Techniques For Endovascular Aortic Arch Repair

Mario Lachat, MD
University Hospital of Zurich
Matteo Orrico, MD
San Camillo-Forlanini Hospital, Rome

Disclosure

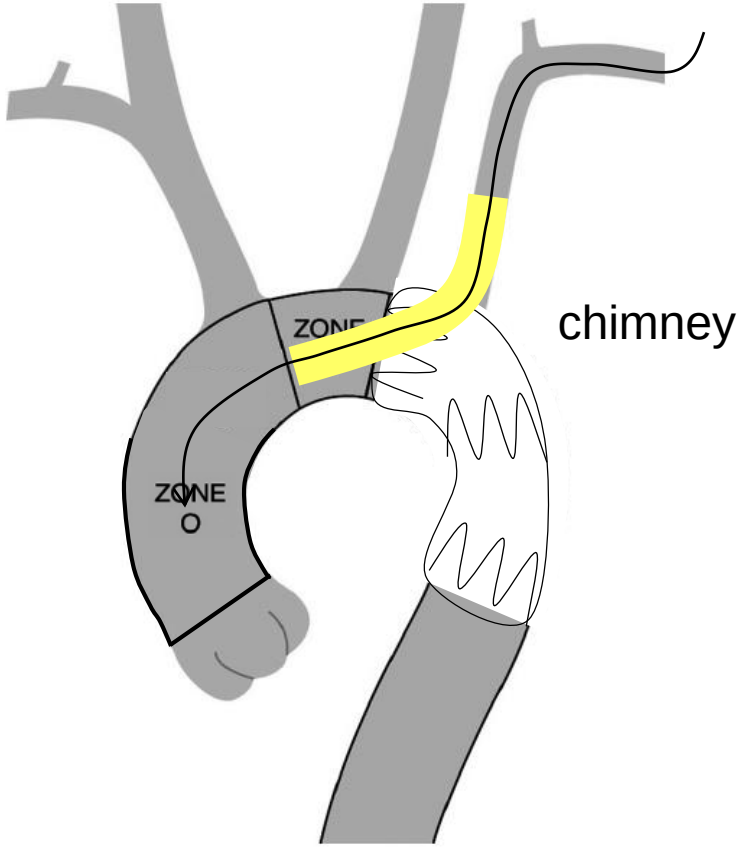
Speaker name: Mario Lachat

- Endospan, Jotec, Medtronic, Gore

Agenda

- Paralell Grafts
- Hybrid Repair
- Arch devices

Parallel Grafts TECH



J ENDOVASC THER
2013;20:728–734

◆CLINICAL INVESTIGATION ◆

Periscope Endograft Technique to Revascularize the Left Subclavian Artery During Thoracic Endovascular Aortic Repair

Mario Lachat, MD[1]; Dieter Mayer, MD[1]; Thomas Pfammatter, MD[2]; Frank J. Criado, MD[3]; Zoran Rancic, MD, PhD[1]; Thomas Larzon, MD, PhD[4]; Frank J. Veith, MD[1,5]; and Felice Pecoraro, MD[1,6]

[1]Clinic for Cardiovascular Surgery and [2]Interventional Radiology, University Hospital Zurich, Switzerland. [3]Division of Vascular Surgery and Vascular Intervention, Union Memorial Hospital-MedStar Health, Baltimore, Maryland, USA. [4]Department of Cardio-Thoracic and Vascular Surgery, Örebro University Hospital, Örebro, Sweden. [5]New York University Medical Center, New York, and The Cleveland Clinic, Cleveland, Ohio, USA. [6]Vascular Surgery Unit, University of Palermo, AOUP "P. Giaccone," Palermo, Italy.

Purpose: To present early and midterm results of the periscope endograft (PG) technique to maintain left subclavian artery (LSA) blood flow in thoracic endovascular aortic repairs (TEVAR) involving zone 3.

Methods: From April 2010 to January 2013, 14 consecutive high-risk patients (11 men; mean age 70±8 years, range 56–87) underwent TEVAR with the PG technique for 10 thoracic aortic aneurysms (TAA), 2 traumatic aortic ruptures, and 2 aortic dissections without a suitable landing zone (>2 cm distal to the LSA). Five procedures were performed emergently for rupture (3 TAAs and the 2 trauma cases). Two patients had a periscope deployed in an aberrant right subclavian artery. The periscope endografts were sized 1 to 2 mm larger than the branch artery at the intended landing zone. The caudal end was extended distal to the intended distal landing site of the thoracic stent-graft, which was usually deployed after the PG. Both the PG and thoracic stent-grafts were generally molded using the kissing balloon technique. Outcomes analyzed were immediate technical success, perioperative mortality and morbidity, aneurysm diameter change, and periscope endograft patency.

Results: Immediate technical success was 100%, with all procedures completed as planned. Perioperatively, one periscope occluded and one of the ruptured TAA patients died. One percutaneous access site hematoma required only conservative management. At a mean follow-up of 26±9 months (range 9–37), there was no additional PG occlusion. The Kaplan-Meier estimate of PG patency was 93% at 2 years.

Conclusion: The periscope endograft is a simple technique to maintain perfusion to the LSA in cases where the aortic stent-graft crosses its ostium. The PG technique can be performed transfemorally and even percutaneously, and it can be applied to all supra-aortic branches. Early and midterm results are encouraging, but more experience and long-term results are mandatory before this technique can be widely recommended.

J Endovasc Ther. 2013;20:728–734

Key words: thoracic aorta, thoracic aortic aneurysm, dissection, arch aneurysm, thoracic endovascular aortic repair, stent-graft, left subclavian artery, periscope graft, deployment technique, proximal landing zone

«Periscope»

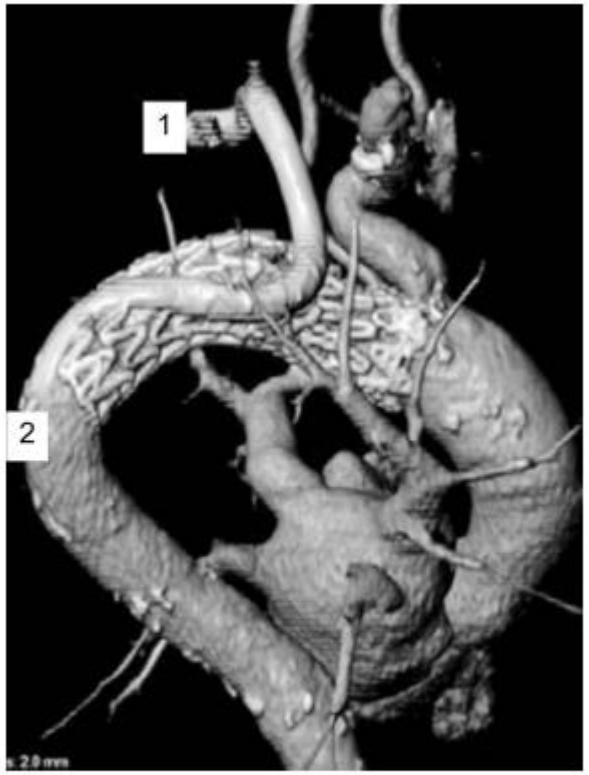


Figure 4 ◆ Follow-up CT (dorsal view of the aortic arch) performed 14 months postoperatively shows the distal (1) and proximal (2) ends of the patent periscope endograft.

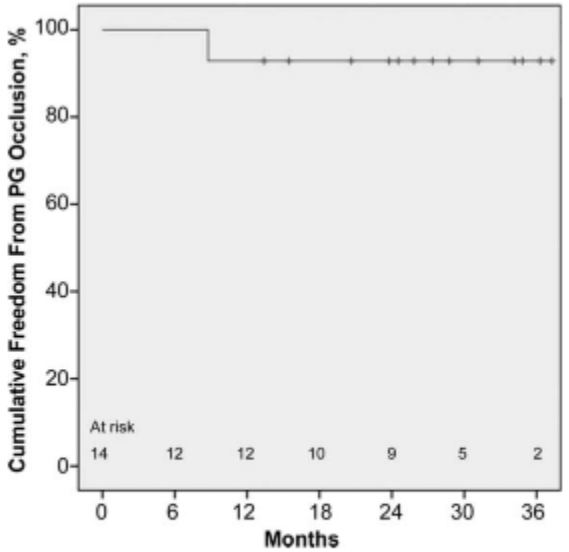
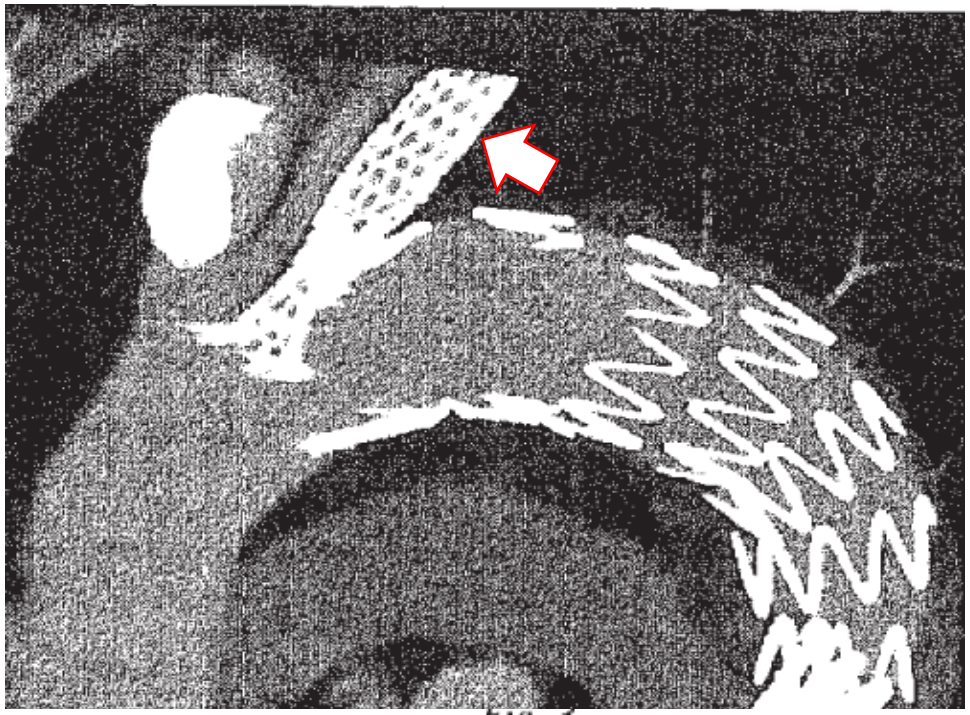


Figure 5 ◆ Freedom from occlusion for the periscope grafts (PG); standard error exceeds 10% at 25 months.

N= 14
Mean follow-up of 27 months (range 9–37)

3 or 4 Parallel Grafts (chimney, periscope)

Sizing with PG



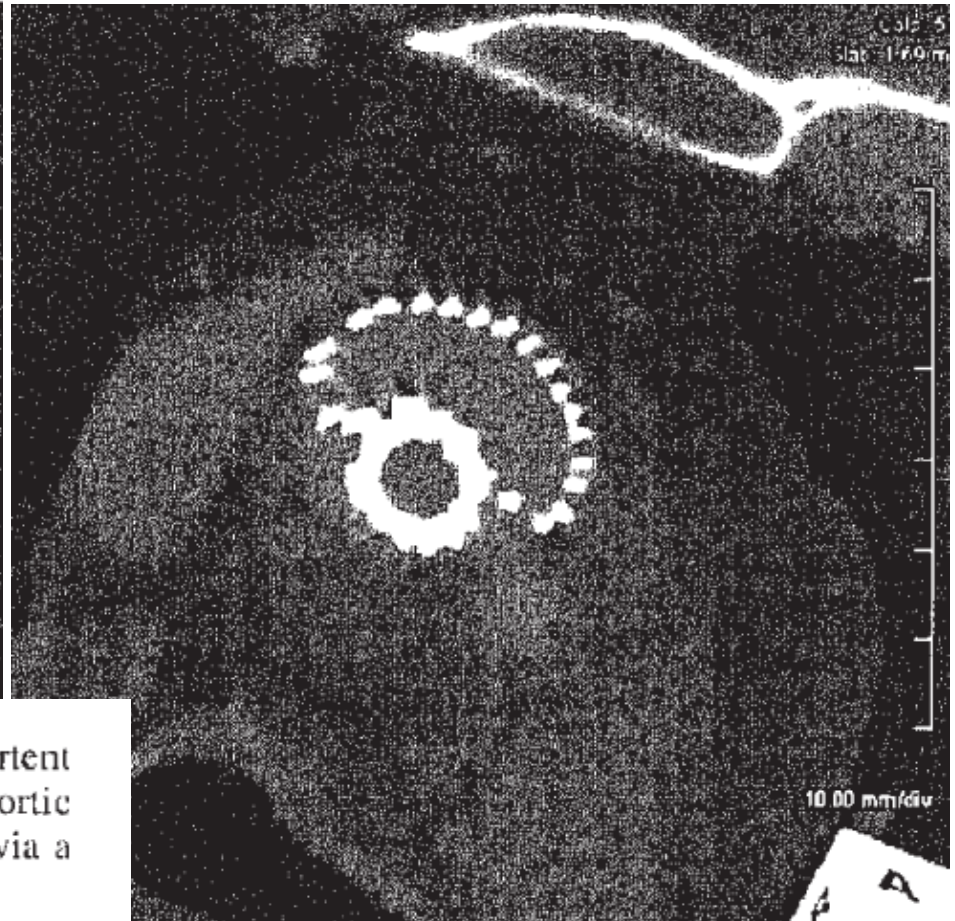
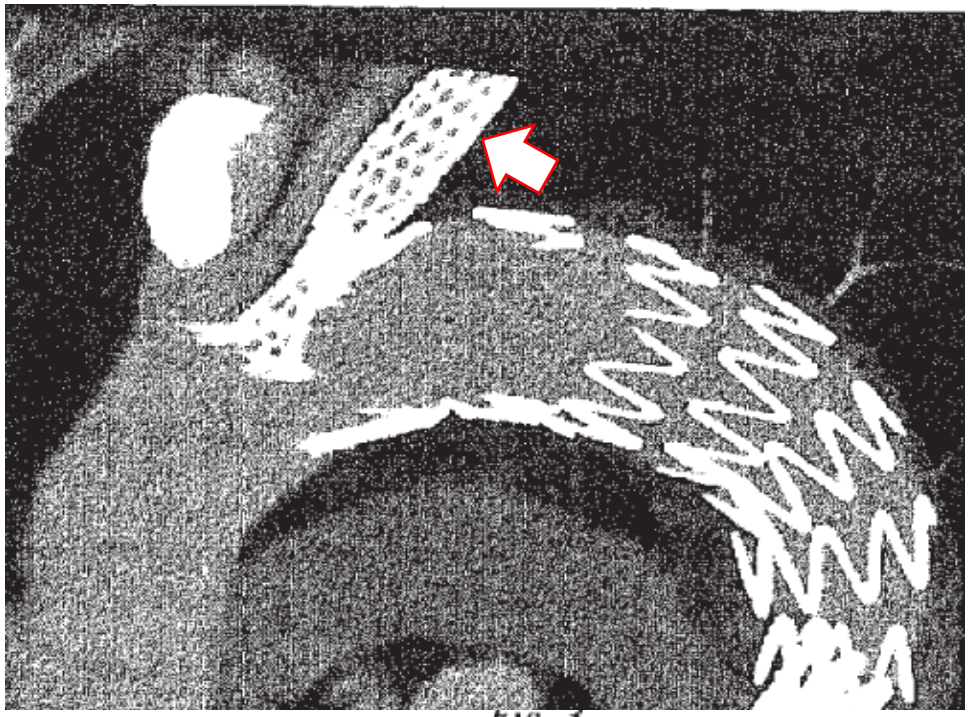


Fig. 3

A chimney in the left subclavian artery, following inadvertent coverage of its ostium in a patient treated for a Type B aortic dissection. Retrograde access to the vessel was achieved via a left brachial approach.



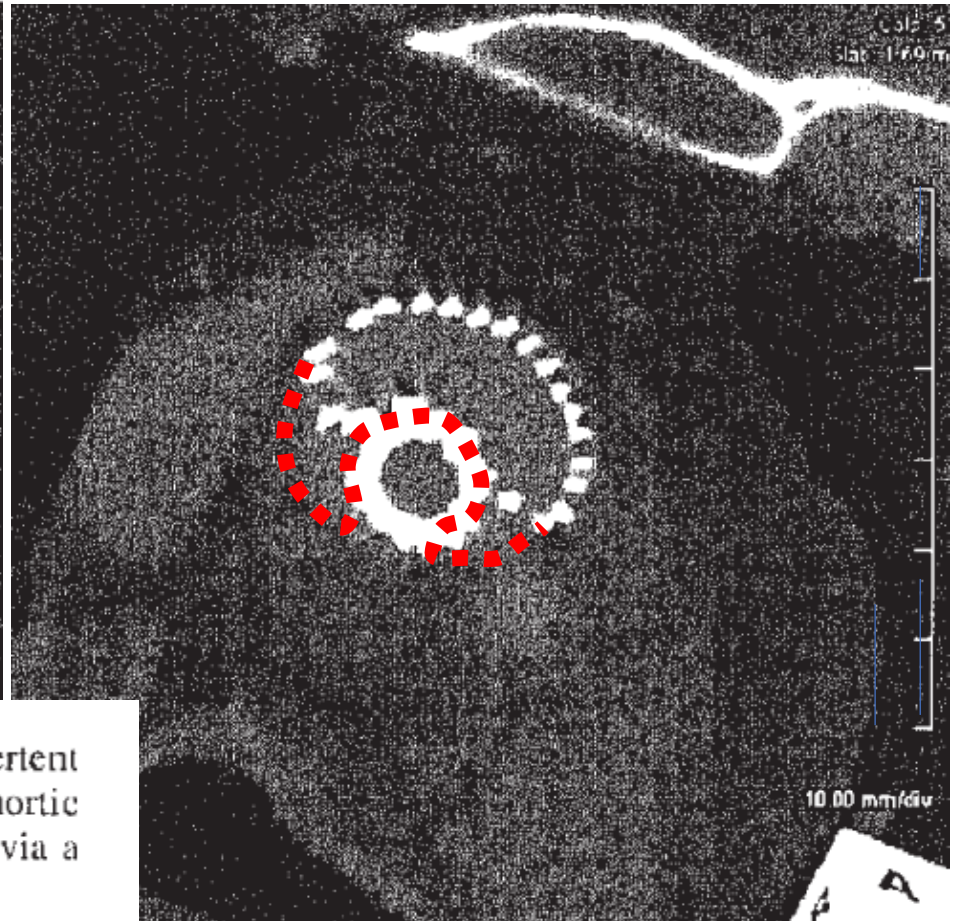
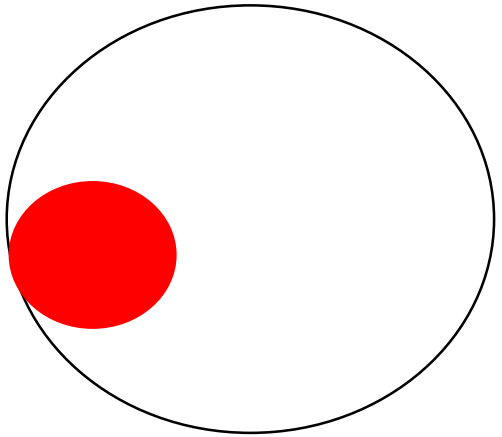


Fig. 3

A chimney in the left subclavian artery, following inadvertent coverage of its ostium in a patient treated for a Type B aortic dissection. Retrograde access to the vessel was achieved via a left brachial approach.

