Laser In Situ Fenestration makes it easy

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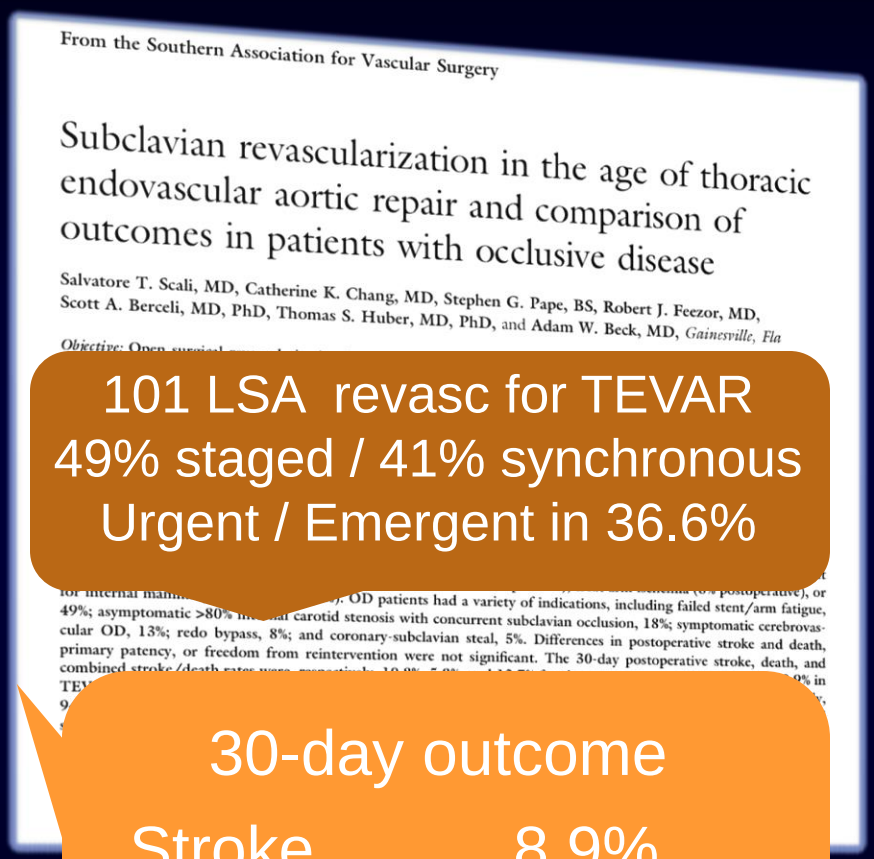
Laser in situ fenestration
Outcomes of TEVAR & LSA revascularization



From the Southern Association for Vascular Surgery

Subclavian revascularization in the age of thoracic endovascular aortic repair and comparison of outcomes in patients with occlusive disease

Salvatore T. Scali, MD, Catherine K. Chang, MD, Stephen G. Pape, BS, Robert J. Feezor, MD, Scott A. Berceli, MD, PhD, Thomas S. Huber, MD, PhD, and Adam W. Beck, MD, *Gainesville, Fla*

101 LSA revasc for TEVAR
49% staged / 41% synchronous
Urgent / Emergent in 36.6%

30-day outcome

Stroke	8.9%
Death	7.1%
Combined	12.9%

Scali ST et al, J Vasc Surg 2013;58:901-9

Hybrid aortic arch repair for complicated type B aortic dissection

Carsten M. Bünger, MD, PhD,[a] Stephan Kische, MD,[b] Andreas Liebold, MD, PhD,[c] Maximilian Leißner,[a] Aenne Glass,[d] Wolfgang Schareck, MD, PhD,[a] Hüseyin Ince, MD, PhD,[b] and Christoph A. Nienaber, MD, PhD,[b] *Rostock, Germany*

in hospital outcome

Stroke	8.8%
Death	11%

Bunger CM et al, J Vasc Surg 2013;58:1490-6

Laser in situ fenestration
Early interest & experience

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◆ CASE REPORT

JEVT 2004

In Situ Stent-Graft Fenestration to Preserve the Left Subclavian Artery

Richard G. McWilliams, FRCS, FRCR[1]; Micheal Murphy, FRCSI, FRCR[1]; David Hartley, FIR[2]; Michael M.D. Lawrence-Brown, FRACS[3]; and Peter L. Harris, MD, FRCS[1]

[1]Royal Liverpool University Hospital, Liverpool, UK. [2]Cook R & D, Royal Perth Hospital, Perth, Western Australia. [3]Centre for Health Services Research, Department of Public Health, The University of Western Australia, Nedlands, Western Australia.

◆ CASE REPORT

JEVT 2009

Endovascular Repair of Acute Traumatic Thoracic Aortic Transection With Laser-Assisted In-Situ Fenestration of a Stent-Graft Covering the Left Subclavian Artery

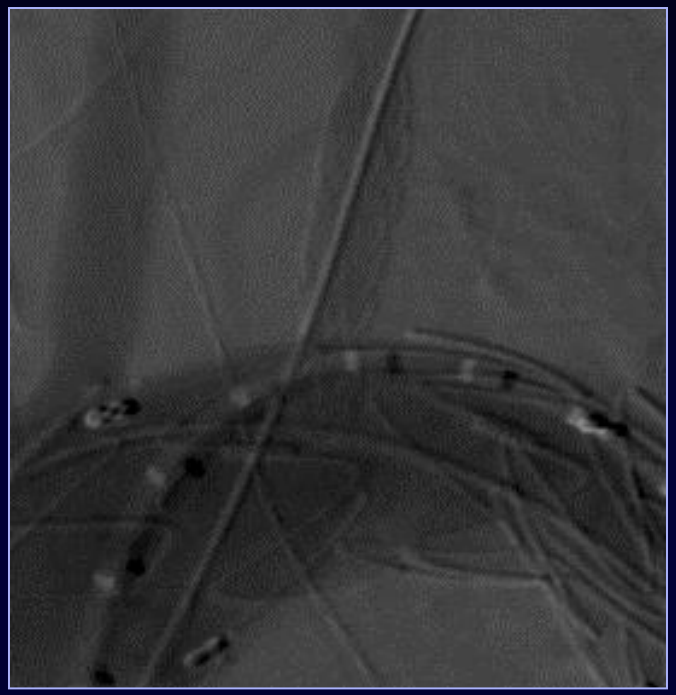
Erin H. Murphy, MD[1]; J. Michael Dimaio, MD[2]; William Dean, MD[3]; Michael E. Jessen, MD[2]; and Frank R. Arko, MD[1]

◆ CLINICAL INVESTIGATION

In Situ Laser Fenestration for Revascularization of the Left Subclavian Artery During Emergent Thoracic Endovascular Aortic Repair

Sadaf S. Ahanchi, MD; Babatunde Almaroof, MD; Christopher L. Stout, MD; and Jean M. Panneton, MD

Division of Vascular Surgery at Eastern Virginia Medical School, Norfolk, Virginia, USA.



