoperative day 9; the patient died from an acute myocardial infarction on day 34. There were no surgical site infections at any time.

The length of follow-up ranged from 29 to 381 (average 199) days. All patients were asymptomatic at their last follow-up visit. The 2 patients with toe gangrene underwent toe amputation, with successful healing of the amputation sites. The ulcer healed in the patient with ulcer. All CFAs were patent at the last follow-up visit. All 9 patients who underwent ultrasonography postoperatively had patent PFA (1 with mild stenosis and 1 with moderate stenosis); all 5 with patent SFA preoperatively had patent SFA (1 had moderate stenosis that progressed to severe stenosis); and all 4 with occluded SFA preoperatively had SFA that remained occluded (but an endarterectomized stump was available for future endovascular treatments if needed). The case of moderate SFA stenosis that progressed to severe stenosis (which is also the case of moderate PFA stenosis) occurred sometime between the 2 ultrasonography scans performed on postoperative days 85 and 205. The peak systolic velocities had increased from 386 cm/s to 525 cm/s. Given the extent of disease progression, reintervention was considered, but the patient developed major cardiac issues. The stenosis was therefore managed conservatively.

Ultrasonography showed that the patient with mild PFA stenosis also had severe stenosis in the proximal external iliac artery, above the iliac stent. At the time of angiography, the interventional radiologist found the proximal external iliac artery to be occluded or near-occluded, with narrowed irregular lumen through the external iliac stent and in the CFA. It was unclear whether this was thrombus, collapsed decompressed vessel or early intimal hyperplasia. AngioJet catheter thrombectomy (Boston Scientific) was performed, followed by drug-eluting balloon angioplasty of the entire length of external iliac artery, CFA and PFA. The culprit lesion above the previous stent was treated with a drug-eluting stent.

All 7 patients who did not undergo adjunctive infrainguinal interventions and for whom preoperative and postoperative ABI and TBI values were available had improvement in their ABI, with an average increase of 0.22 (average increase in baseline ABI of 44%). Six of the 7 had improvement in their TBI, with an average change of 0.18 (average increase in baseline TBI of 75%).

DISCUSSION

Common femoral endarterectomy and patch arterioplasty is typically a durable and robust procedure.⁶ However, the use of an implanted prosthetic carries the risk of patch infection.⁷ In addition, we had experienced an increased incidence of early severe stenosis at our local institution that we were concerned could be related to our use of bovine pericardial material.⁸ Although we have been more aggressive with rinsing our bovine pericardial patches, we have found our transition to an all-autologous repair to be a simpler approach.

We present a technique for autologous repair of CFA disease without a patch in an anatomic configuration that is very simple and is nearly the same as the eversion endarterectomy technique that is well established for carotid endarterectomy. Our study shows that the patchless profundoplasty technique is feasible, with a technical success rate of 100% and infection rate of 0%. There was 1 case of CFA restenosis. The other complications and the death observed in this study were unrelated to the patchless profundoplasty technique compared to patch repair and reflect the substantial burden of comorbidity that is associated with peripheral artery disease.

The patchless profundoplasty technique we describe has several differences from previously described autologous techniques. Common femoral artery transection has been well described,¹ with multiple studies to assess its performance.^{9,10} However, compared to CFA transection, our technique of patchless profundoplasty allows better visualization of the end point of the endarterectomy in the PFA and easier placement of a tacking suture if needed; has a lower chance of purse-stringing compared to an end-to-end anastomosis; allows closer procedural similarity to the carotid eversion endarterectomy technique; and avoids a transverse suture line, which may need to be cut in case of revision.

The other autologous techniques described include using a piece of the SFA as a patch,⁷ but this requires ligation of the SFA and loss of the anatomic continuity of the SFA if future revisions or interventions are pursued. A technique of creating longitudinal arteriotomies along the SFA and PFA in which a patch is used⁸ has been modified and demonstrated in a video:⁹ the use of a patch is mitigated by folding the SFA and PFA together to patch themselves. This requires substantial distortion of the arteries but may be more versatile for disease that extends farther down the PFA. Other techniques of eversion endarterectomy can be complicated and still require a patch.¹⁰

In addition to the benefits of an all-autologous anatomic repair, the patchless profundoplasty technique may also have the advantages of lower material cost, shorter operative time (the anastomotic suture line typically has a shorter circumference than a patch) and lower restenosis

rate. We also find subsequent endovascular access through the native artery (either the CFA or the proximal SFA) to be easier to close than access through a patch.

The challenges particular to the patchless profundoplasty technique are also the 2 main disadvantages of the technique. The first is when the disease extends far down the PFA; the configuration then becomes distorted, depending on how splayed the CFA bifurcation is. The second challenge is ensuring the proximal part of the CFA endarterectomy does not have any residual debris or flap. Angiography or a sterile laparoscope should be used to visualize, because palpation alone may miss thin flaps and debris.

Limitations

Limitations to this study include the fact that it was retrospective in nature. We did not perform case-control analysis of our bovine pericardial patch cases and are therefore unable to determine accurately our prior local restenosis rate. The length of follow-up was short, and the number of patients was small.

CONCLUSION

The patchless profundoplasty technique is feasible and results in an autologous anatomic repair of CFA disease without the need for vein. It allows direct visualization and management of the proximal PFA. This technique may replace the ubiquitous vascular procedure of patch arterioplasty of the CFA, depending on the anatomic configuration.

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Competing interests: None declared.

Contributors: Both authors designed the study. L. Tse acquired the data, which both authors analyzed. L. Tse wrote the manuscript, which V. Kapila critically revised. Both authors gave final approval of the article to be published.

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