Actual Sizing PG TECH ARCH @ USZ



Diameter Aorta + 20%

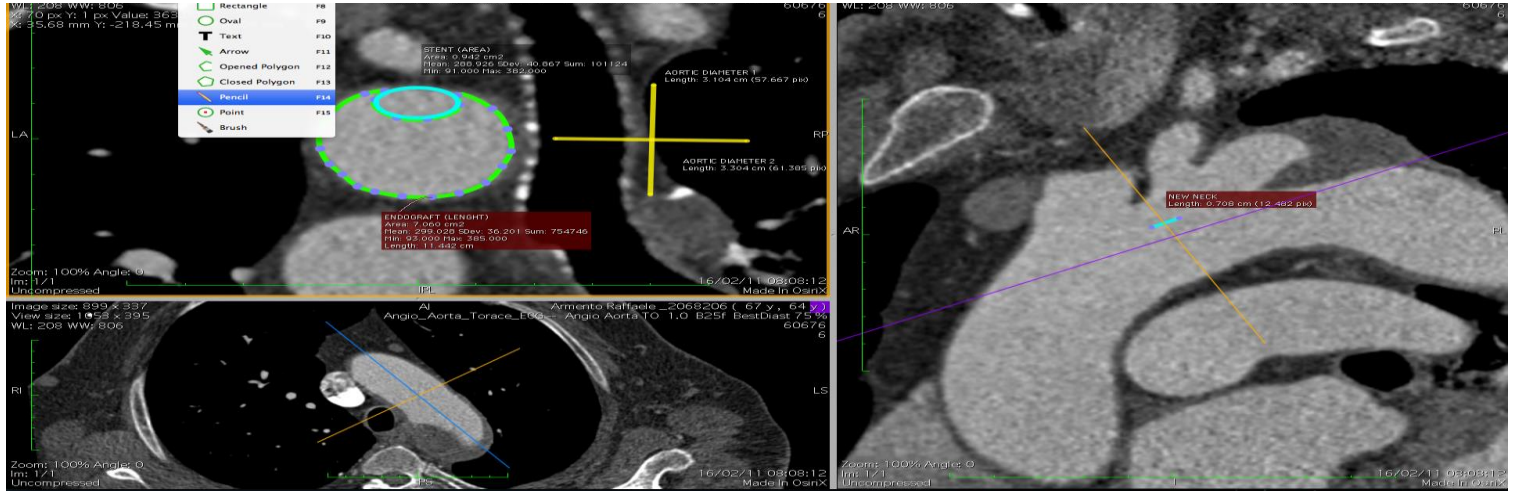
+

½ diameter PG

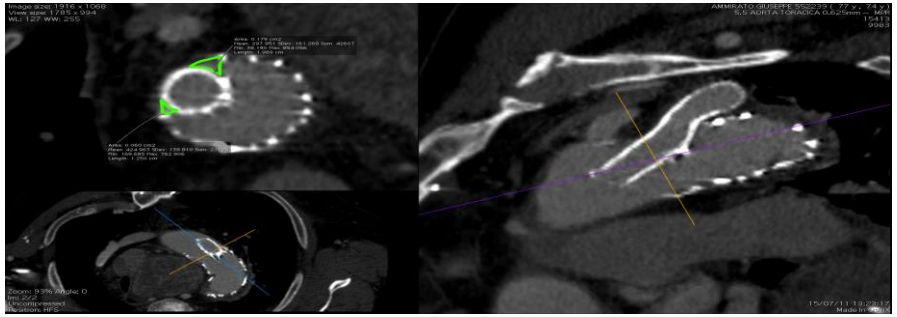
Example: (Aorta 30mm) and PG to LSA (13mm)
Regular sizing aortic stentgraft= 36mm
Sizing aortic stentgraft with PG=45
(30+6+6,5= 42.7mm)

Title: "Over-SIRIX": a new method for sizing aortic endografts in combination with the chimney grafts. Early experience with aortic arch disease.
Paper code: J Cardiovasc Surg-9687

Stefano Fazzini[1]*, Metteo Orrico[1], Sonia Ronchey[1], Vittorio Alberti[1], Barbara Praquin[1], Ombretta Martinelli[2], Nicola Mangialardi[1]

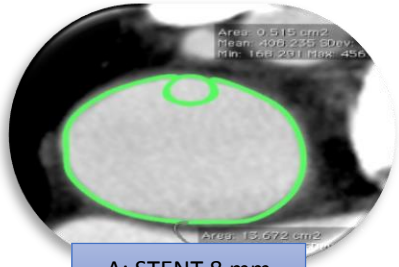


GUTTERS AREA

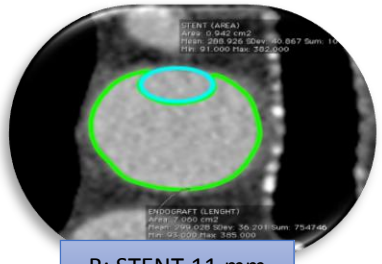


OSIRIX EVALUATION

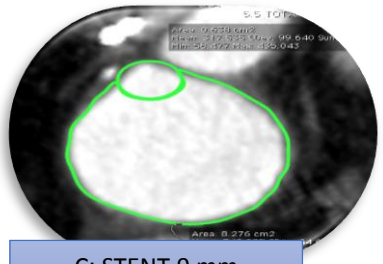
Oversizing &



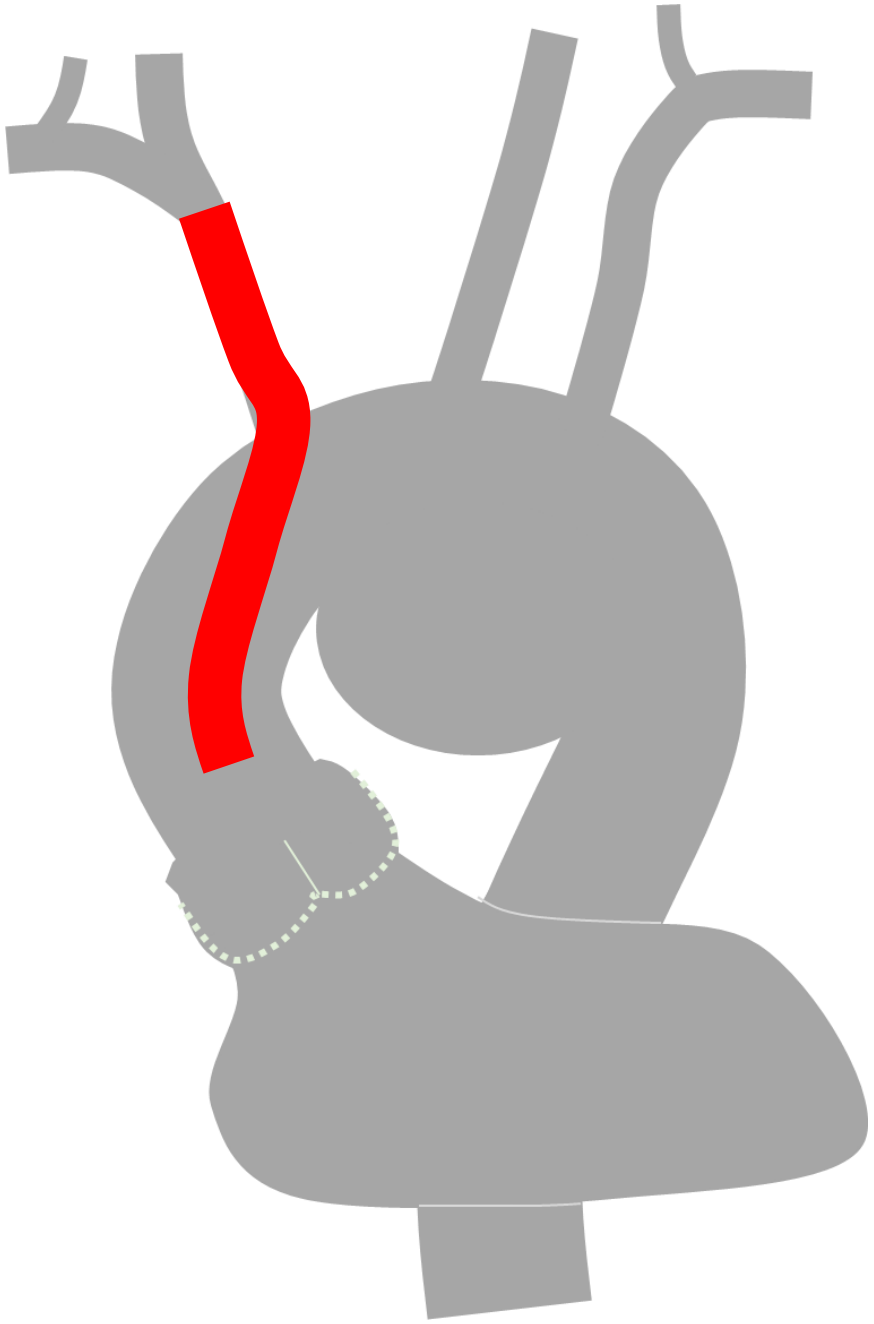
A: STENT 8 mm



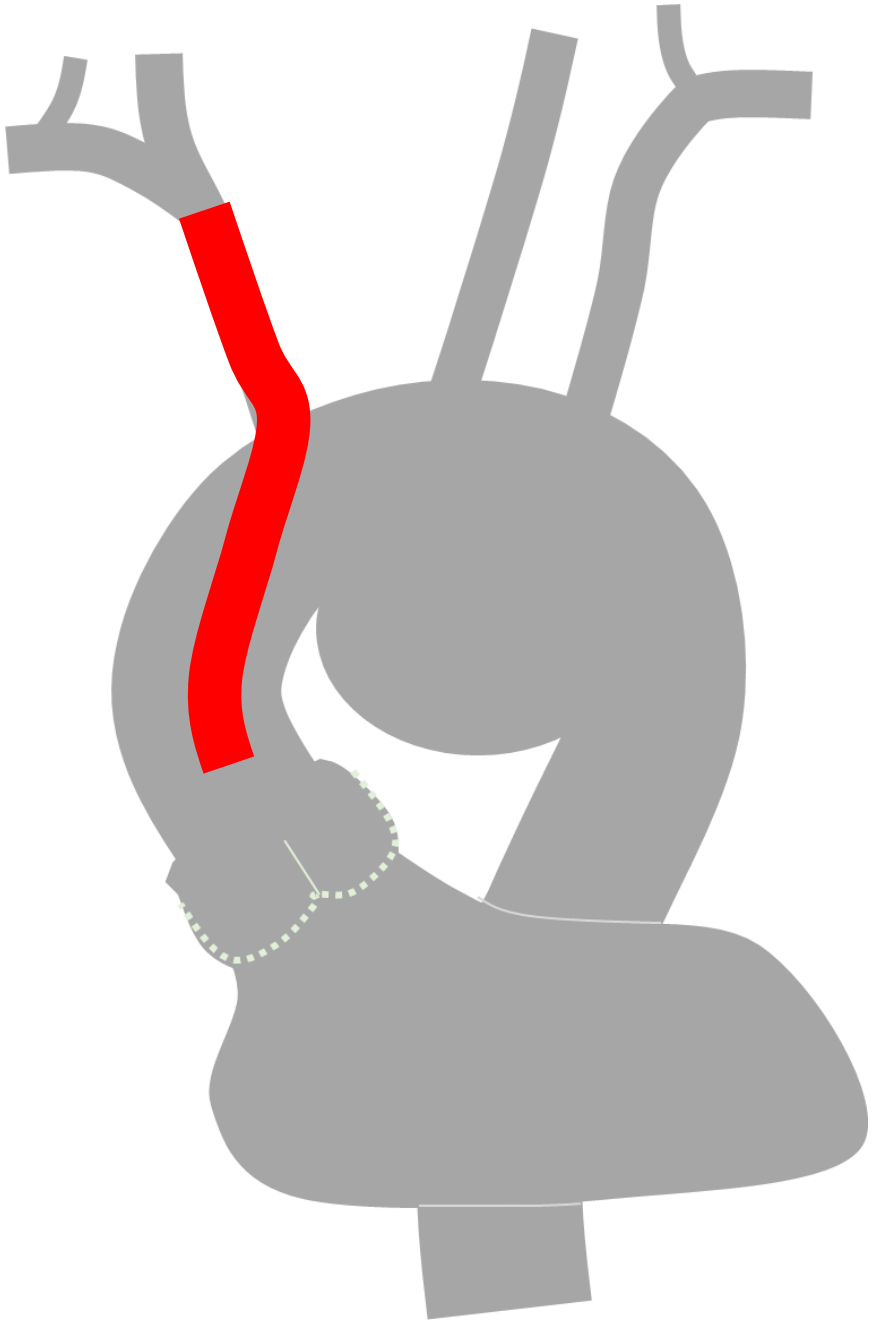
B: STENT 11 mm



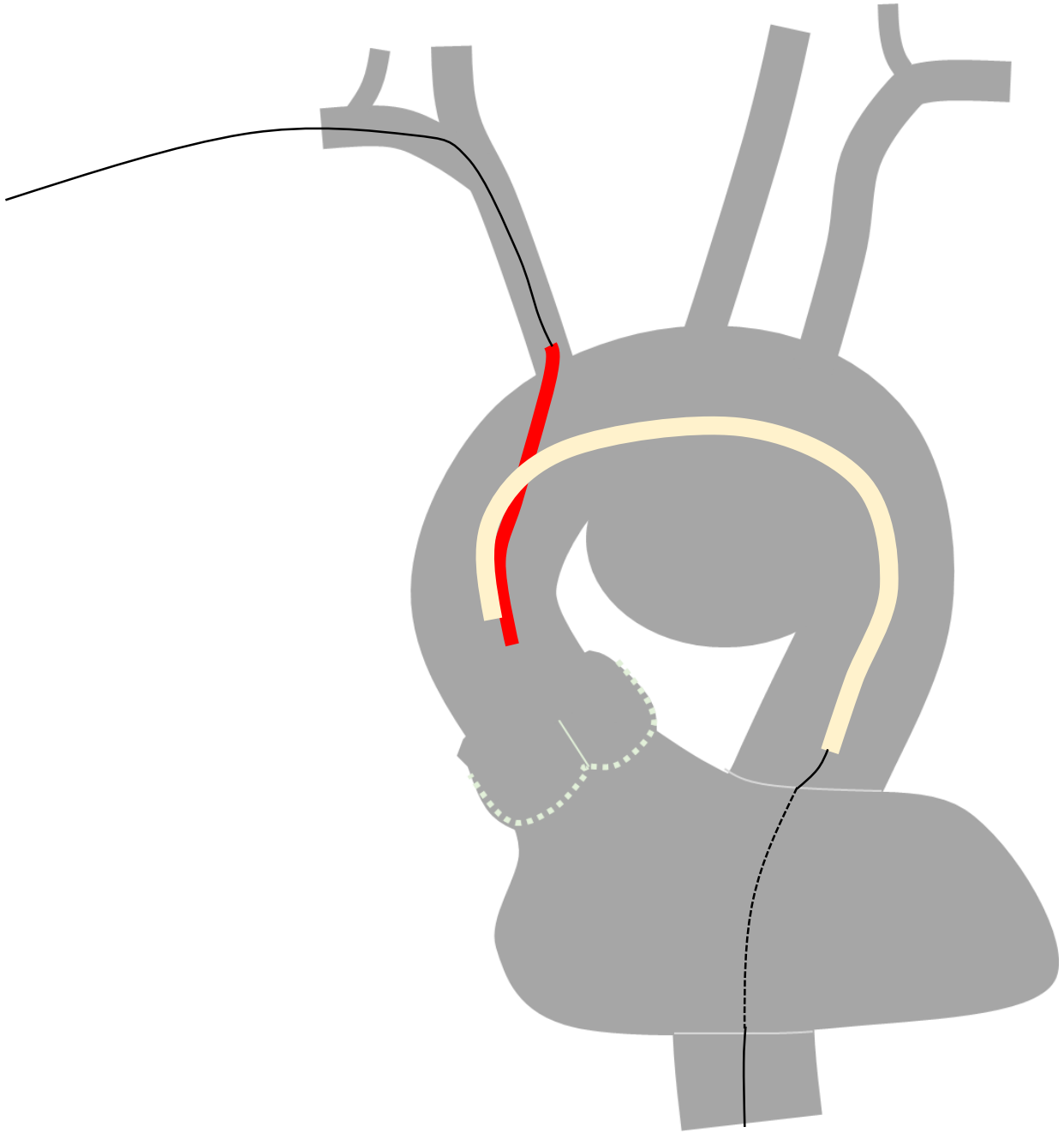
C: STENT 9 mm
(ostio dei TSA)