5/6 successful fenestration (83%)

No operative or late mortality

No neurologic complication

No fenestration related complication

J Endovasc Ther 2012;19:226-30

Laser in situ fenestration
Required tools

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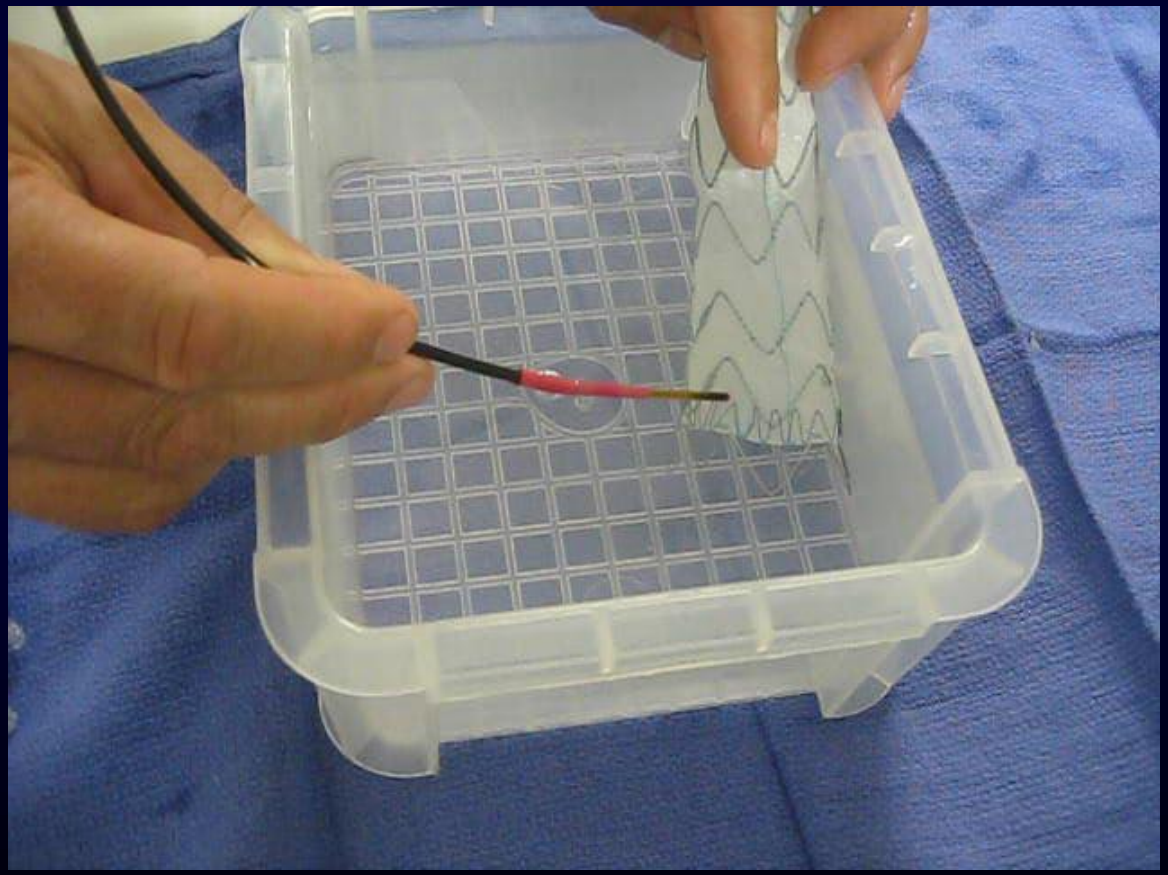
Spectranetics Turbo Elite 2.3-2.5 Laser



7 Fr Sheath
0.018 Guidewire
0.035 stiff guidewire
Balloon 6 x 40
Atrium iCast 8-10 x 40
Balloon 14 x 20

Laser in situ fenestration
Ex vivo benchwork

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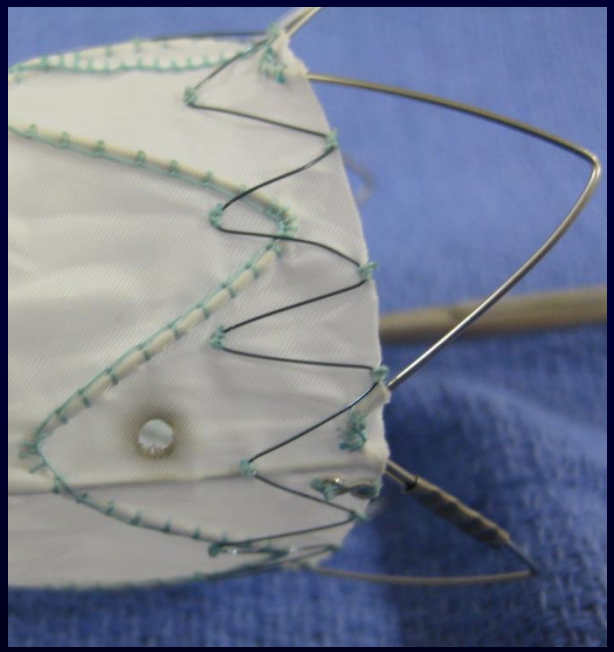
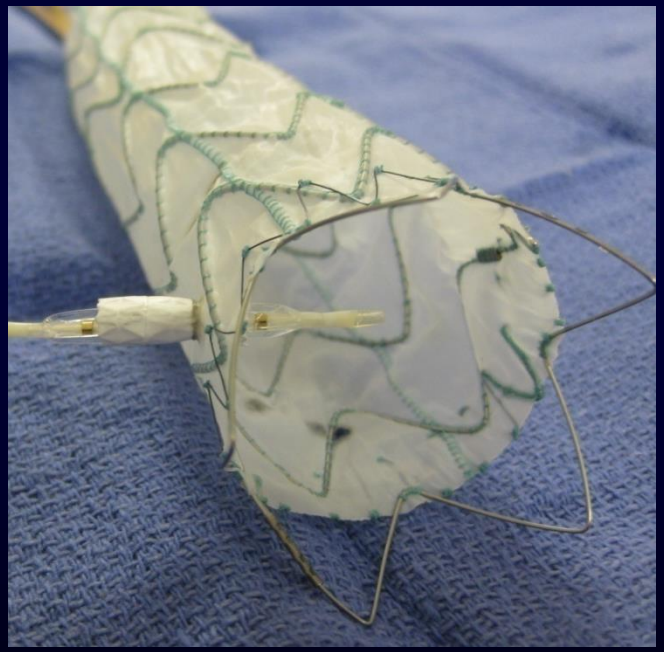
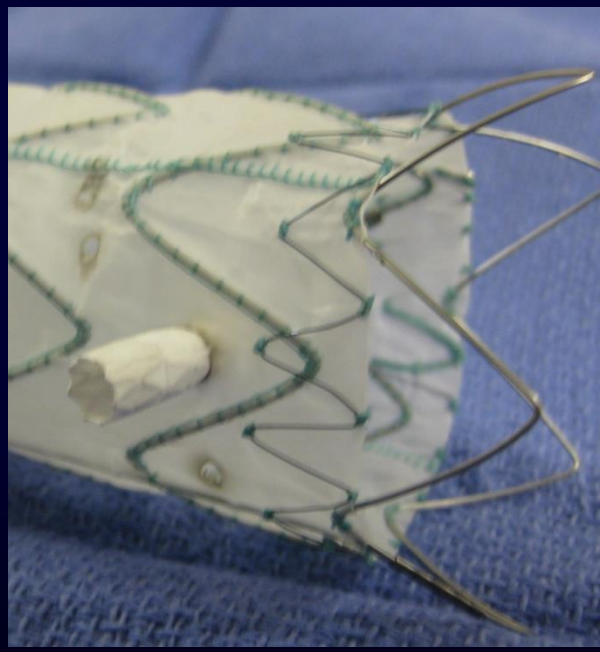
Ex Vivo Laser Fenestration:

Predilation with 6x40
ICast Stent Deployment

Laser in situ fenestration
Ex vivo Benchwork with SEM

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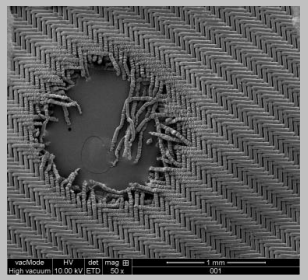
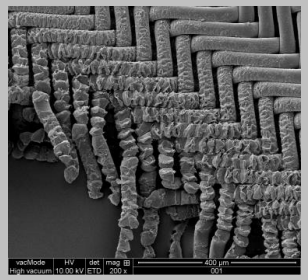
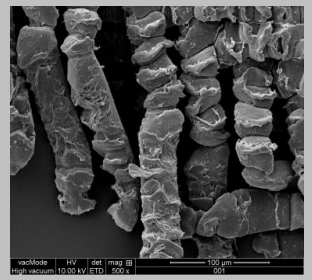
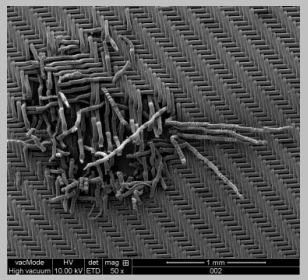
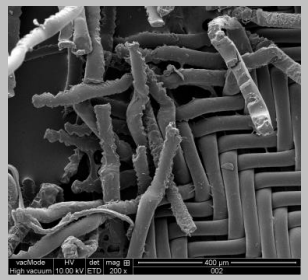
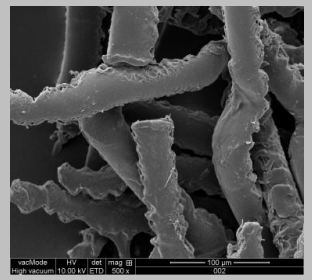
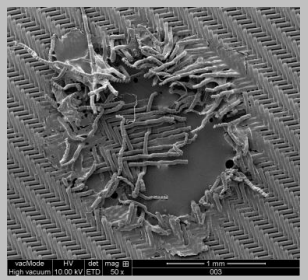
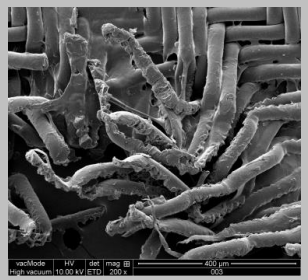
Diameters of laser probes（mm）	Light microscope	Different magnification		
		50 x	200 x	500 x
1.7				
2.0				
2.3				

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EVMS Experience

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CLINICAL RESEARCH STUDIES
From the Southern Association for Vascular Surgery

In situ laser fenestration during emergent thoracic endovascular aortic repair is an effective method for left subclavian artery revascularization

Richard E. Redlinger Jr, MD, Sadaf S. Ahanchi, MD, and Jean M. Panneton, MD, *Norfolk, Va*

Background: Retrograde laser fenestration of the left subclavian artery (LSA) during emergent thoracic endovascular aortic repair (TEVAR) uses a relatively simple intraoperative method of endograft modification to revascularize aortic branches for a variety of acute thoracic aortic pathologies. This study presents our expanded experience and midterm outcomes of TEVAR with laser fenestration to revascularize the LSA as an alternative to debranching.
Methods: Patients who underwent TEVAR with LSA revascularization by laser graft fenestration from September 2009 through August 2012 were retrospectively reviewed. TEVAR was performed with deployment of a Dacron (DuPont, Wilmington, Del) endograft over the LSA orifice. Laser catheter fenestration of the graft was performed through retrograde brachial access, followed by balloon-expandable covered stent deployment through the fenestration to traverse the endograft and LSA. Routine postoperative follow-up imaging with computed tomography angiography was performed to assess TEVAR and LSA fenestration patency, endoleak, and aneurysm/dissection exclusion.
Results: TEVAR with laser fenestration was successfully performed in 22 patients (12 men; mean age, 57 years) in an urgent or emergent setting secondary to unremitting symptoms or rupture. Twelve patients had large symptomatic thoracic aortic aneurysms (eight secondary to chronic dissection); four patients had acute symptomatic type B aortic dissection, and six patients had an intramural hematoma or penetrating aortic ulcer, or both. An average of two endografts (range, 1-4) were deployed. LSA-covered stents were 8 to 10 mm in diameter. Mean operative time was 154 ± 65 minutes. Average hospital length of stay was 12 ± 7 days. No major fenestration-related complications occurred. One patient developed postoperative paraplegia. One patient died in the postoperative period, for an in-hospital mortality rate of 4.5%. Two patients died of non-TEVAR-related causes at a mean follow-up of 10 months (range, 1-40 months). Follow-up computed tomography angiography imaging demonstrated a 100% primary patency for the LSA stents. One patient had an asymptomatic LSA stent stenosis. Type II endoleaks from the LSA in two patients required endovascular coil embolization. No fenestration-related type I or III endoleaks were noted.
Conclusions: In situ retrograde laser fenestration is a feasible and effective option for LSA revascularization during TEVAR involving a spectrum of acute thoracic aortic pathology. Laser fenestration provides a rapid, reproducible method of fenestrating the endograft material. The high technical success, low fenestration-related morbidity, and excellent midterm patency support this technique of intraoperative endograft modification. (J Vasc Surg 2013;58:1171-7.)