Technique to reduce diam of PG and/or aortic stress



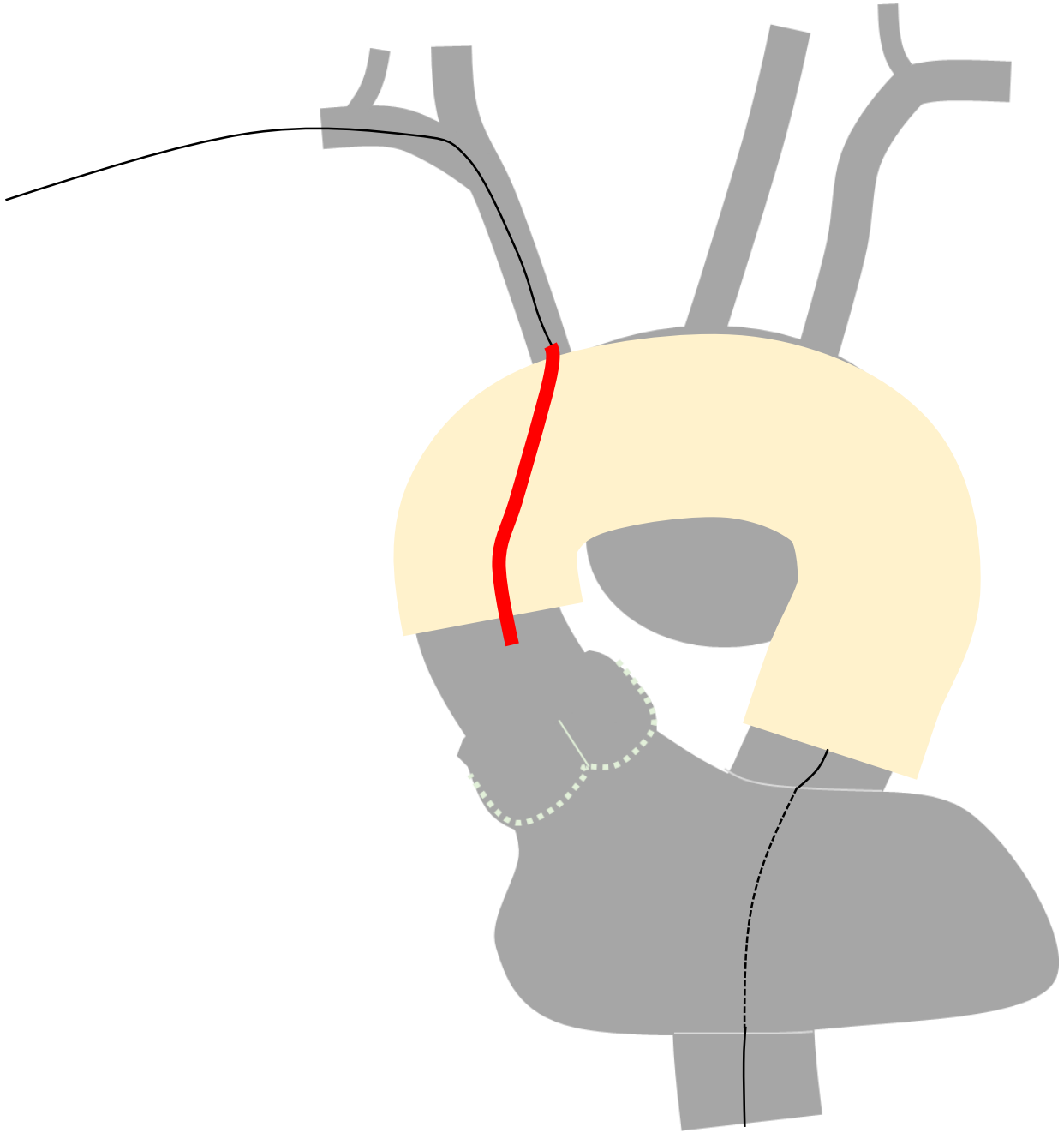
Intended PG size: 13mm



Intended PG size: 13mm

10mm PG parked

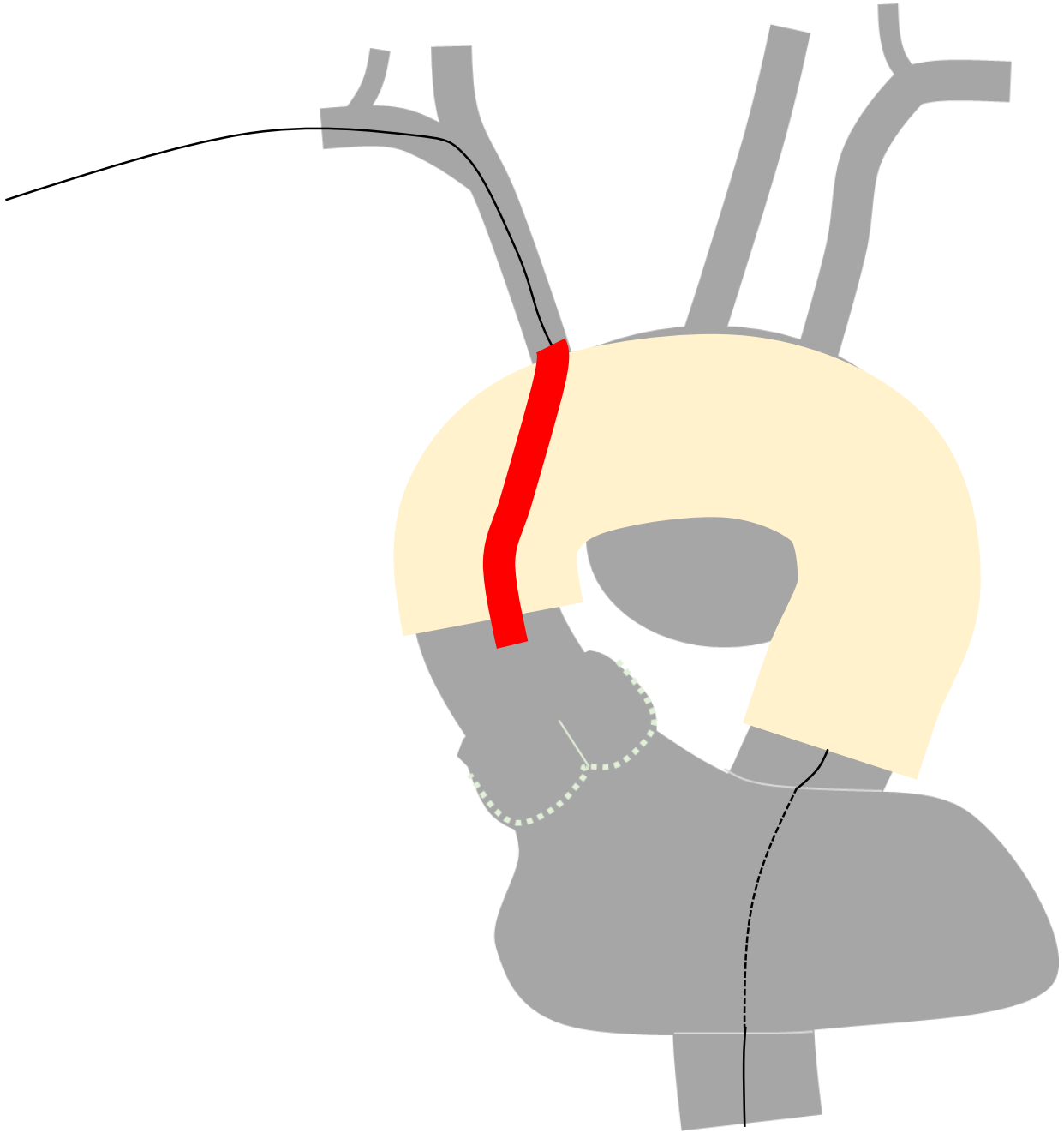
ASG parked



Intended PG size: 13mm

10mm PG parked

ASG parked
ASG deployed

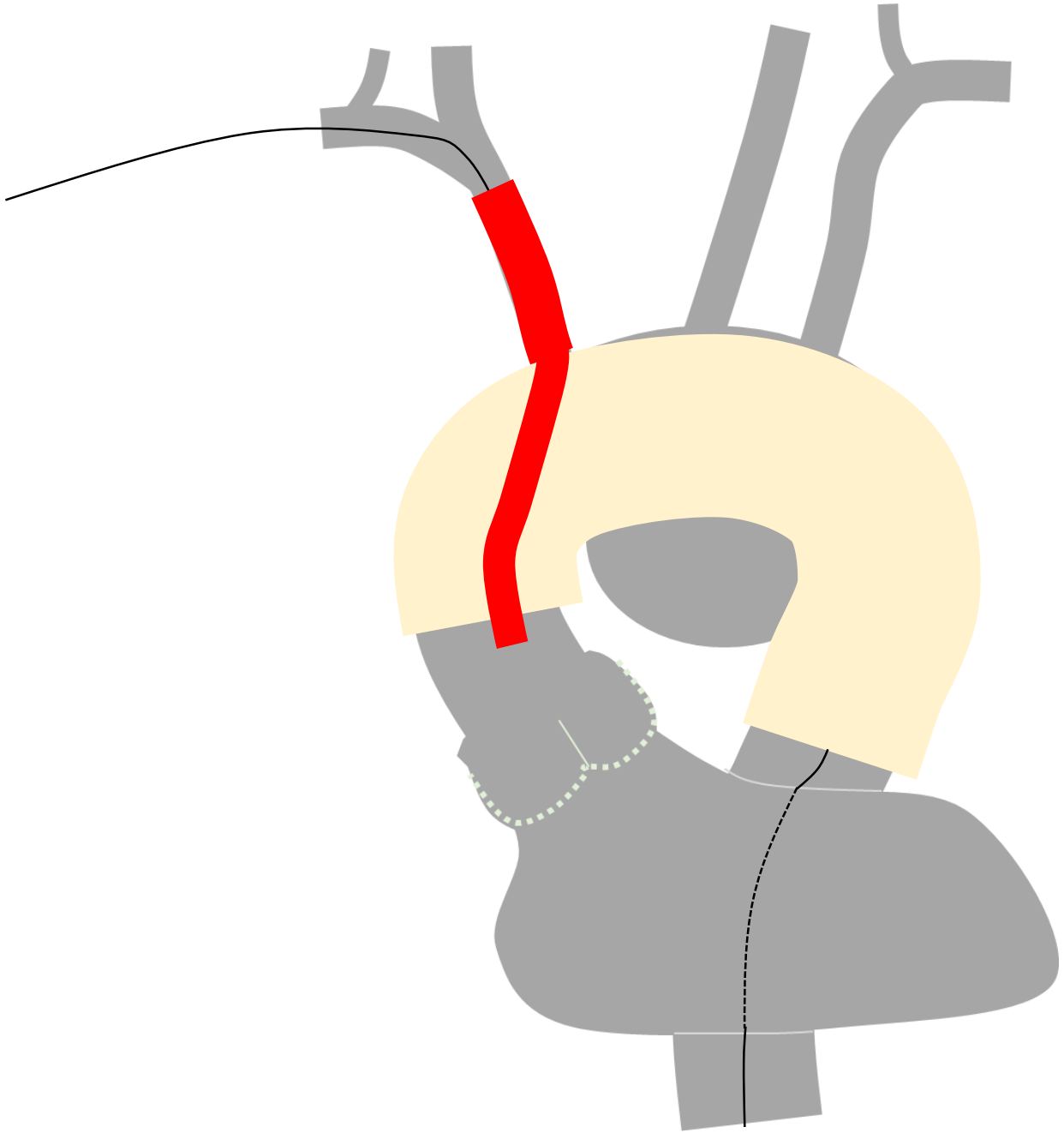


Intended PG size: 13mm

10mm PG parked

ASG parked
ASG deployed

10mm PG deployed

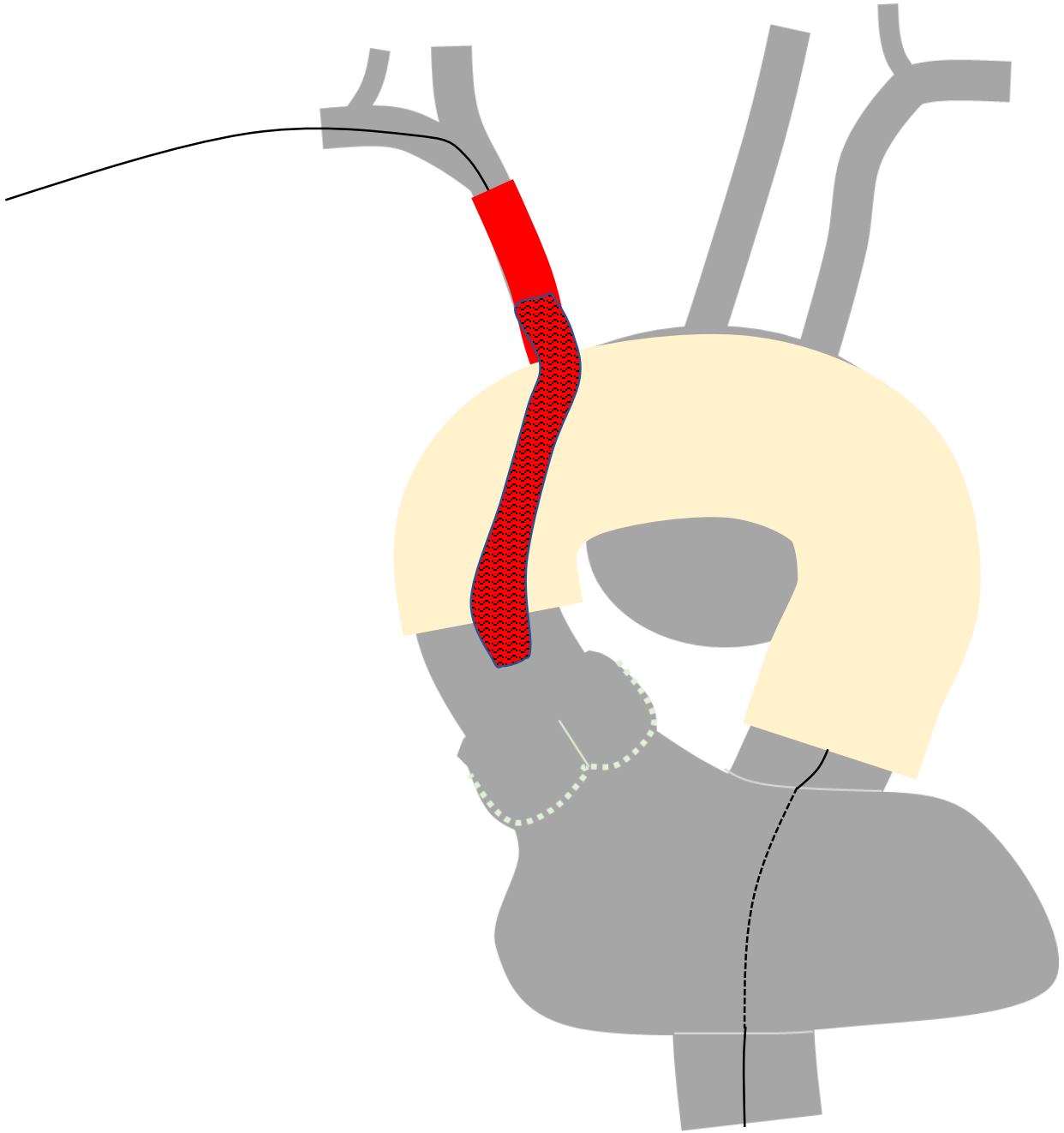


Intended PG size: 13mm

10mm PG parked

ASG parked
ASG deployed

10mm PG deployed
Extension with 13mm PG



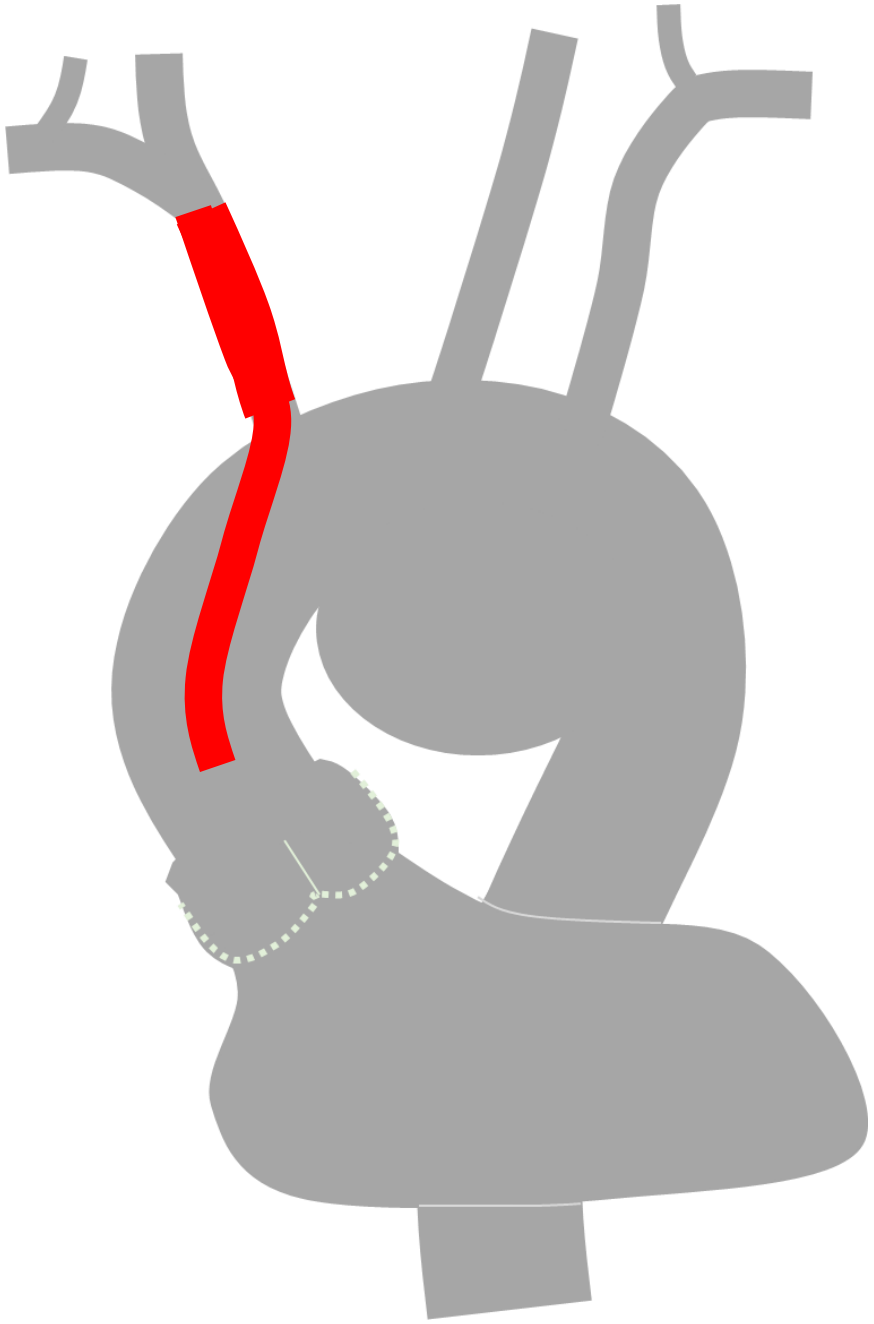
Intended PG size: 13mm

10mm PG parked

ASG parked
ASG deployed

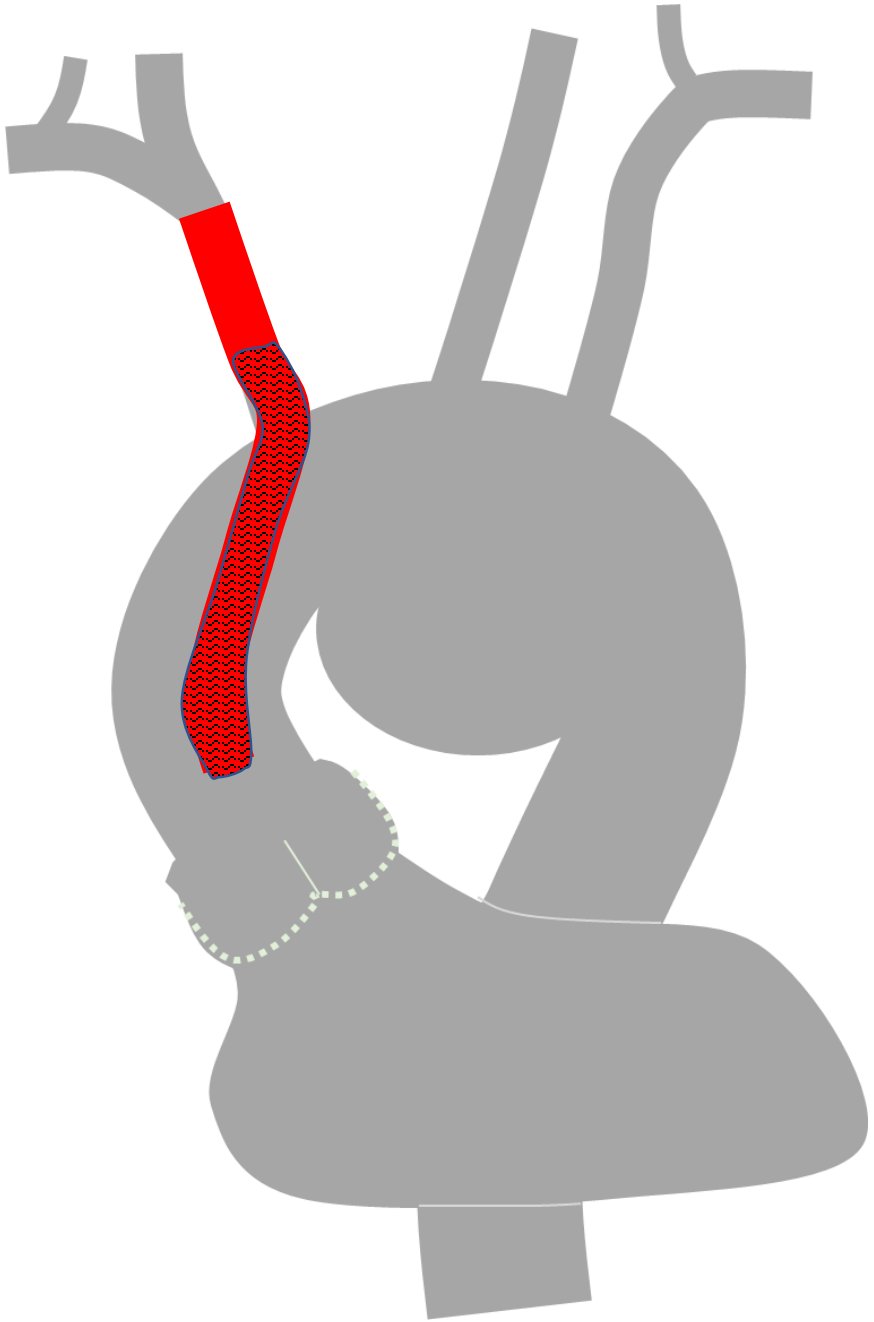
10mm PG deployed
Extension with 13mm PG

Primary relining with wallstent



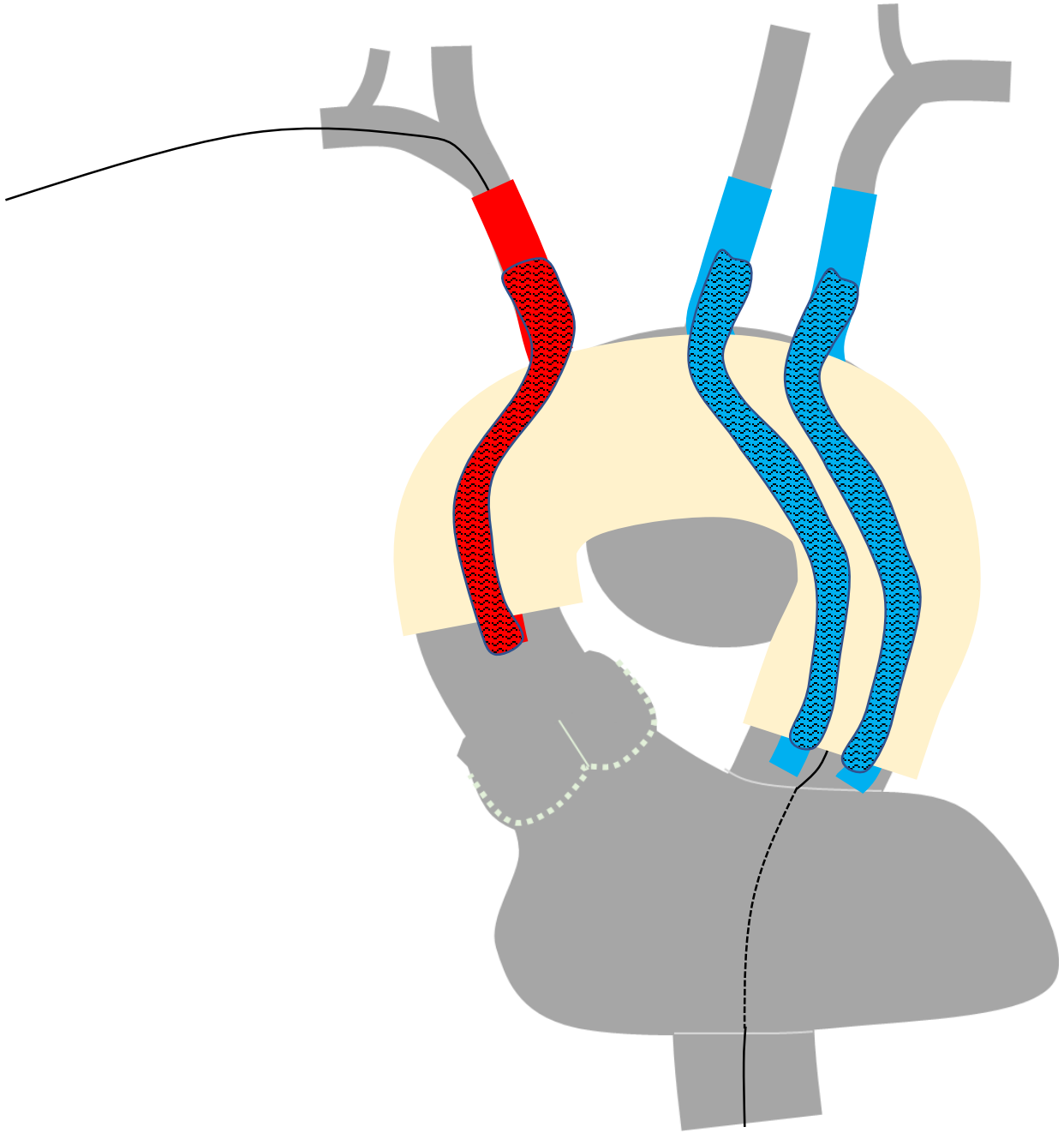
Summary

2 different SG sizes
-As small as possible in aortic LZ
-10% oversize in target vessel