Acute thoracic aortic pathologies that encroach on aortic arch vessels result in inadequate proximal endograft landing zones and classically have mandated traditional open repair or thoracic endovascular aortic repair (TEVAR) with coverage of the left subclavian artery (LSA). Conventional open thoracic aortic repair in an urgent or emergent setting has been demonstrated to have mortality rates close to 20% and significant morbidity, including a risk of spinal cord ischemia that can affect 18.6% of patients.[1,2] Intentional endograft coverage of the LSA was initially thought to be a viable alternative in this setting to extend the applicability of TEVAR.[3] Unfortunately, expanding experience with intentional LSA coverage without revascularization portends a significantly increased risk of subclavian steal syndrome, arm claudication, vertebral territory stroke, and spinal cord ischemia by eliminating collateral blood supply to the spinal cord from the vertebral artery.[4,5]

Several options have been described that allow patency of the LSA to be maintained, including elective debranching before TEVAR, the chimney technique by deploying an LSA stent parallel to the thoracic endograft,

From the Division of Vascular Surgery, Eastern Virginia Medical School.
Author conflict of interest: Dr Panneton is a consultant and on the Speakers' Bureau for Cook Medical and Medtronic Inc.
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Reprint requests: Jean M. Panneton, MD, Eastern Virginia Medical School, Division of Vascular Surgery, Sentara Heart Hospital, 600 Gresham Dr, Ste 8620, Norfolk, VA 23507 (e-mail: pannetjm@evms.edu).
The editors and reviewers of this article have no relevant financial relationships to disclose per the JVS policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.
0741-5214/$36.00

http://dx.doi.org/10.1016/j.jvs.2013.04.045

J Vasc Surg 2013;58:1171-7

Laser in situ fenestration
When it's not easy

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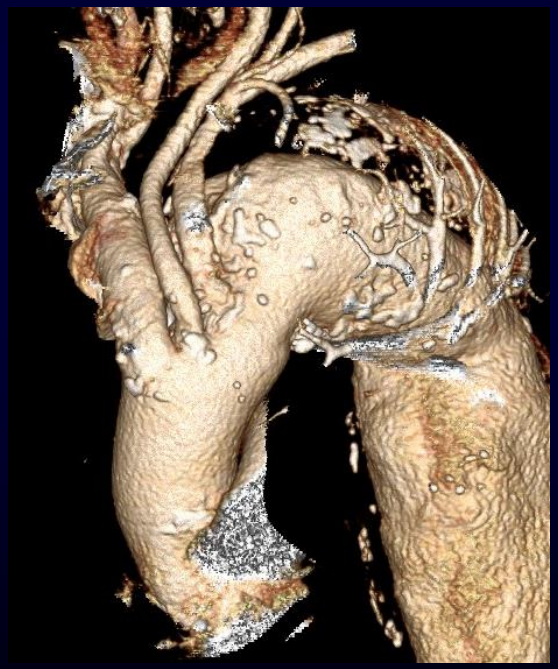
The arch anatomy dictates the feasibility

Type III arch

Acute takeoff

Offset take off



- Low Vertebral artery origin
- SCA dissection
- SCA dilatation

Laser in situ fenestration
Technique

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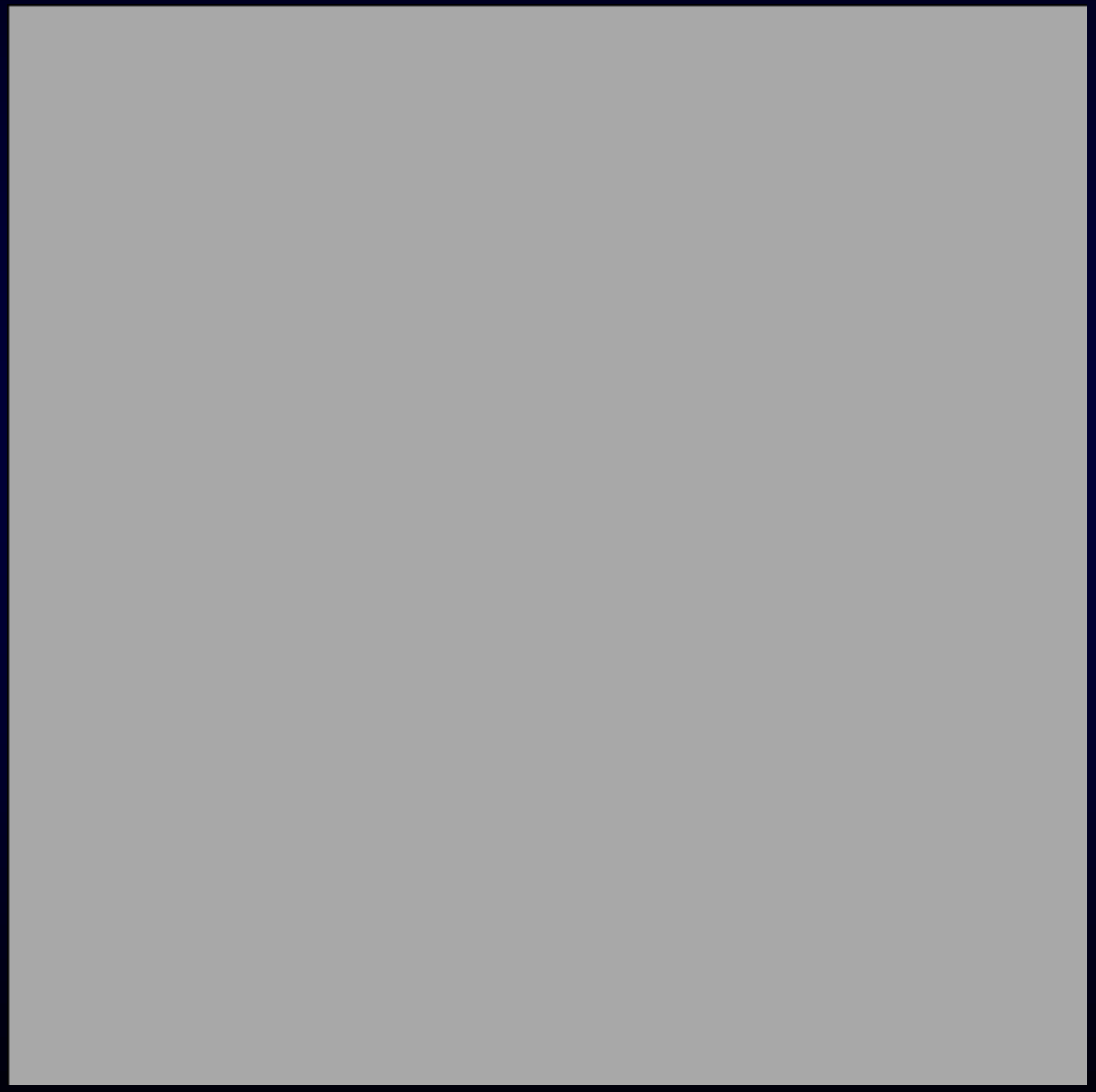

63 yrs old female patient with Ruptured Acute Type B Aortic Dissection

Laser in situ fenestration
Technique: Orientation

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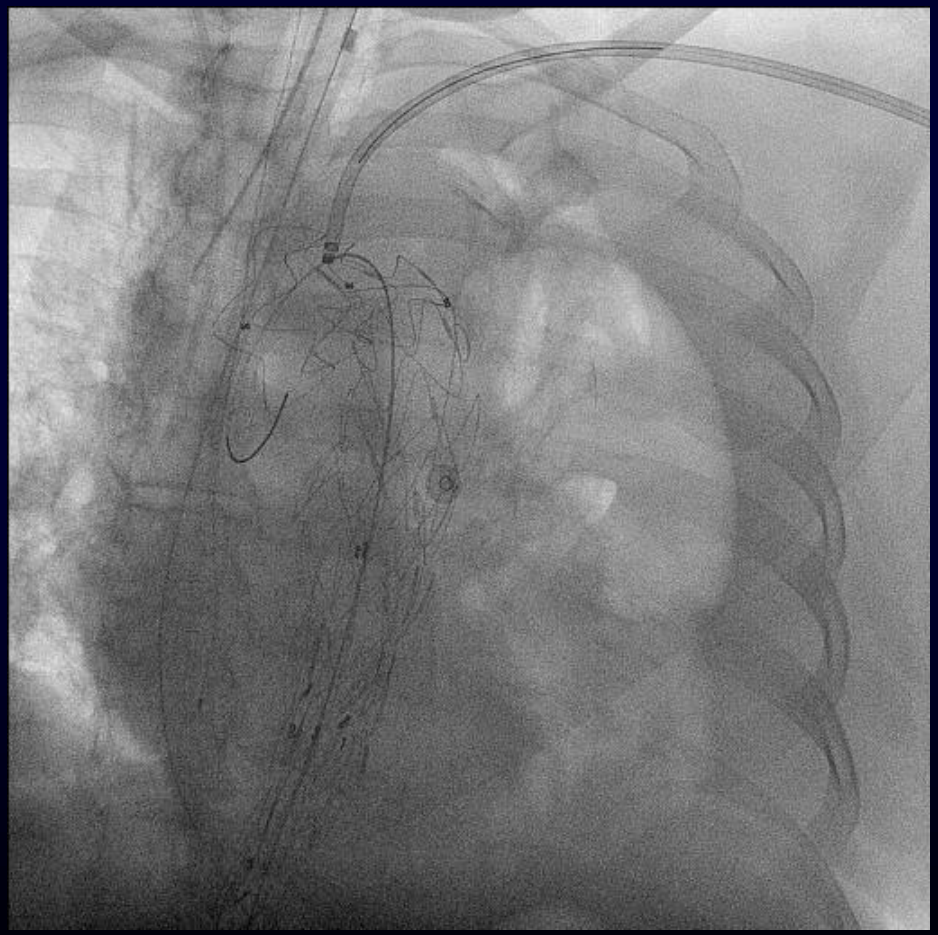
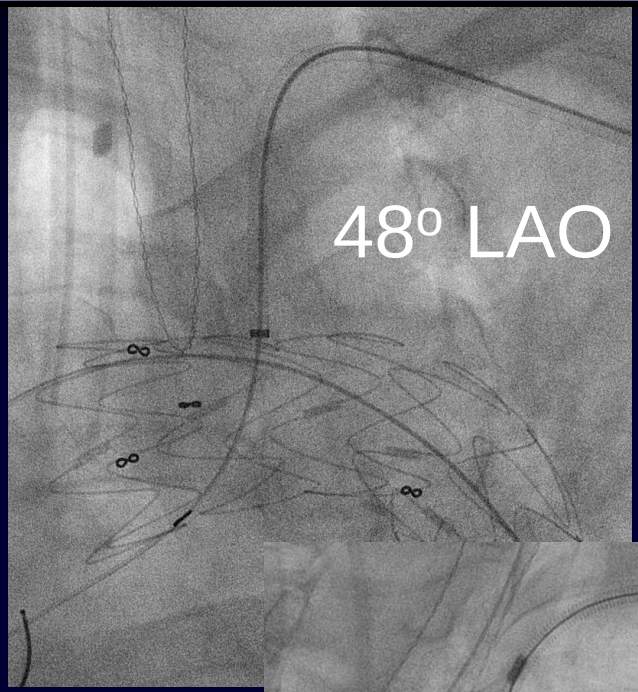
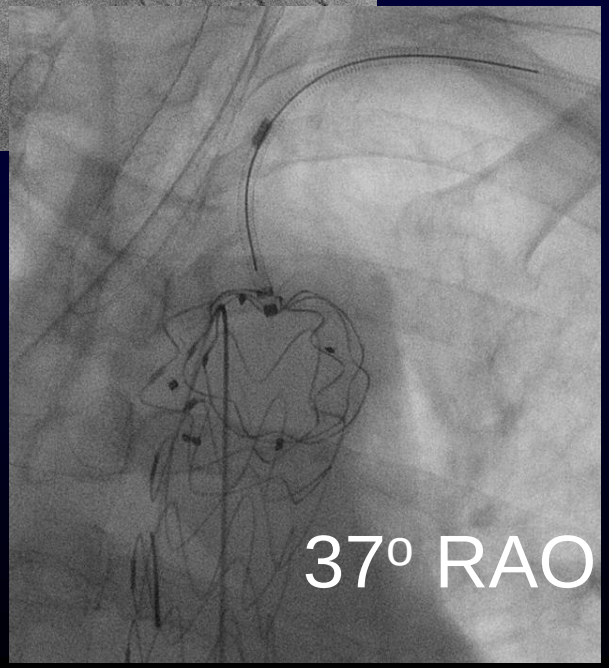
Post TEVAR deployment
Laser positioned at LSA ostium
via retrograde brachial access