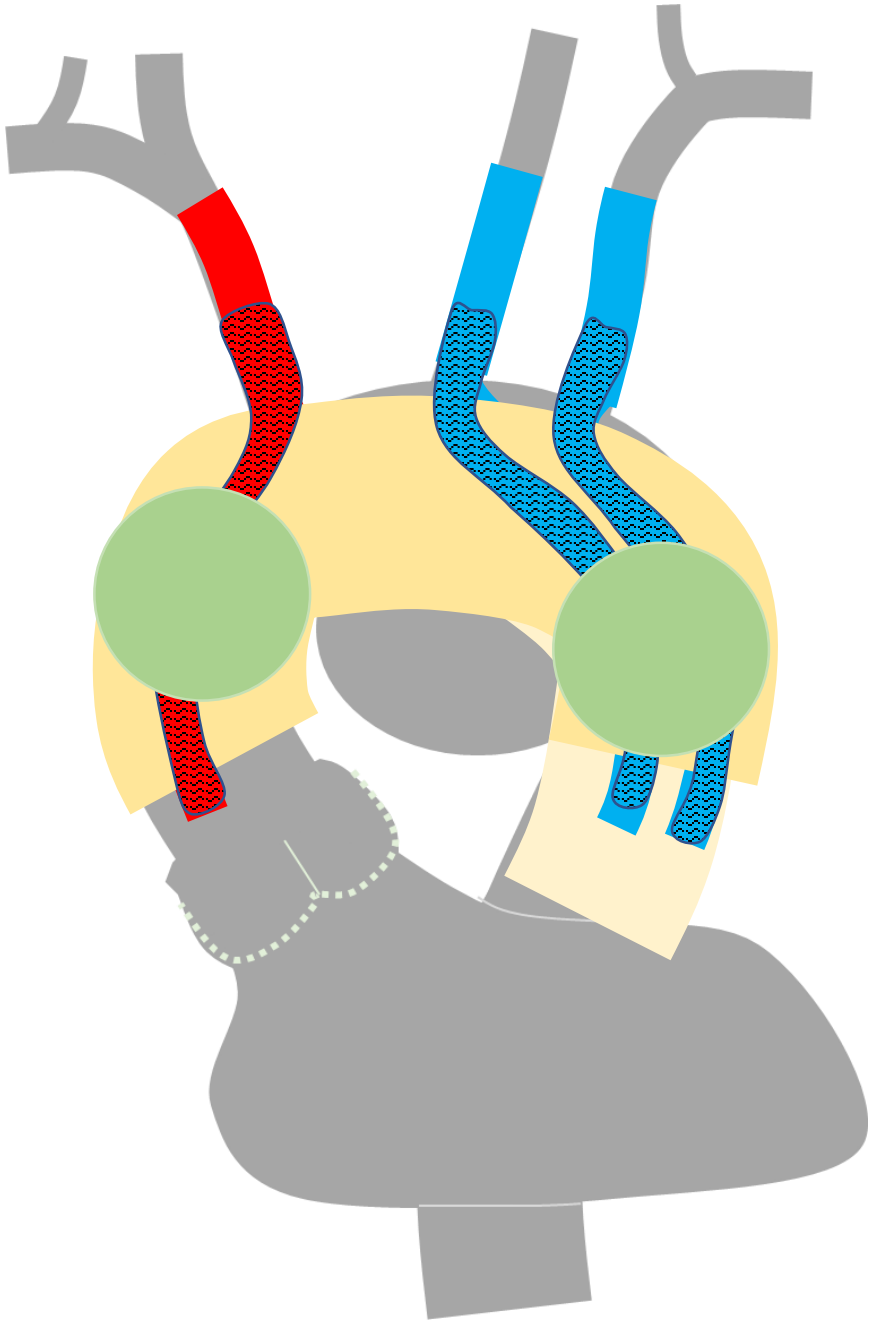


Primary relining with wallstent

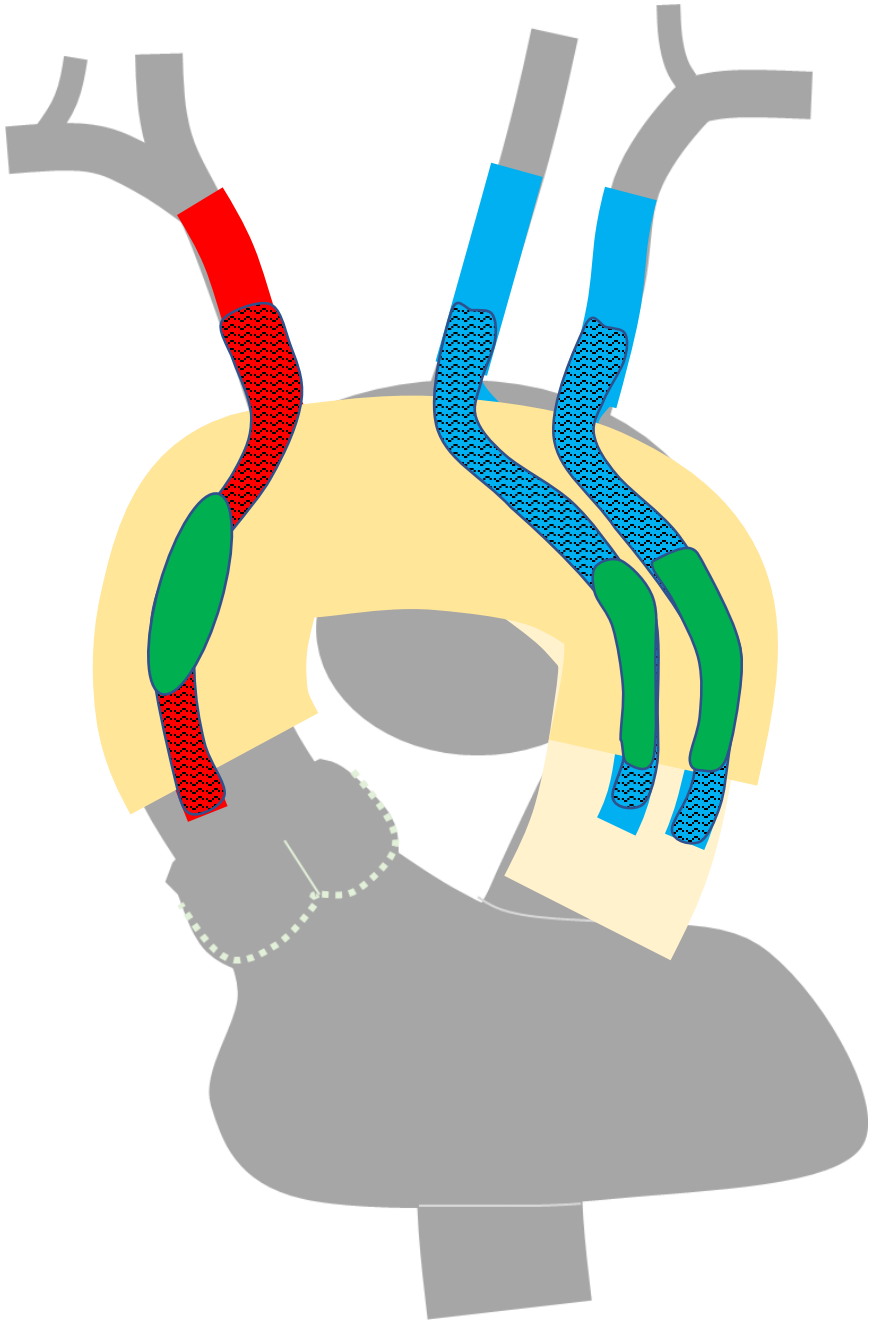
-To reinforce PG
-To reduce endoluminal infolding (2nd PG)



Similar approach for all SAV

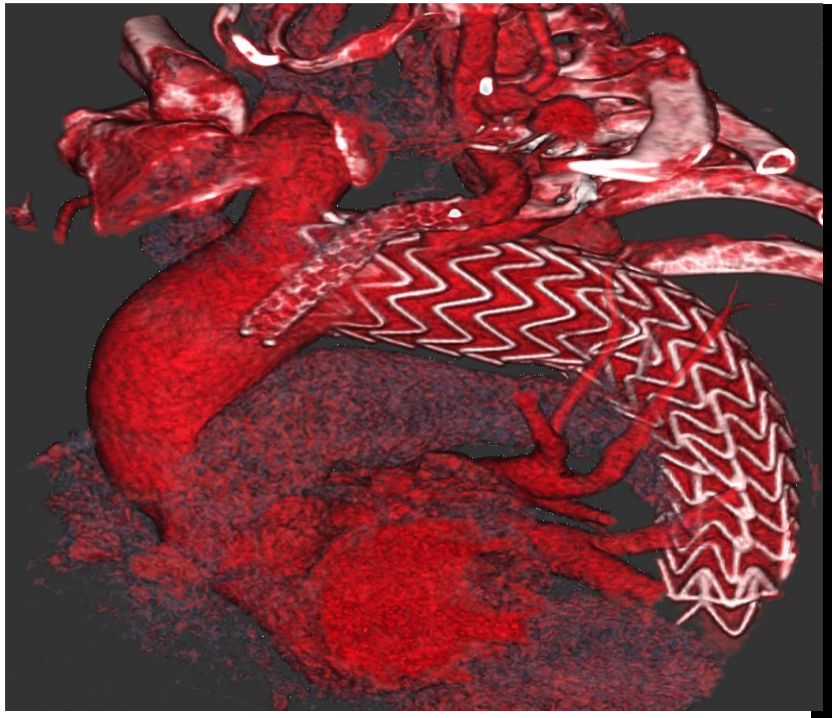


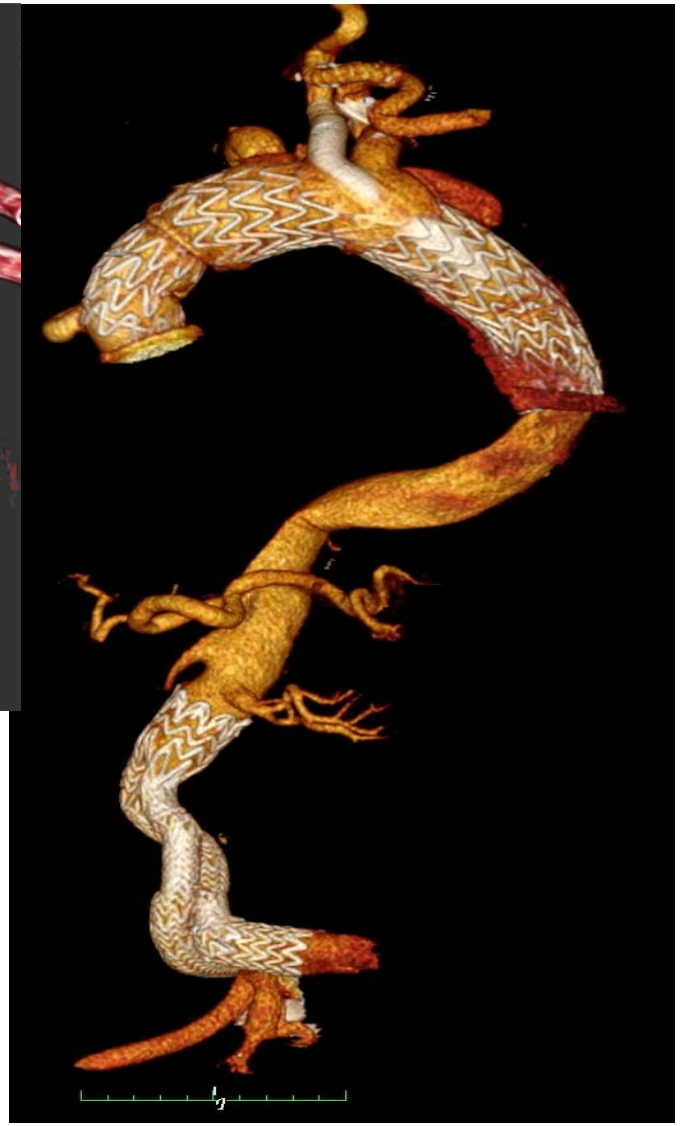
Moulding ASG



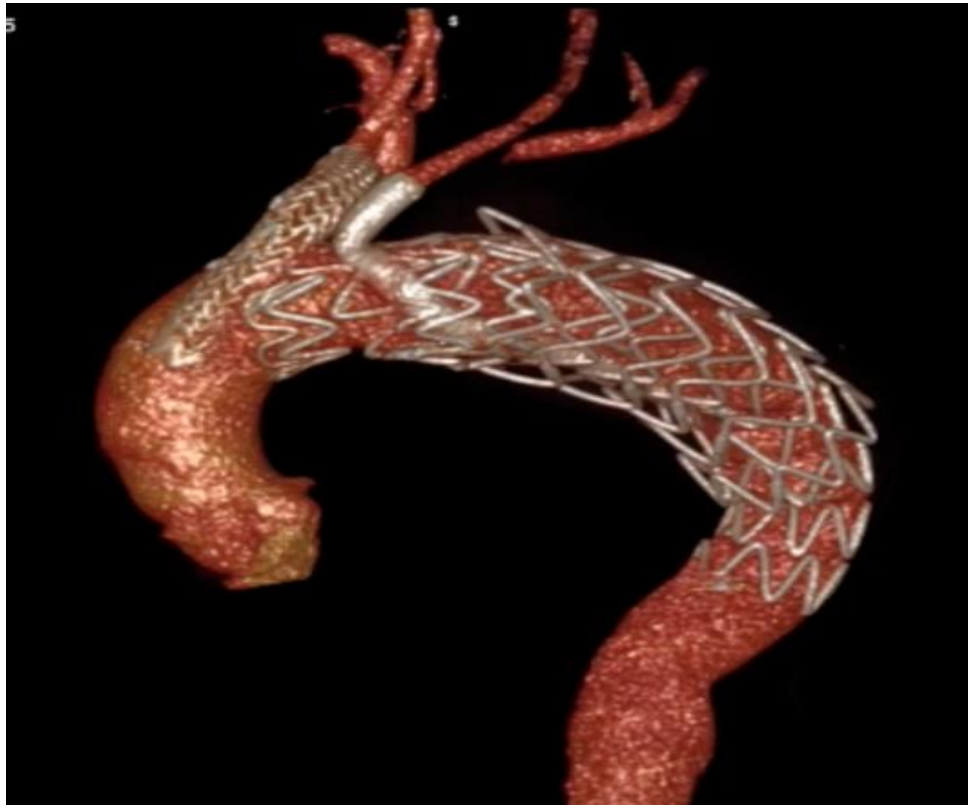
Moulding PG

CHIMNEY ORIENTATION





VESSELS
TAKE-OFF



REDUCE INTERACTION
IN THE ASCENDING

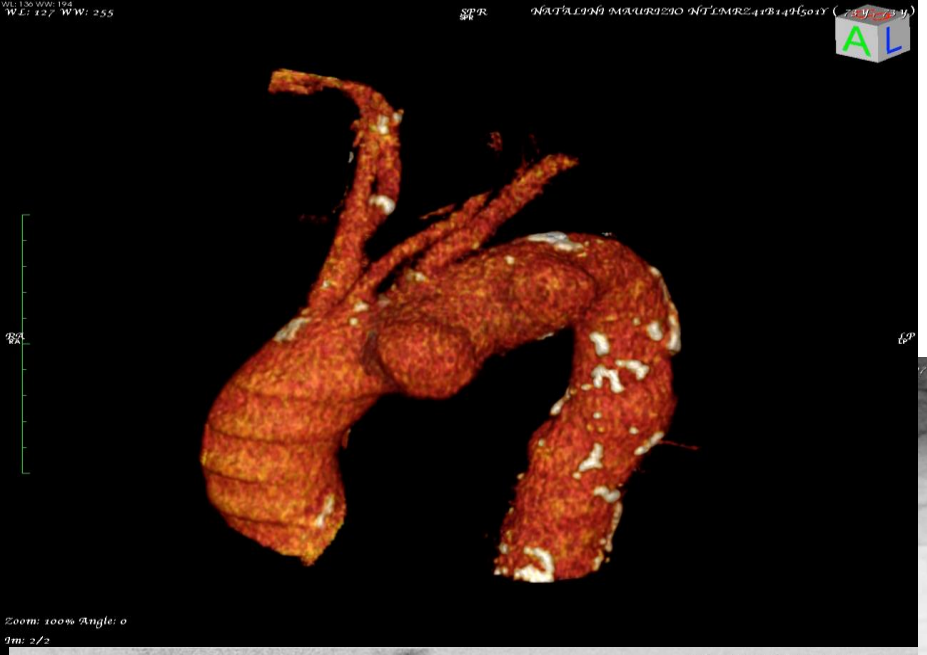
GUTTERS

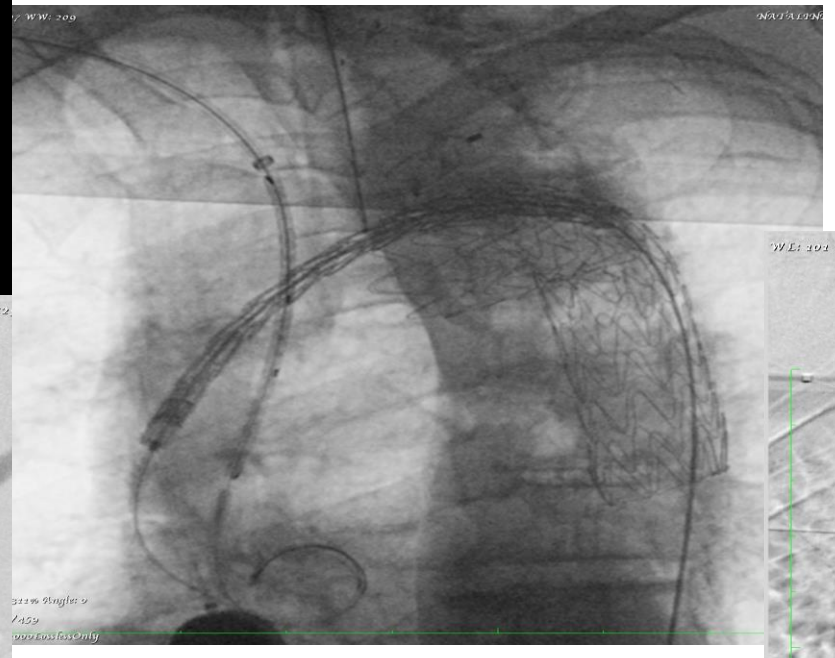
CHIMNEY OVERLAPPING → HOW LONG?