Laser in situ fenestration
Technique: Fenestration

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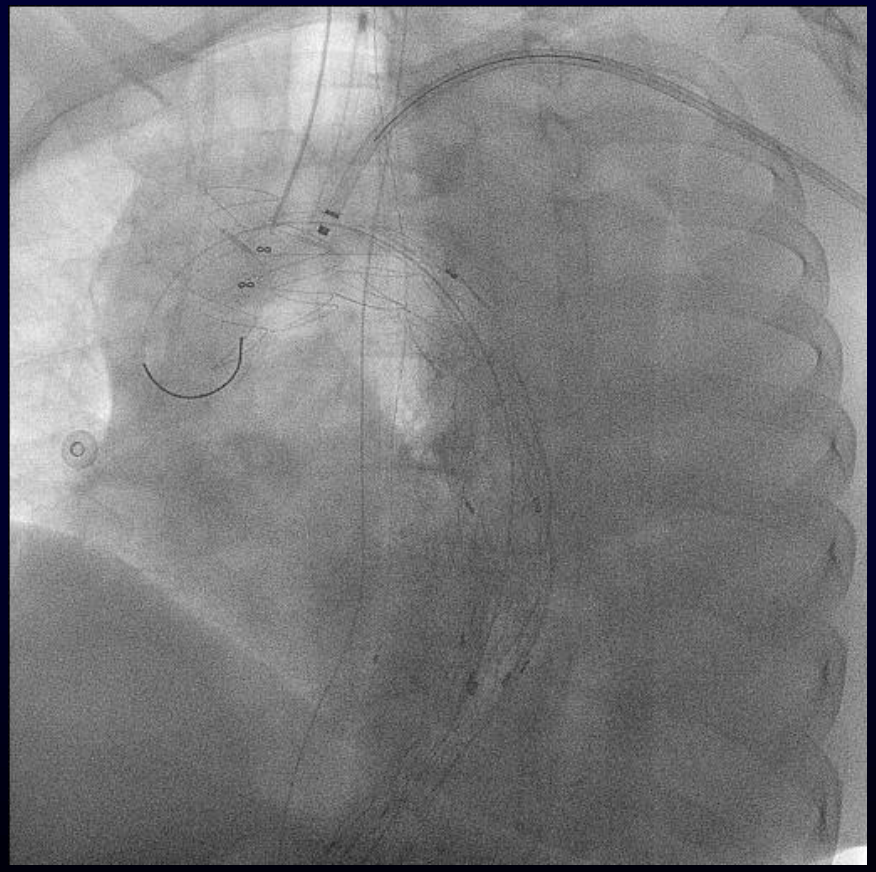
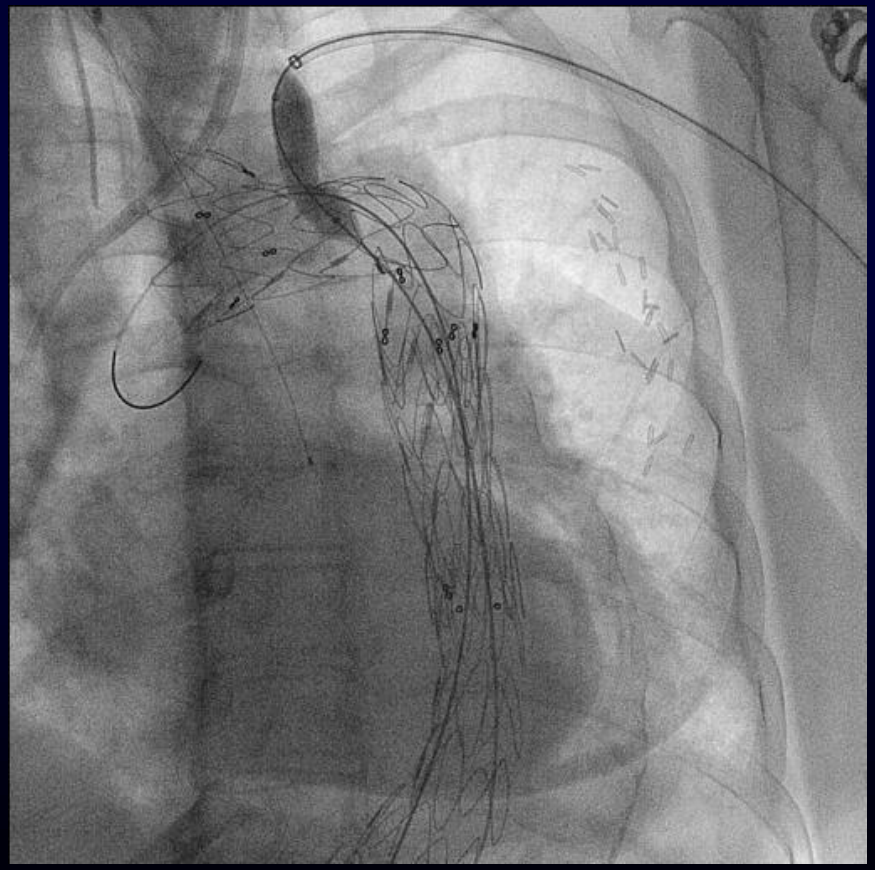
Laser activated, advanced into the endograft and guidewire placed in ascending aorta



Over stiff 0.035 guidewire predilation with 6x40 balloon



Laser in situ fenestration
Technique: Stenting

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iCast stent positioning

Retrograde angiogram
after iCast deployment

Laser in situ fenestration
Technique

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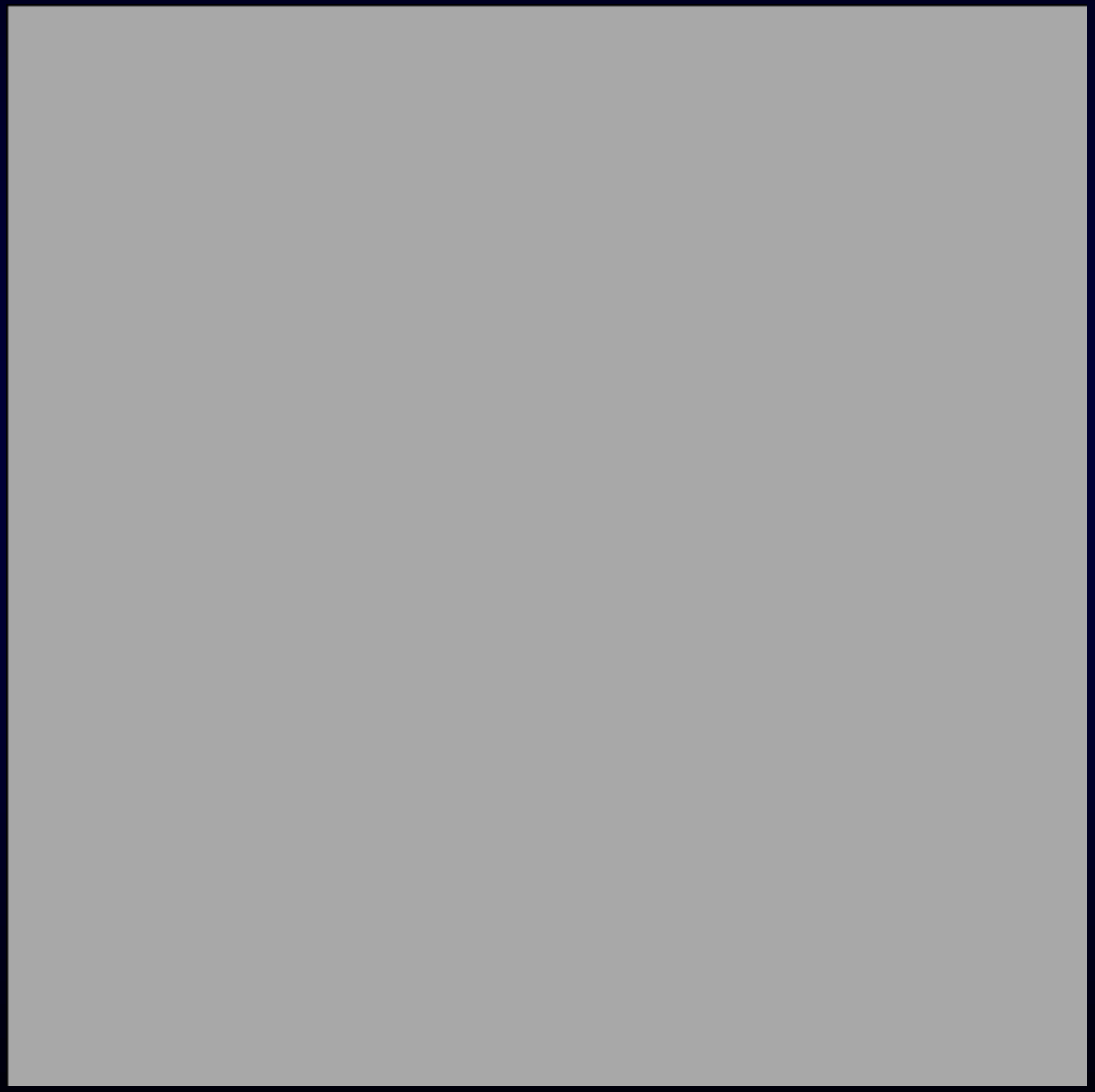

Completion Aortogram

Laser in situ fenestration
EVMS experience

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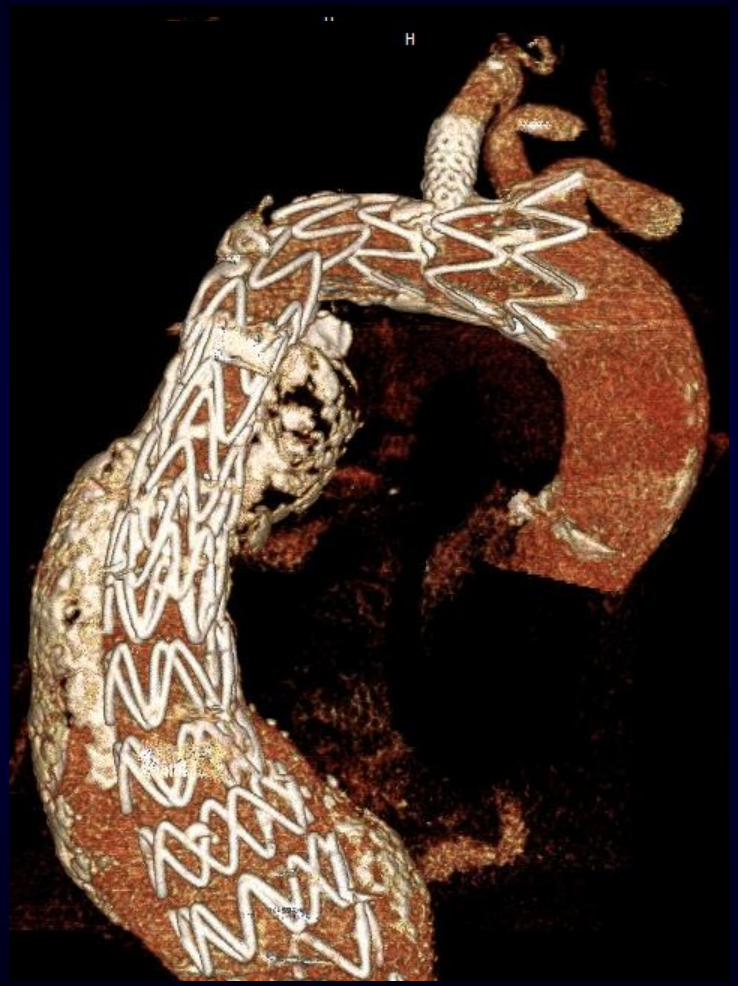
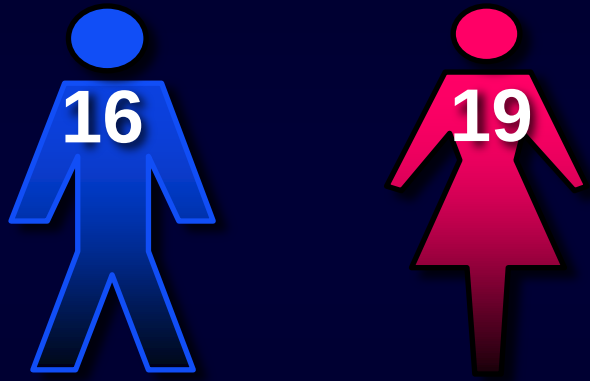


July 2009 – October 2013

N = 35 patients



Mean Age of 62 yrs

Aortic Dissection, IMH, BTAI,
Thoracic aneurysms or TAAA

Laser in situ fenestration
Procedural Data

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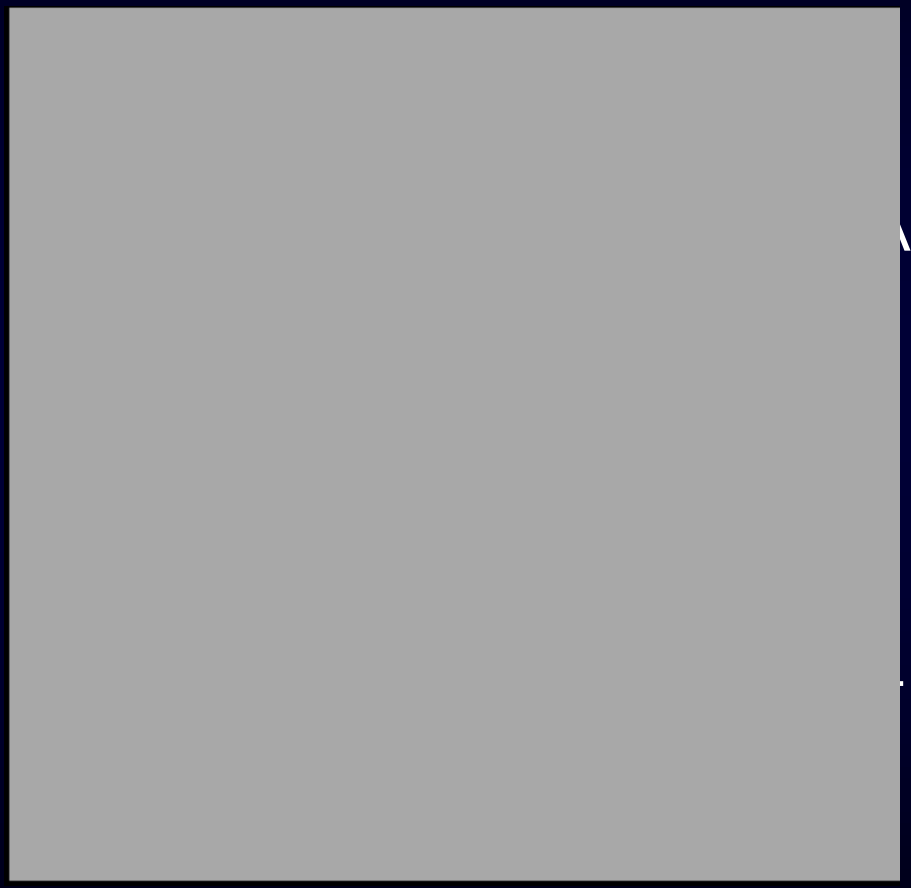
Variable	*n*
Number of endografts*	
1	9
2	15
3	8
4	3
Percutaneous brachial access	8
iCast Stent (mm)	
8	4
9	4
10	27
Mean OR Time (min)	162±71
Mean Contrast (mL)	134±64