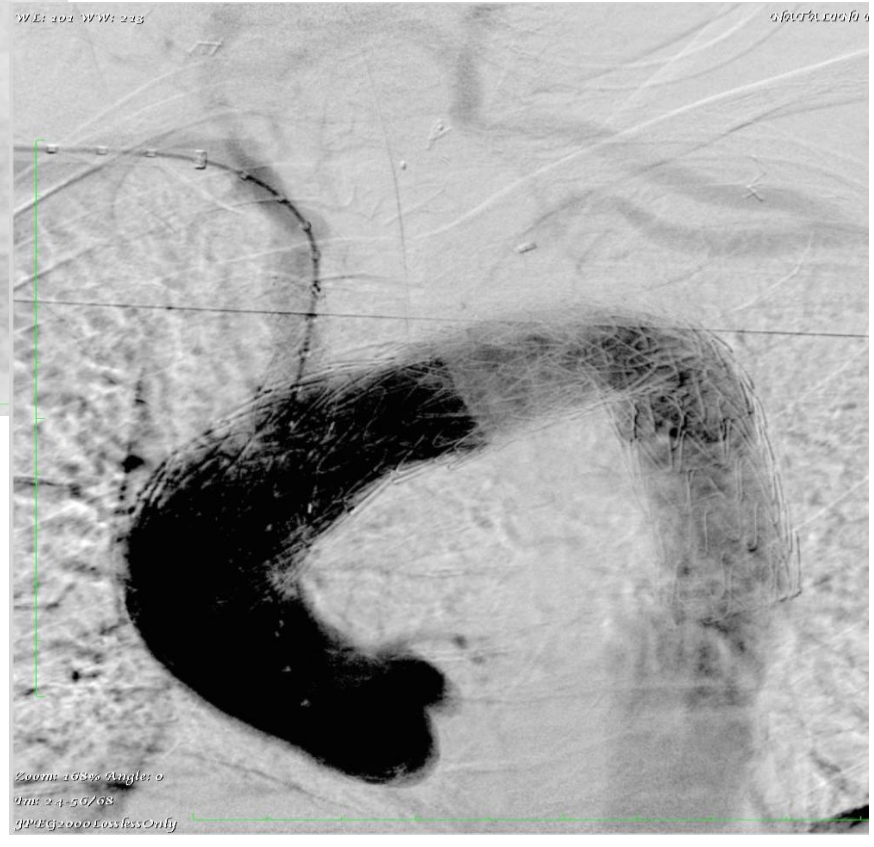
- Longer chimney → reduce EL (gutters)

- Bad landing zone → curvature/graft LZ

RETROGRADE TYPE A

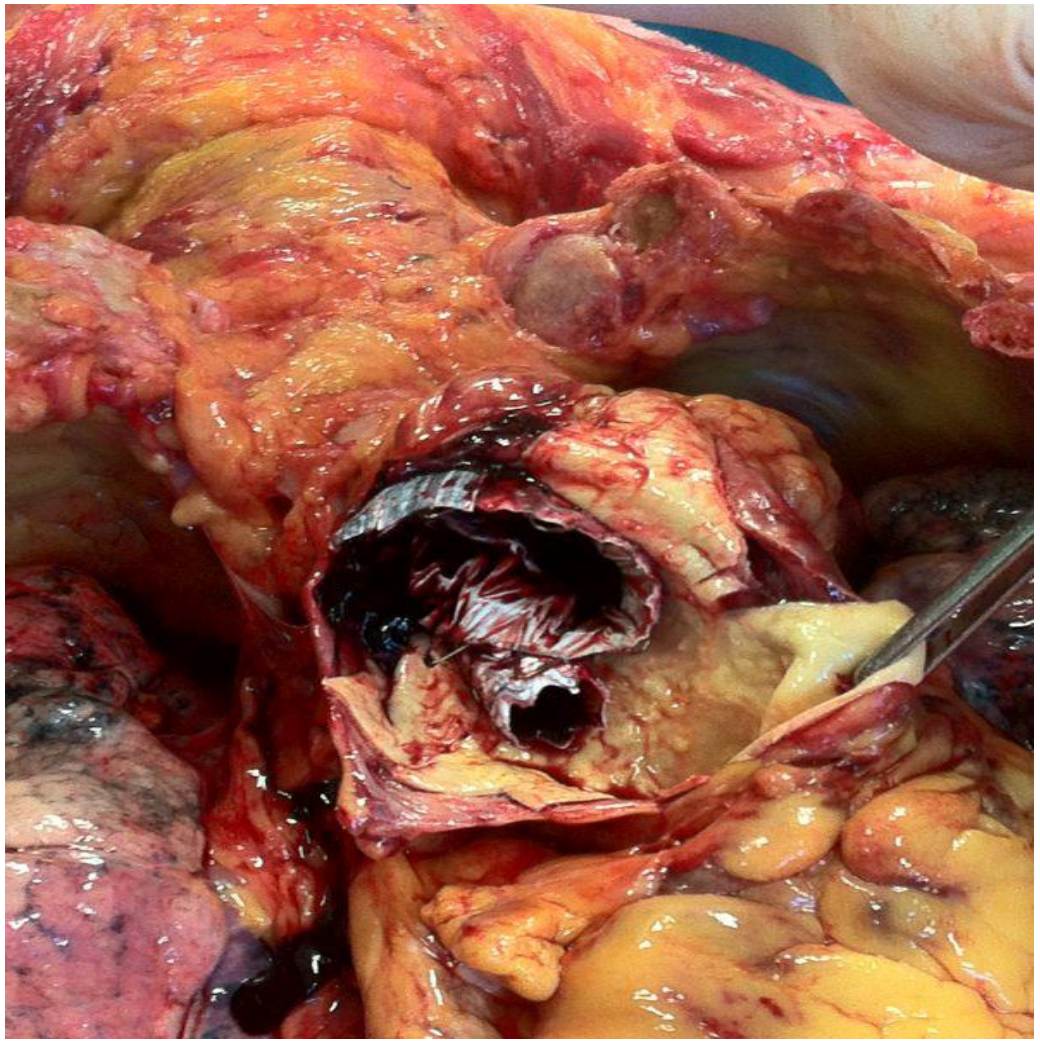


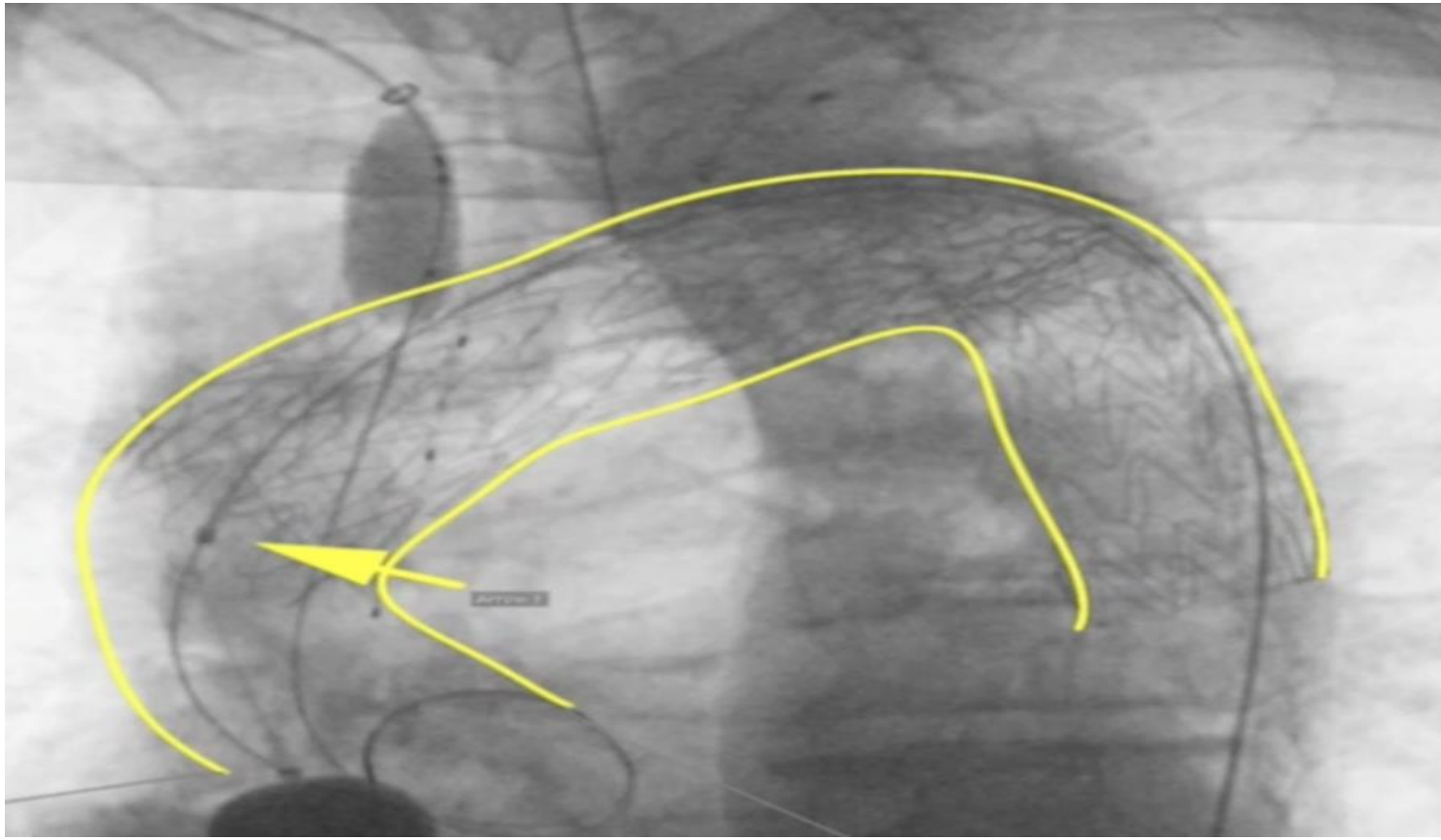




RETROGRADE TYPE A

Day 4 sudden death





DO THEY WORK?

Chimney Technique for Aortic Arch Pathologies:
An 11-Year Single-Center Experience

Nicola Mangialardi, MD; Eugenia Serrao, MD; Holta Kasemi, MD; Vittorio Alberti, MD; Stefano Fazzini, MD; and Sonia Ronchey, MD, PhD

Department of Vascular Surgery, San Filippo Neri Hospital, Rome, Italy.

- TECHNICAL SUCCESS 39/39 100%
- MORTALITY 4 10.2%
- PROCEDURE REL COMPLICATIONS 4 10.2%
  - MINOR STROKE (2 RUPT-1 ELECT) 3
  - PARAPARESIS 1
  - EARLY TYPE I EL 0

J Endovasc Ther. 2014;21:312–323

Median FUP of 36 months

J ENDOVASC THER
2014;21:312–323

◆CLINICAL INVESTIGATION ◆

Chimney Technique for Aortic Arch Pathologies:
An 11-Year Single-Center Experience

Nicola Mangialardi, MD; Eugenia Serrao, MD; Holta Kasemi, MD; Vittorio Alberti, MD; Stefano Fazzini, MD; and Sonia Ronchey, MD, PhD

Purpose: To report our single-center experience with the chimney technique for aortic arch pathologies and the mid- to long-term results in these patients.
Methods: From June 2002 to May 2013, 26 patients (18 men; mean age 71.2 years, 53–86) underwent thoracic endovascular aortic repair (TEVAR) combined with chimney technique. Indications for treatment were: a proximal landing zone <15 mm long distal to the left subclavian artery (LSA), thoracic aortic aneurysm (n=13), complicated type B aortic dissection (n=10), type I endoleak after previous TEVAR (n=2), and penetrating aortic ulcer (n=1). Treatment was performed in the emergency setting in 7 cases. The 28 chimney stent-grafts (double chimneys in 2 patients) were deployed in the innominate artery (n=7), left common carotid artery (n=10), and LSA (n=11). All patients underwent computed tomography before discharge, at 1, 6, and 12 months, and yearly thereafter.
Results: Technical success was 100%. One (3.8%) perioperative death was due to a cerebral hemorrhage. No major stroke was registered, but 3 (11.5%) minor strokes occurred (all resolved). Paraparesis developed in 2 (7.7%) patients. Median follow-up was 36.8 months (range 1–131), during which an additional 4 (15.4%) patients died, but only 1 death was aneurysm-related. Chimney graft patency was 89.3% (25/28); an asymptomatic fracture was found in a patent chimney stent-graft at the 18-month follow-up. The type I endoleak rate was 23% (n=6); 3 endoleaks associated with aneurysm sac enlargement were treated.
Conclusion: The chimney technique for aortic arch pathologies is safe and feasible and may be an option in patients considered at high risk for surgery or who are ineligible for conventional TEVAR, especially in the emergency setting. Concern persists regarding type I endoleak, and long-term follow-up remains mandatory.

J Endovasc Ther. 2014;21:312–323

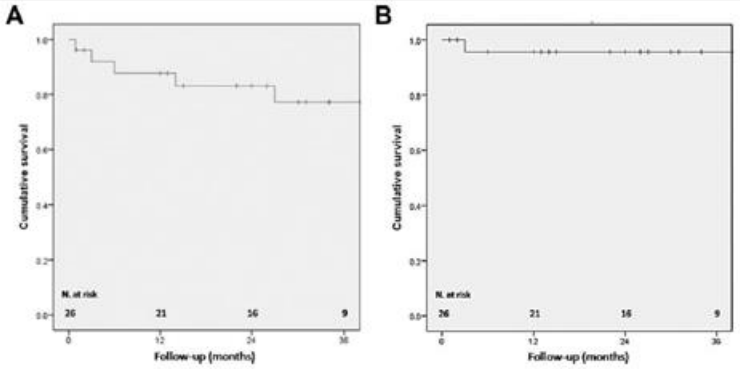


Figure 3 ◆ Kaplan-Meier estimates of (**A**) overall survival and (**B**) freedom from aneurysm-related death. The + indicates censored data. The standard did not exceed 10% at 34 months.

European Multicenter Registry for the Performance of the Chimney/Snorkel Technique in the Treatment of Aortic Arch Pathologic Conditions

Michel J. Bosiers, MD,* Konstantinos P. Donas, MD,* Nicola Mangialardi, MD, Giovanni Torsello, MD, Vincent Riambau, MD, Frank J. Criado, MD, Frank J. Veith, MD, Sonia Ronchey, MD, PhD, Stefano Fazzini, MD, and Mario Lachat, MD

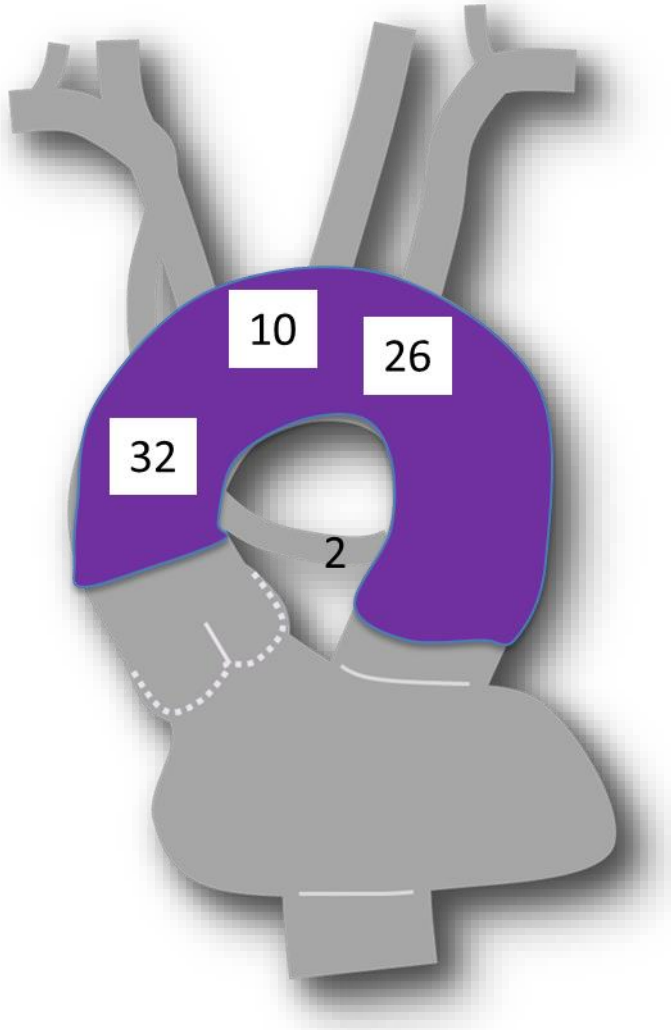
Ann Thorac Surg. 2016

95 PTS → 48 EMERGENCY

- TECHNICAL SUCCESS 89.5%
- 30 DAYS MORTALITY 9.5%
  (NONE AORTA RELATED)
  MAJOUR STROKE 2%
- TYPE I EL 10.5%
  (SOLVED SPONTANEOUSLY 50%)
- PRIMARY PATENCY 98%
- REINTERVENTION RATE 5.8%

Parallel Grafts ARCH@USZ

(all Gore TAG/Viabahn/Excluder)



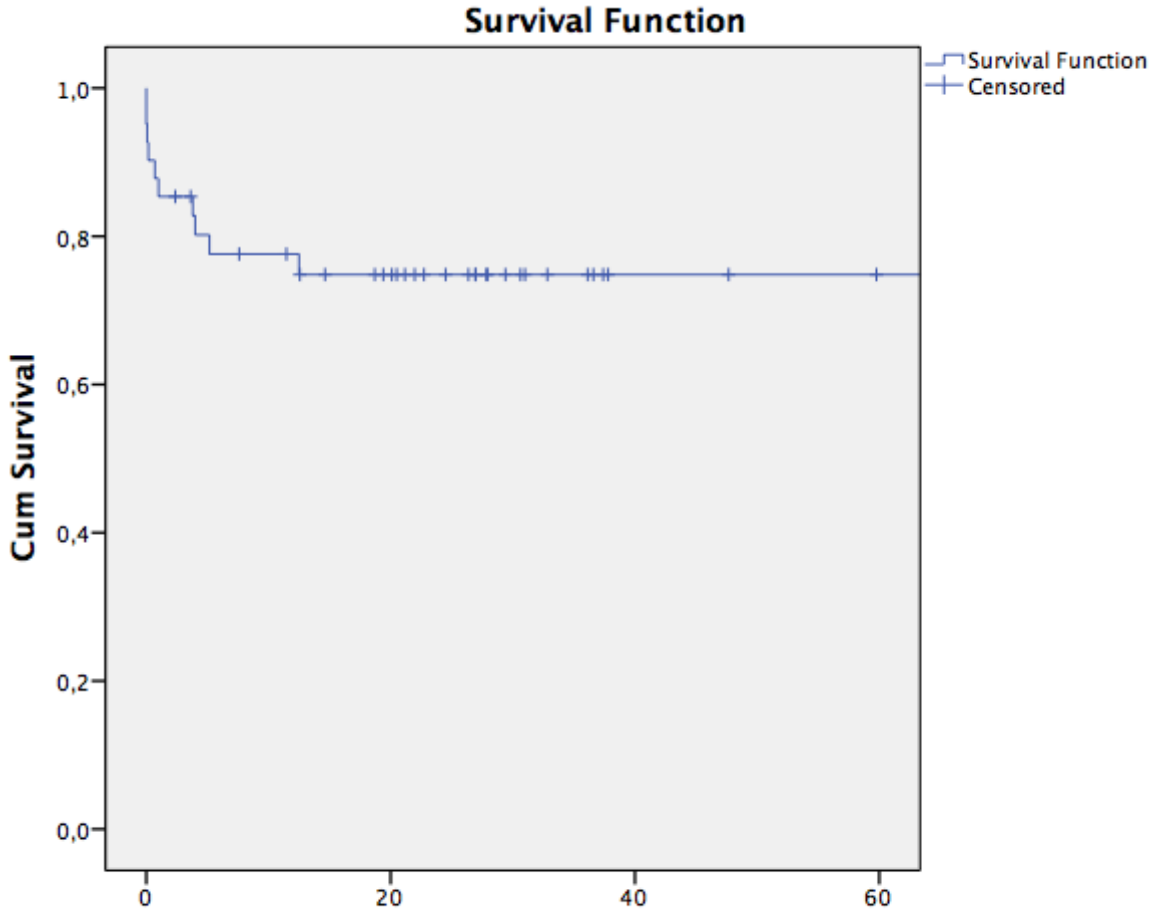
n	30d mortality	CVA/SCI	EL
68	12%	9%	18%

40% acute patients
49% redo thoracic aorta

USZ Long-Term Study

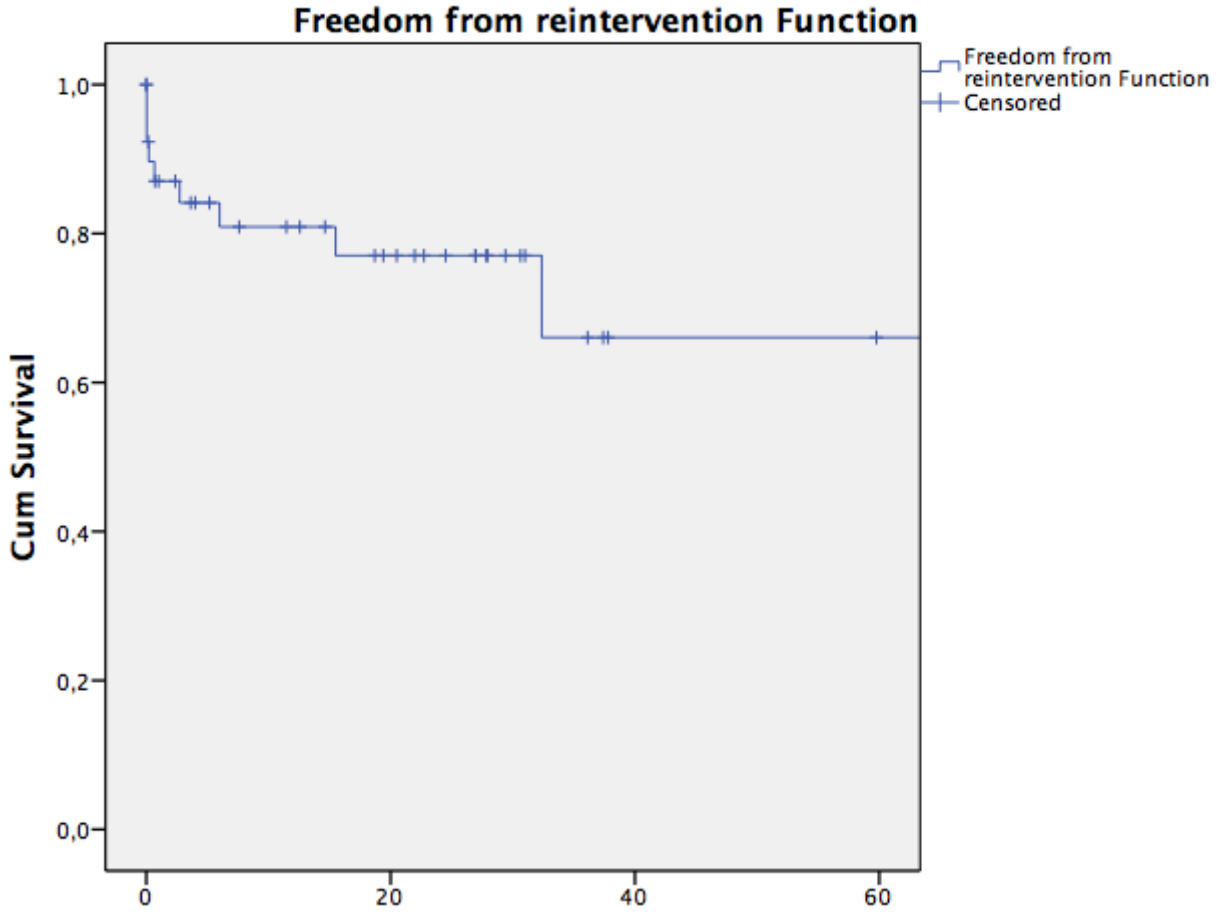
- **41** first ARCH PG-EVAR patients treated up to **May 2014**

Mean FUP **22** (0-65; 17) months



Pt at risk	41	23	4	2

Mean FUP **22** (0-65; 17) months



months	0	20	40	60
Pt at risk	41	18	3	2

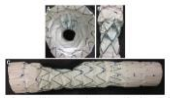
Parallel Grafts - Conclusions

Parallel grafts used in the aortic arch

- **Off-The-Shelf repair technique**
- **Safe in selected patients**
- **Behave durable up to 3 years mean follow-up**
  - **Taking into account substantial number of reinterventions to maintain seal or branch patency**

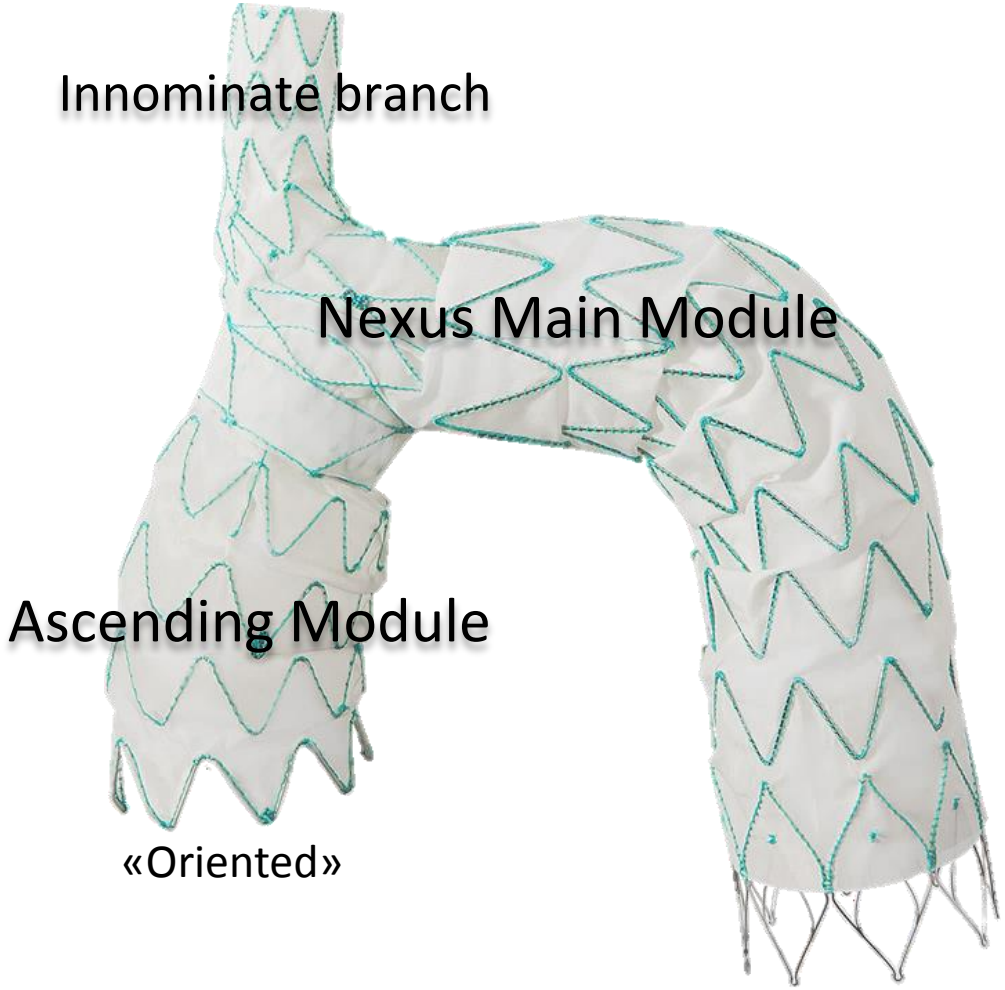
ARCH devices

Aortic Arch Devices: Results @ 30days

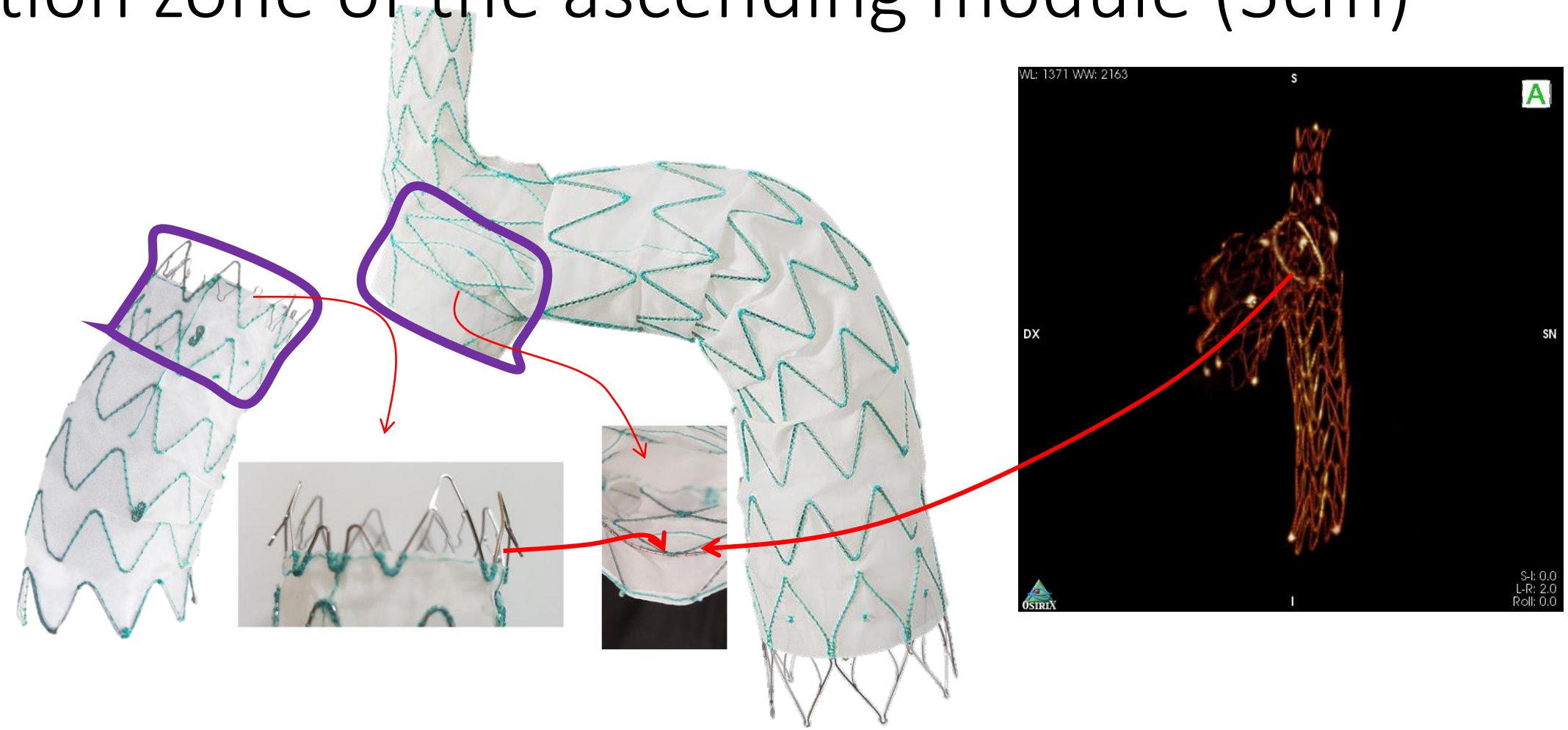


Fabric	n	30d mortality	CVA/SCI	EL
Gore	**30**			
Zone 0-1	7	0	29%	NA
Zone 2	23	0	4%	22%
Medtronic	**9**			
Zone 2	9	0	33%	0
Bolton	**34**			
Single Branch	8	25%	13%	17%
Double Branch	26	12%	4%	22%
Cook	**38**			
Arch	38	5%	16%	11%

Nexus

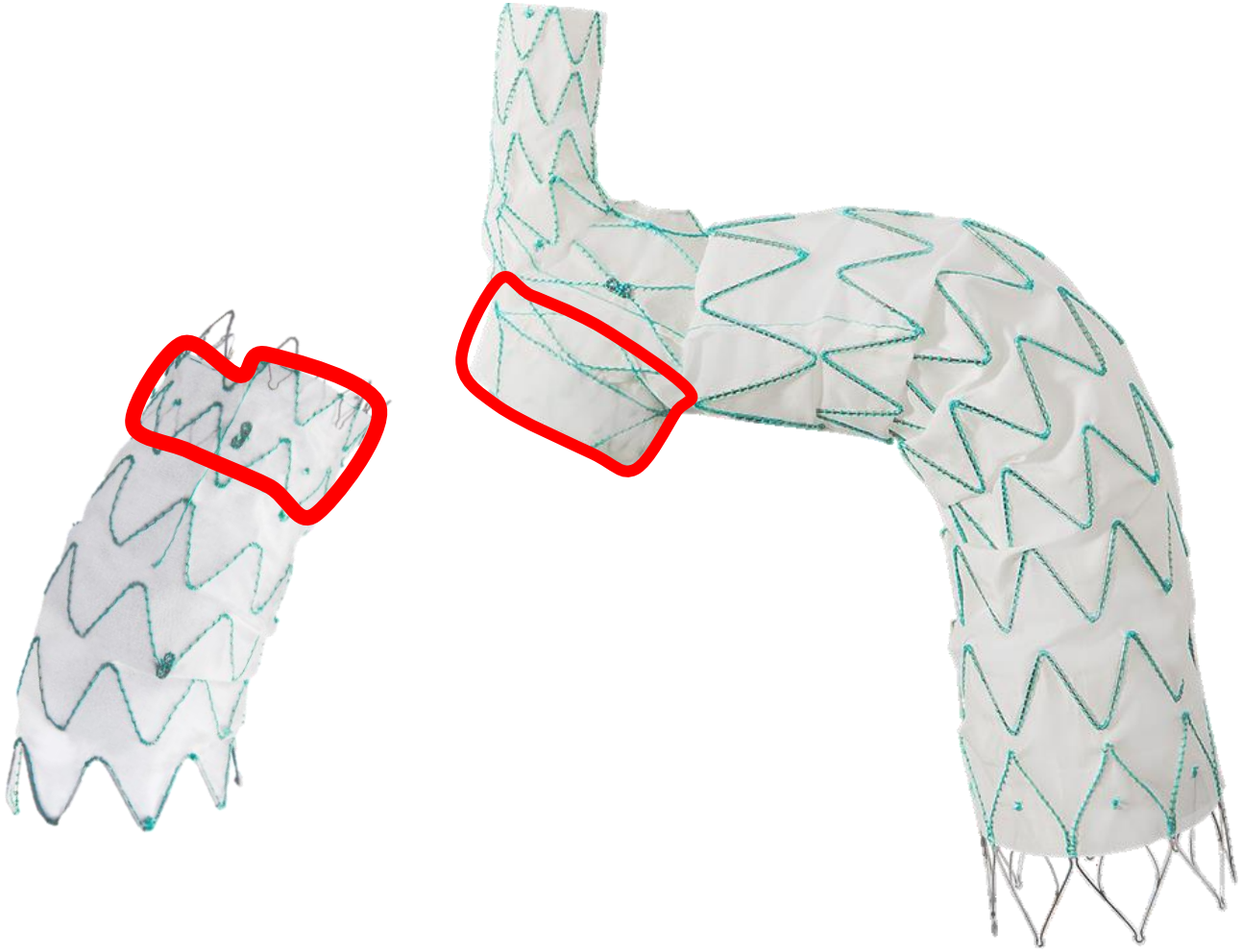

Innominate branch
Nexus Main Module
Ascending Module
«Oriented»

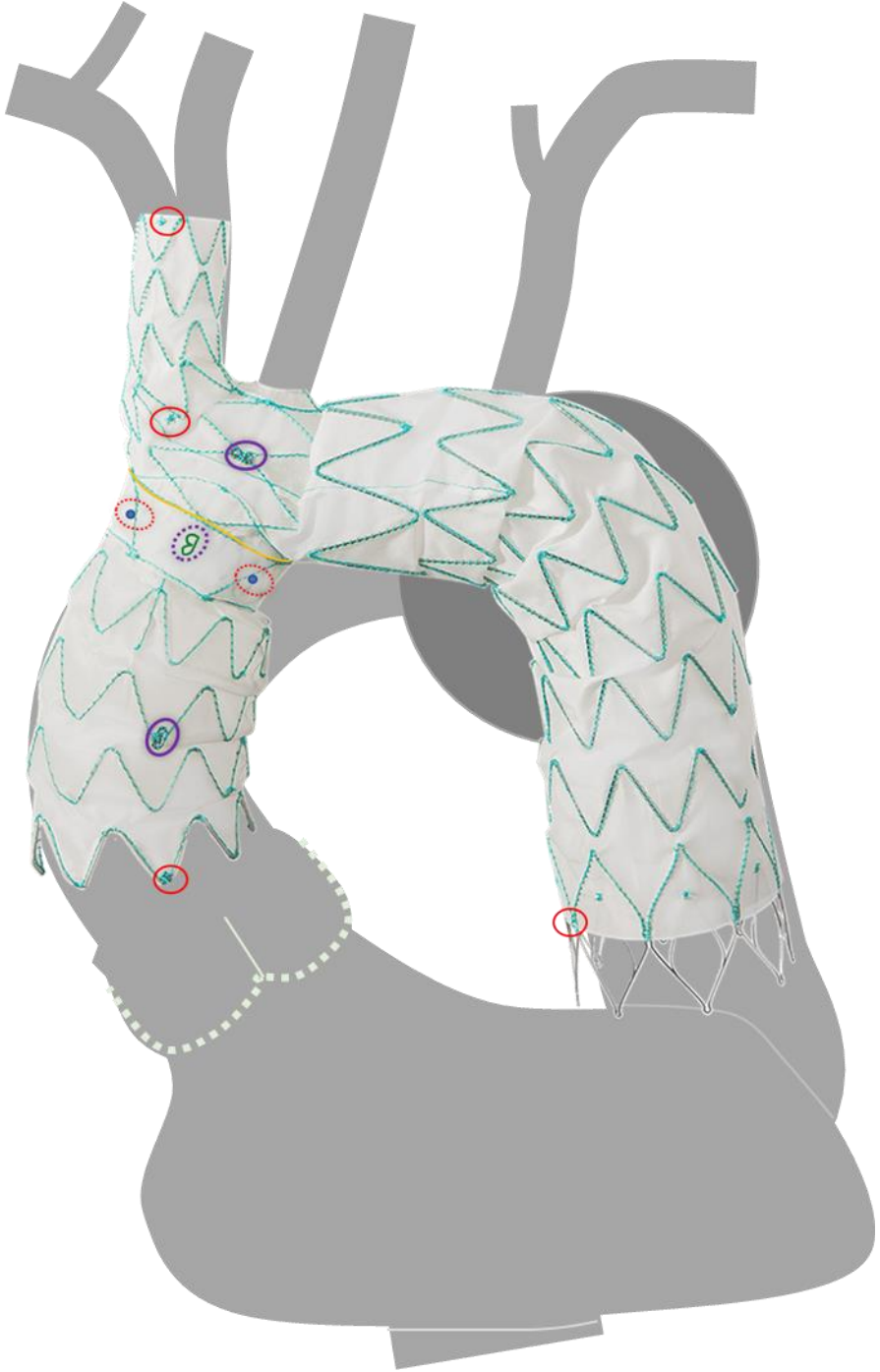
Fixation zone of the ascending module (3cm)



Separation forces of the modules: mean 20N (SD 3) [ref 10N]

Sealing zone of the ascending module (2cm)



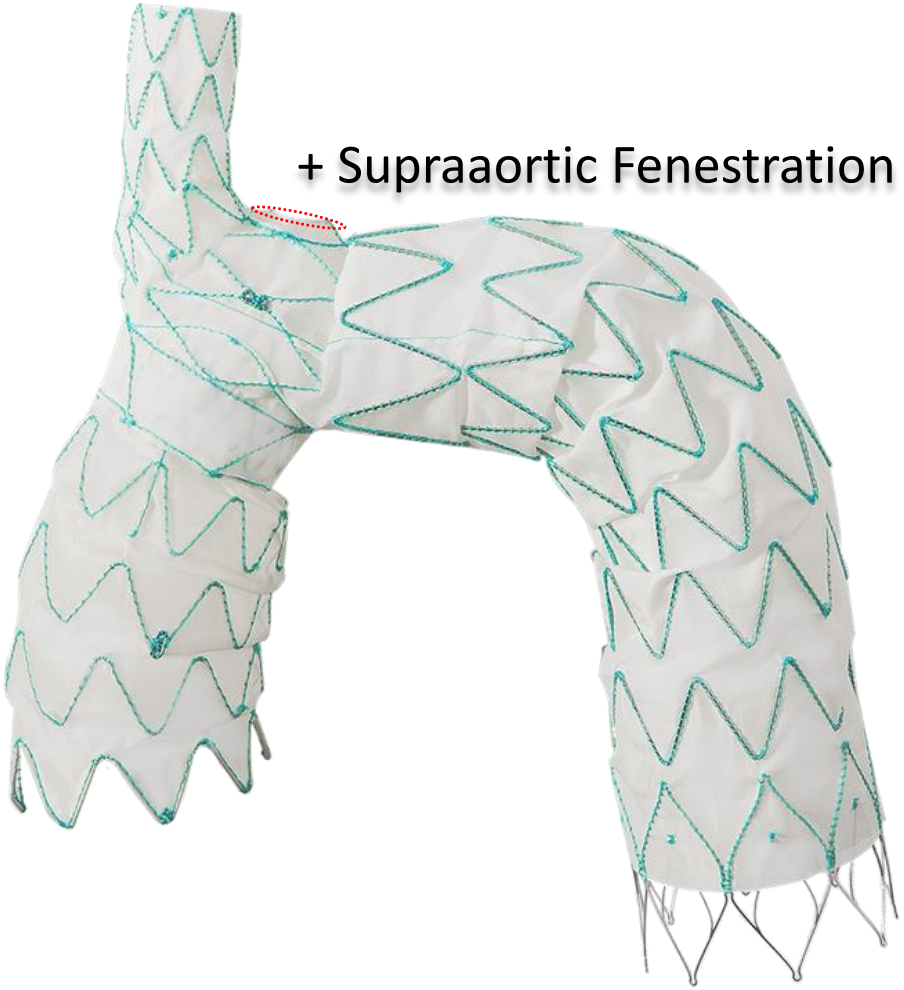


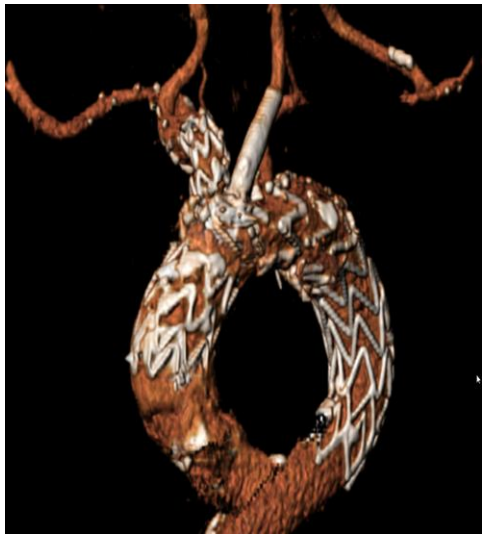
RO Markers

«B» markers for orientation (3)

Dot markers for position (8)

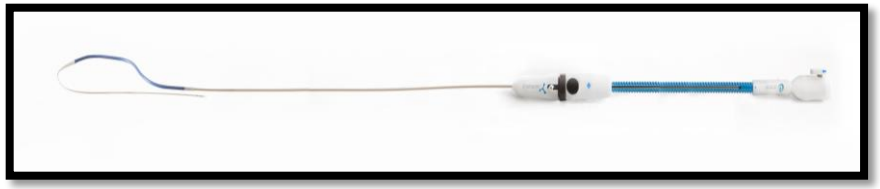
Ring marker for connection (1)

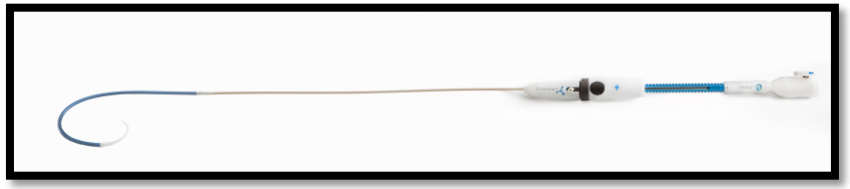

+ Supraaortic Fenestration



Delivery system

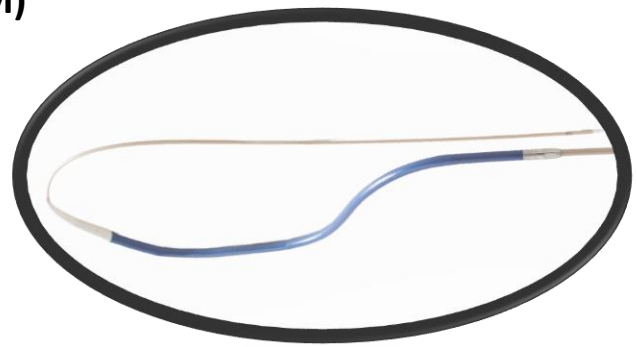
- 20 Fr
- Pre-curved , Pre-shaped
  - Delivery system and tip