1 patient with Left CCA fenestration

* Patient underwent a total arch fenestration

Laser in situ fenestration
Early Outcome

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Technical Success: 97.2 % (35 / 36)

One patient converted to a snorkel

Operative Mortality = 5.7% (2 /35)

Neurologic Complication:

Stroke : 1 (2.9%) (preop CVA and ruptured IMH)

Paraplegia : 1 (2.9%) (ruptured acute type B)

Fenestration related Complication rate = 2 / 35 (5.7%)
(arm hematoma evacuation)

Mean Length of Stay = 12 days

Laser in situ fenestration
Imaging surveillance

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Patients were studied with CTA with TeraRecon

Assess for:

- LSA stent patency
- LSA stent fracture
- Type III endoleak between LSA stent and TEVAR endograft
- Type Ib endoleak of LSA stent
- Type Ia endoleak

Laser in situ fenestration
Imaging surveillance

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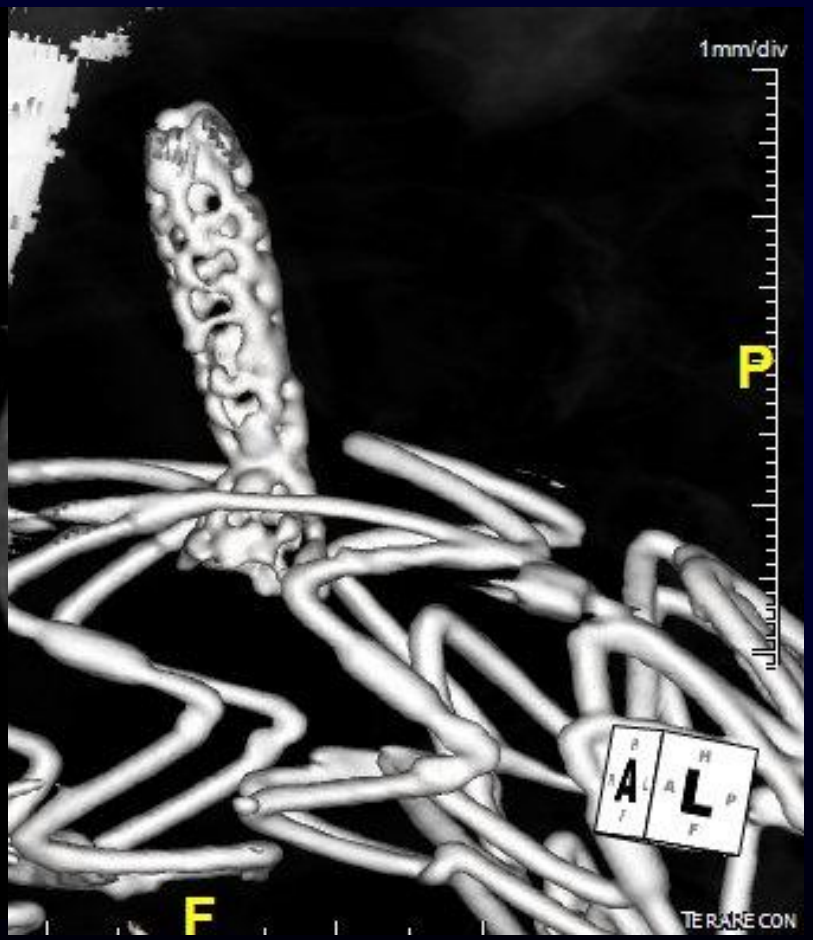
Mean imaging follow up of 16 months (range 0-60 months)



1 patient @ 5 yrs

3 patients @ 4 yrs

5 patients @ 3 yrs

CTA Findings

- All LSA Stents are patent with 2 asymptomatic stenosis
- Not identified any stent fracture

Laser in situ fenestration
Clinical surveillance

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Mean clinical follow up of 23 months (range 1–66 mo)

LSA fenestration related reintervention rate = 7.5%

1 early type Ib endoleak requiring coiling around LSA stent

2 late type Ib endoleaks: LSA distal restenting at 17 & 30 months

Laser in situ fenestration
Clinical surveillance

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Late Aortic related reintervention rate = 5.4%

1 for type Ia and Ib endoleaks from an innominate fenestration required an open total arch replacement at 1yr

1 for type Ia endoleak required hemiarch debranching with innominate chimney and redo TEVAR, the LSA stent was occluded with Amplatzer plug

Laser in situ fenestration
Summary

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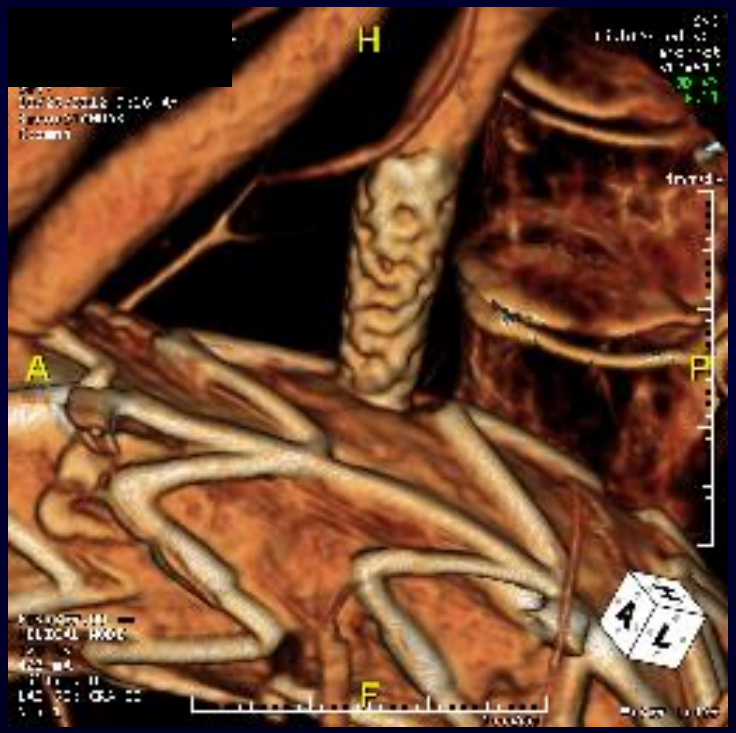

In Situ Retrograde Laser Fenestration is an innovative and simple technique to revascularize arch vessels during emergent TEVAR in properly selected patients

Imaging surveillance by CTA has documented the durability of this procedure with no stent failure nor any fenestration related type Ia or III endoleak.