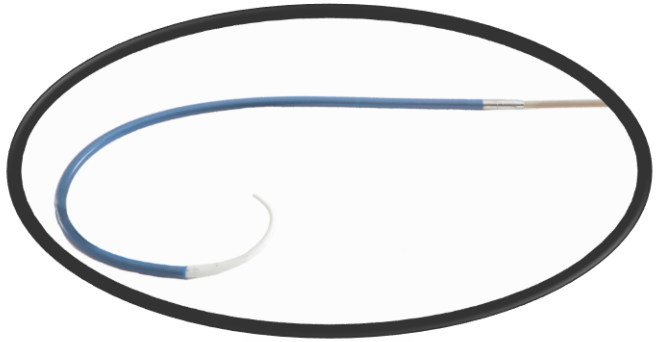




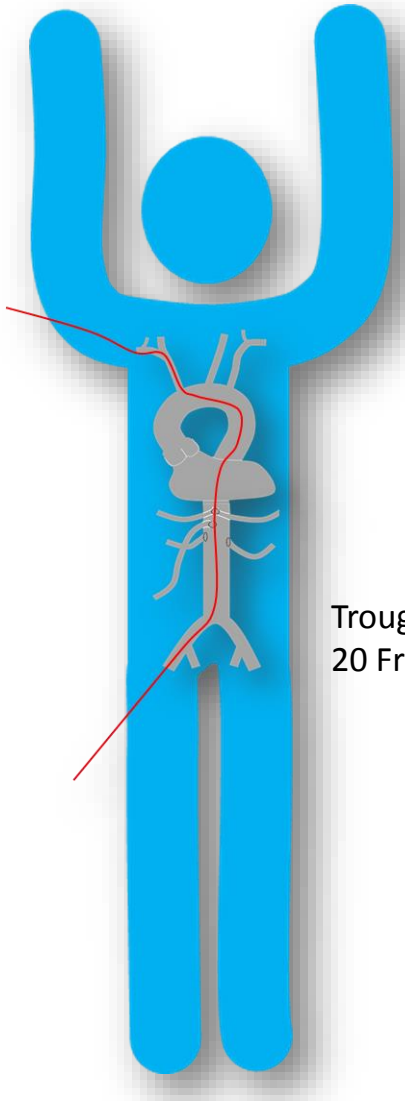
Nexus Main Module (NMM)

Nexus Ascending Module (NAM)

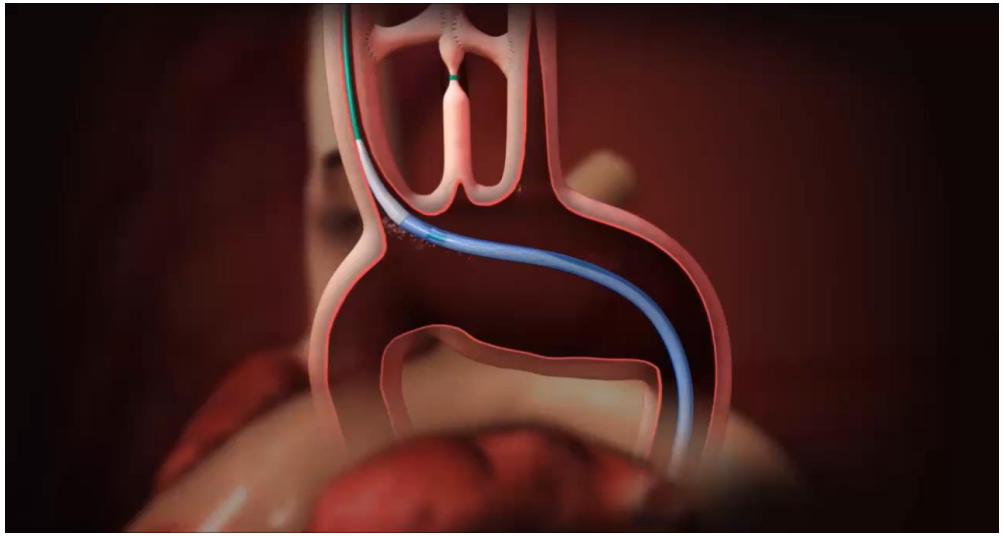




Implantation technique

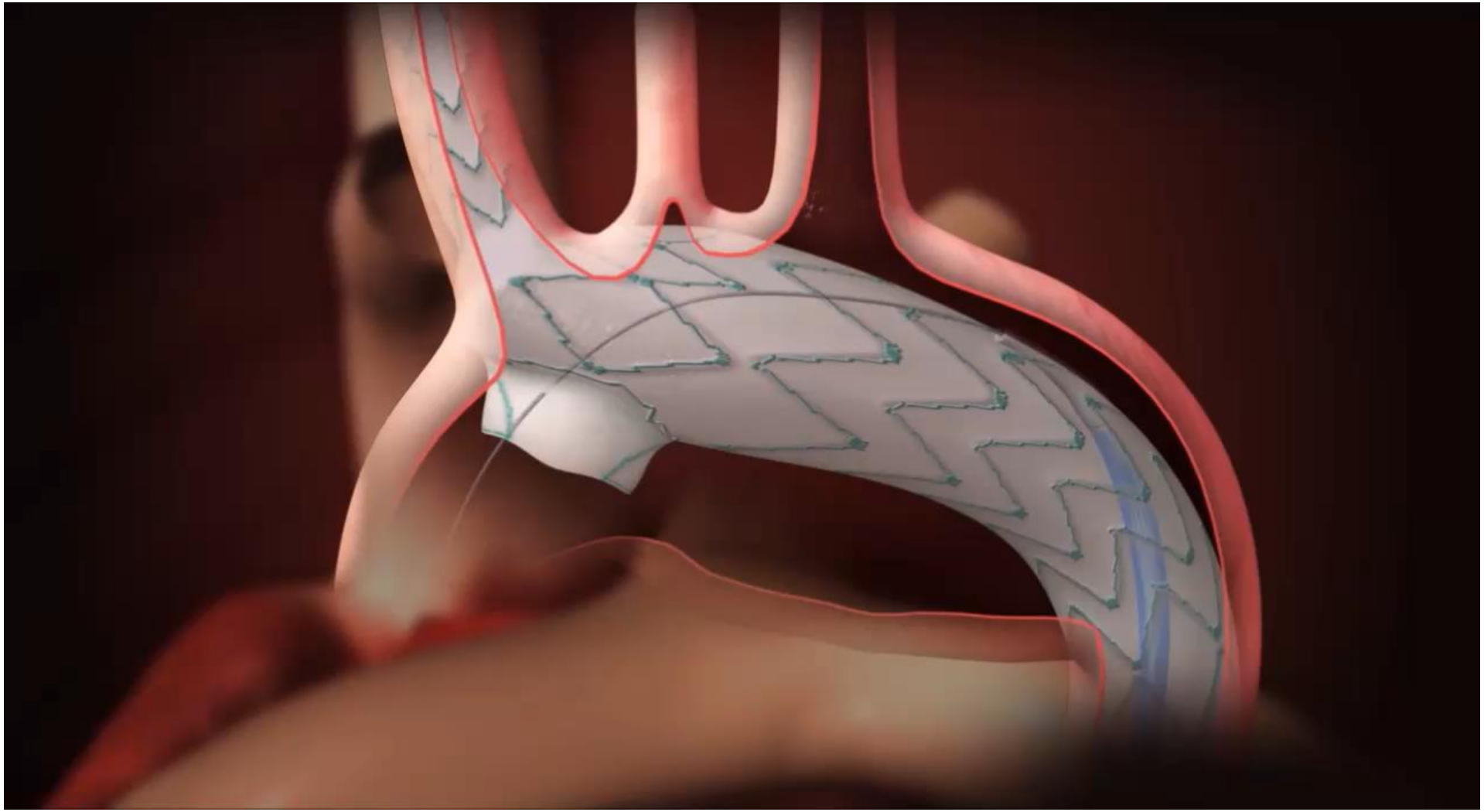


Trough & Trough GW
20 Fr sheath



Heparin bolus 300 IU/kg BW (ACT>300’’)
Anti-Trendelenburg for deployment

Implantation technique



Rapid Pacing

Clinical History

- 61 y
- Male
- Former Smoker
- Hypertension
- Dislypedimia
- IRC
- CAD
- TIA (15 y ago, unknown)


R
L
Zoom: 204% Angle: 0
Im: 1/571 S (S -> I)
JPEG2000
Thickness: 2.00 mm Location: 359.00 mm
P


Dimensioni visualizzazione: 931 x 1298
WL: 60 WW: 396
T.A.P. 18G Bas.+3Fasi-Abdomen

Nx_Can_#76 _BG

RSA: Ø14.5

RCCØ9.1

Ø20/ Ø15

L 34mm

Ø24/Ø22

Ø35.4

L 99mm

Ø36

L 66mm

L 50mm

Ø9.4/Ø8.5

Ø11/Ø8

Ø12/Ø8

L Main module170mm

Ø35.3
Landing zone main module

L Gore 150 mm

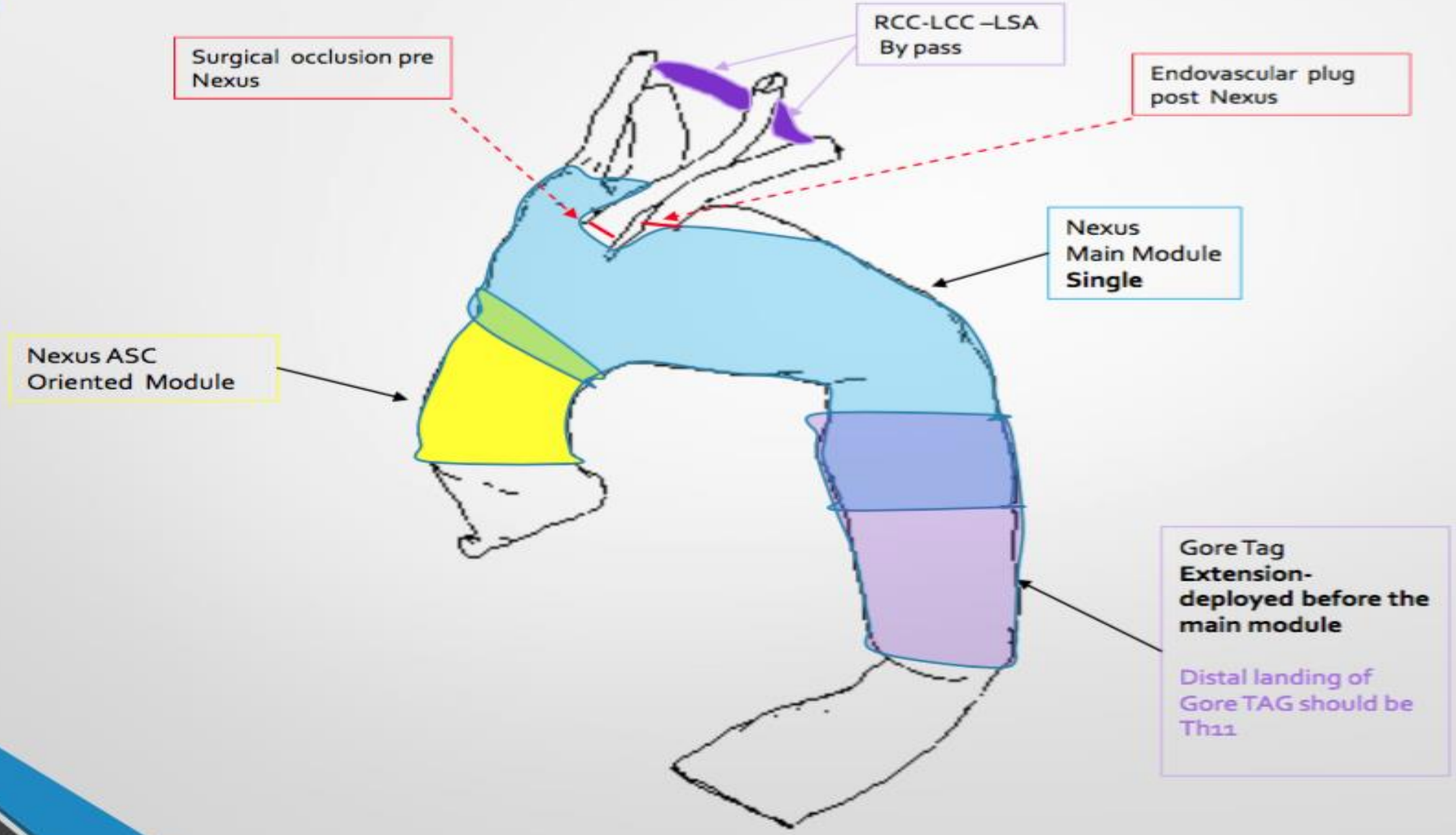
Ø35/Ø32
Landing zone gore

Ø28/Ø29
Proximal to Celiac

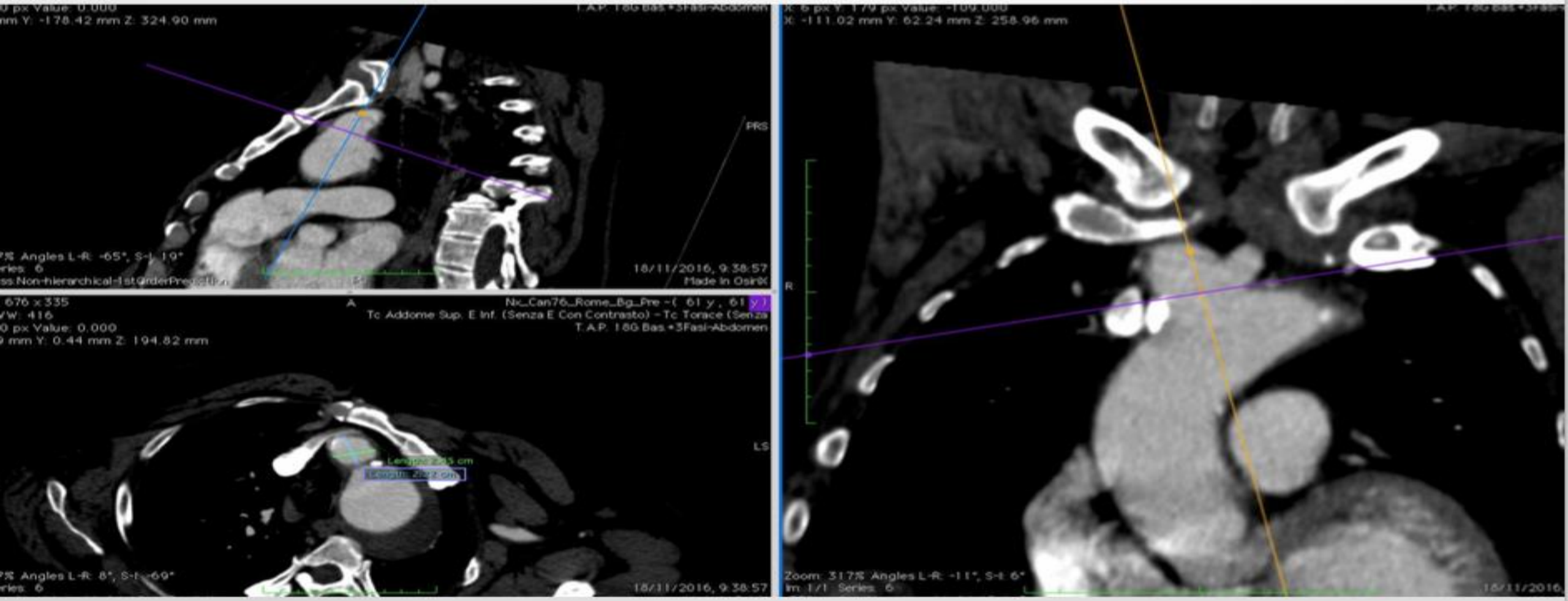
Plan

- Pre Nexus procedure (7 -14 days before) :
  - Bypass RCC-LCC-LSA 09.03.17 ✓
- Nexus procedure:
  - Gore Tag deployed in the Descending.
  - Main module deployed in the BCT
  - Oriented ASC module deployed in Ascending.

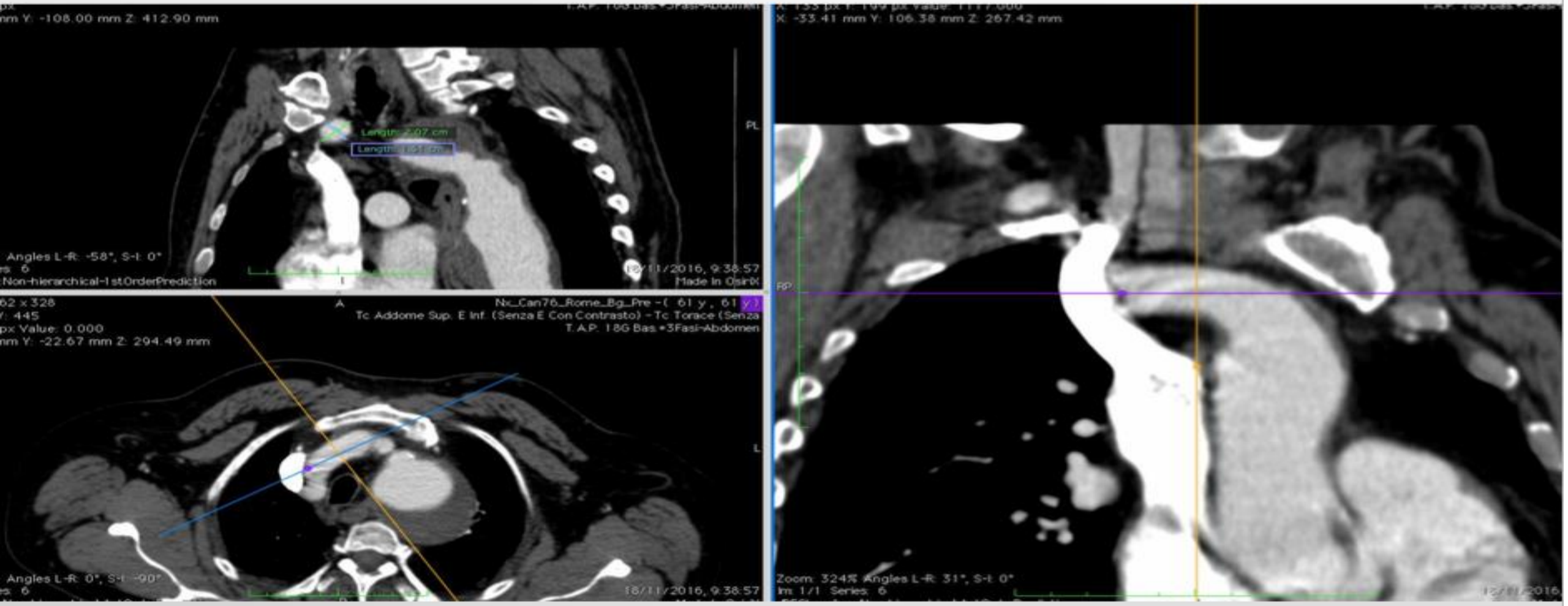
Assembly scheme



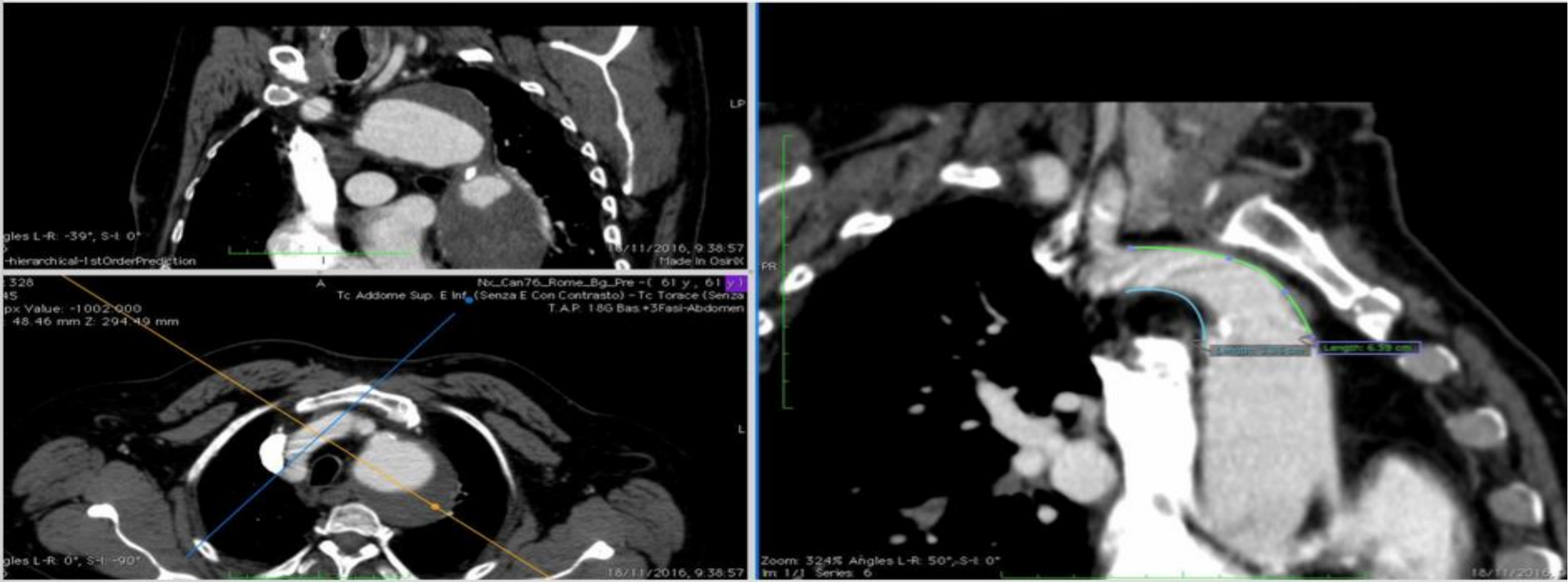
BCT 1


mm Y: -178.42 mm Z: 324.90 mm
PRS
18/11/2016, 9:38:57
Made In Osirix
676 x 335
WW: 416
0 px Value: 0.000
9 mm Y: 0.44 mm Z: 194.82 mm
A
Nx_Can76_Rome_Bg_Pre -(61 y , 61 y)
Tc Addome Sup. E Inf. (Senza E Con Contrasto) - Tc Torace (Senza
T.A.P. 180 Bas +3Fasi-Abdomen
LS
18/11/2016, 9:38:57
X: -111.02 mm Y: 62.24 mm Z: 258.96 mm
R
Zoom: 317% Angles L-R: -11°, S-I: 6°
Im: 1/1 Series: 6

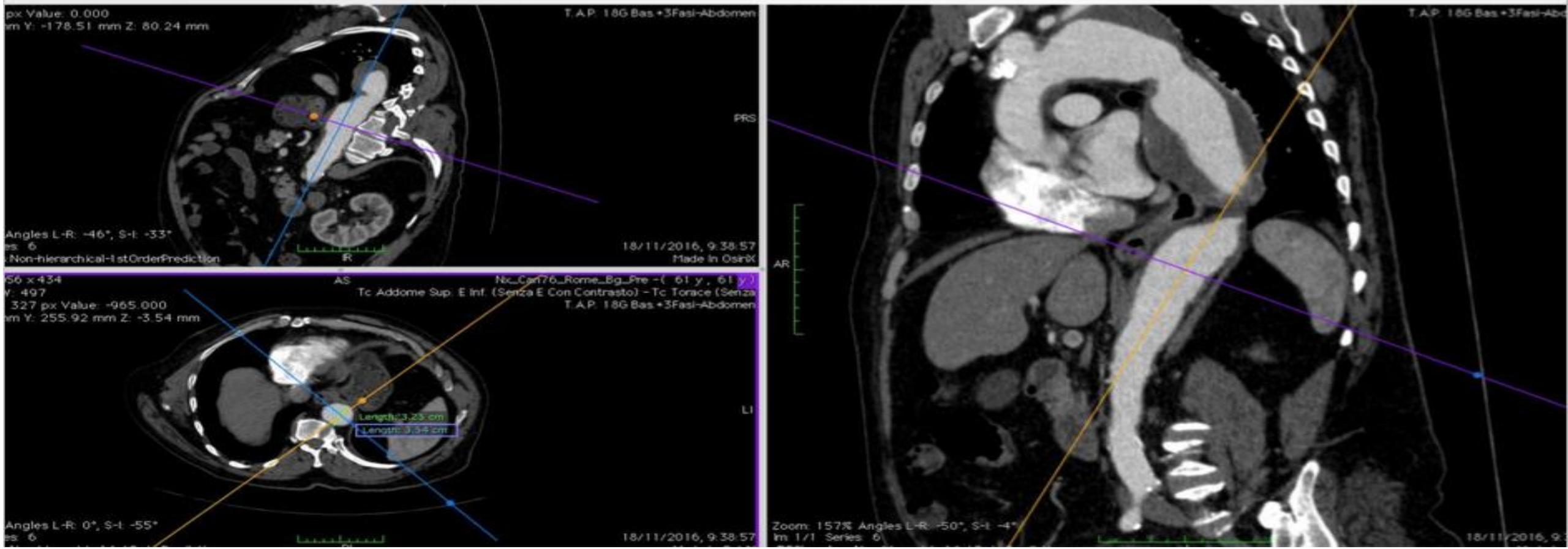
BCT2


mm Y: -108.00 mm Z: 412.90 mm
PL
Angles L-R: -58°, S-I: 0°
Non-hierarchical-1stOrderPrediction
Made in OsiriX
A
px Value: 0.000
mm Y: -22.67 mm Z: 294.49 mm
Tc Addome Sup. E Inf. (Senza E Con Contrasto) - Tc Torace (Senza
T.A.P. 18G Bas +3Fasi-Abdomen
L
Angles L-R: 0°, S-I: -90°
X: -33.41 mm Y: 106.38 mm Z: 267.42 mm
FP
Zoom: 324% Angles L-R: 31°, S-I: 0°
Im: 1/1 Series: 6

L - BCT

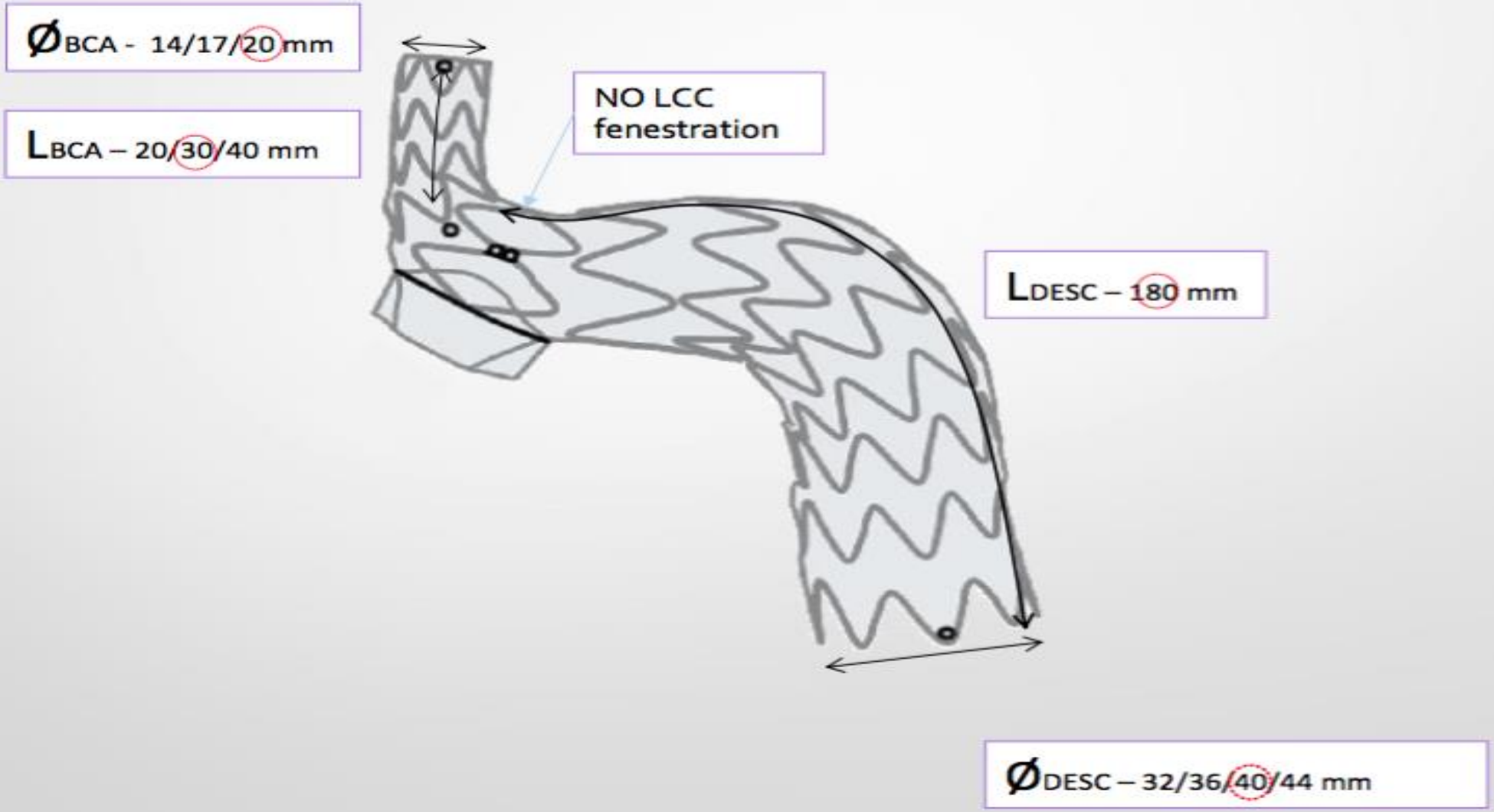

LP
gles L-R: -39°, S-I: 0°
-hierarchical-IstOrderPrediction
16/11/2016, 9:38:57
Made In Osirix
A
Nx_Can76_Rome_Bg_Pre -(61 y , 61 y)
Tc Addome Sup. E Inf. (Senza E Con Contrasto) - Tc Torace (Senza
T.A.P. 18G Bas +3Fasi-Abdomen
px Value: -1002.000
48.46 mm Z: 294.49 mm
L
gles L-R: 0°, S-I: -90°
16/11/2016, 9:38:57
PR
Length: 6.59 cm
Zoom: 324% Angles L-R: 50°, S-I: 0°
Im: 1/1 Series: 6

Landing zone Desc

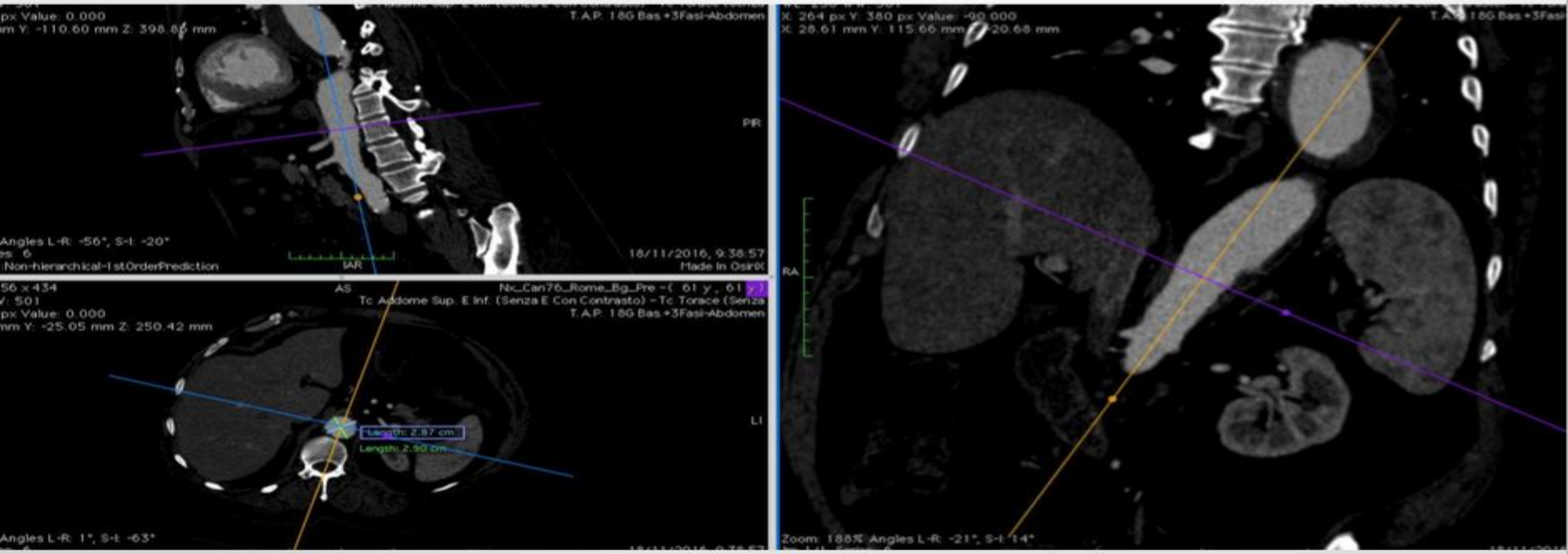


Main Module – option A

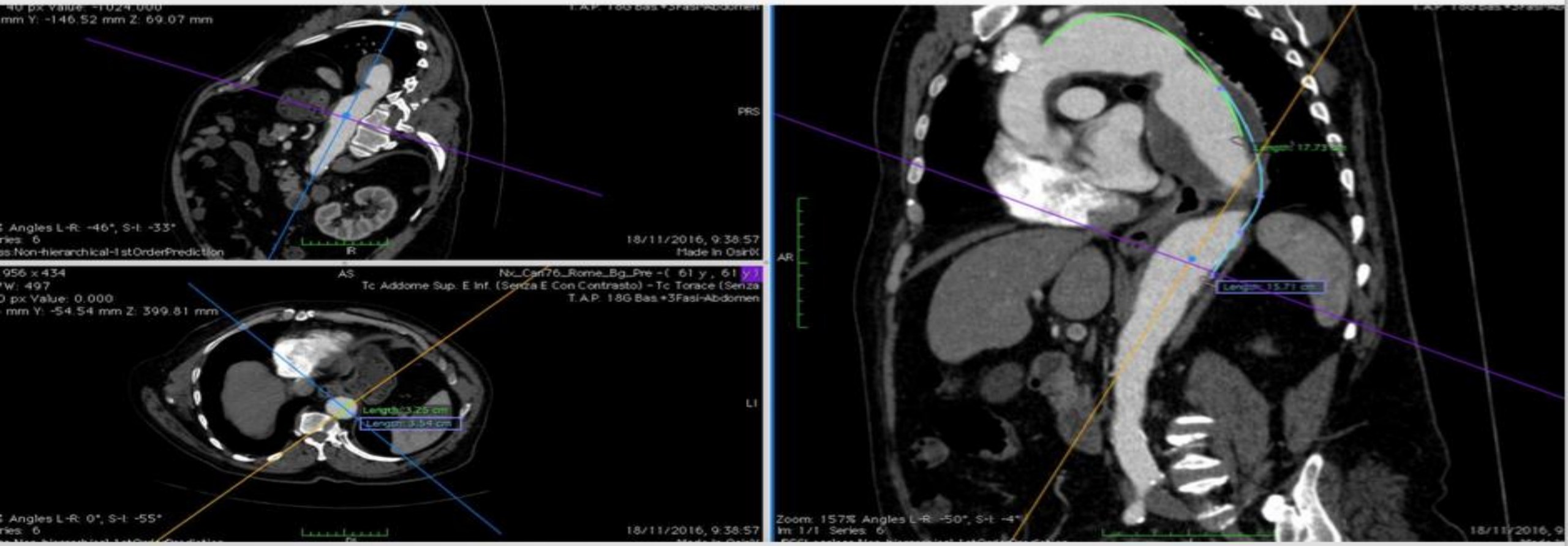
recommended sizes (red circles ◯)



landing zone above the celiac



landing zone Gore+ Main



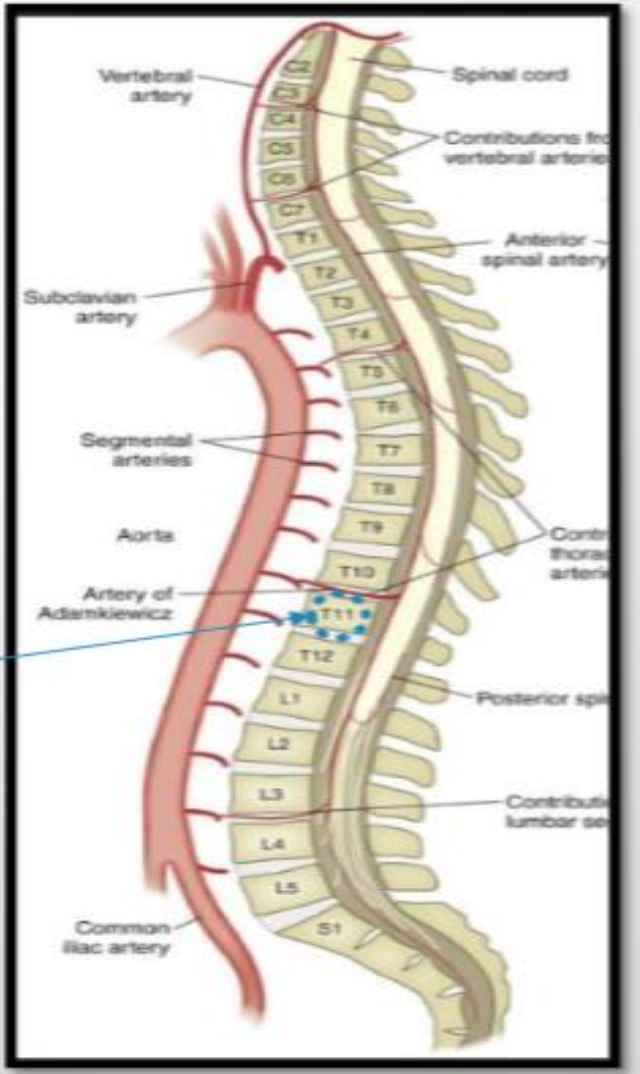
Gore TAG

recommended sizes (red circles ◯)

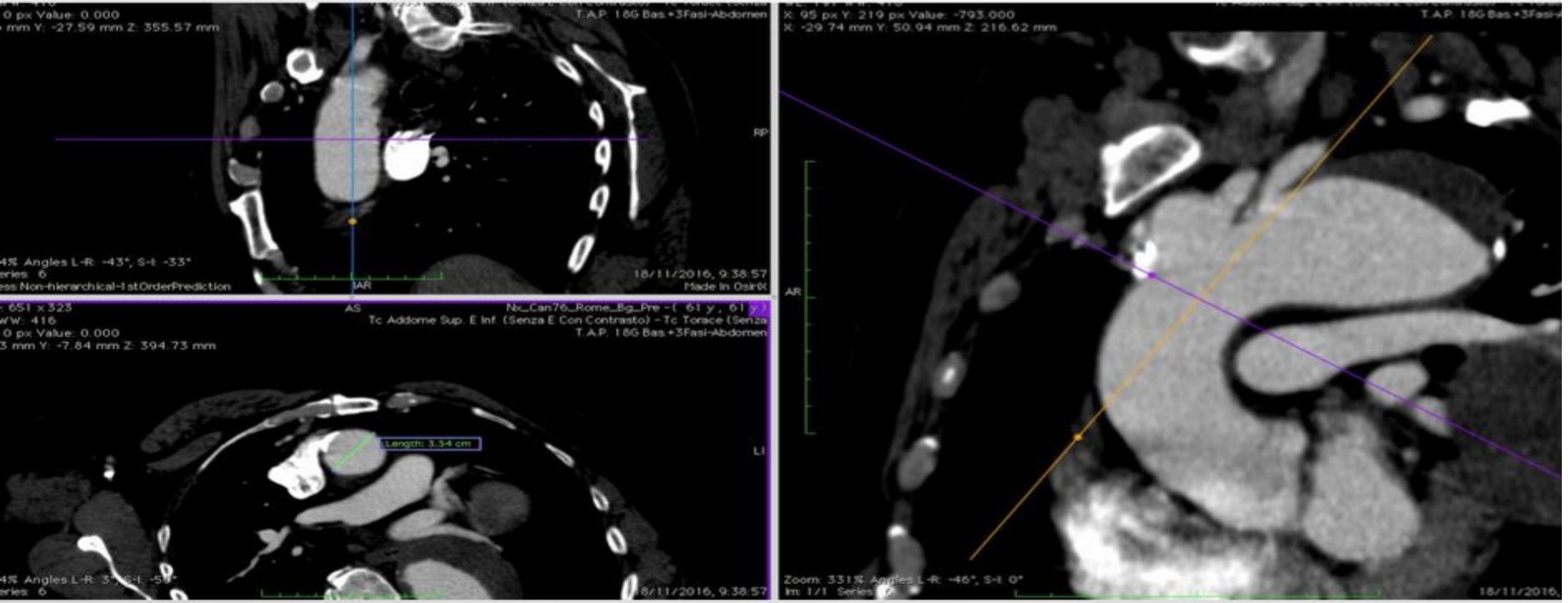
Table 34. Sizing Guide

Intended Aortic Inner Diameters[1] (ID) (mm)	Endoprosthesis Diameter[2] (mm)	Endoprosthesis Lengths[2,3] (cm)	Recommended GORE® Introducer Sheath Size (Fr)
23 - 24	26	10	20
24 - 26	28	10 / 15	20
26 - 29	31	10 / 15	22
29 - 32	34	10 / 15 / 20	22
32 - 34	37	10 / 15 / 20	24
34 - 37	40	10 / 15 / 20	24
37 - 42	45	10 / 15 / 20	24

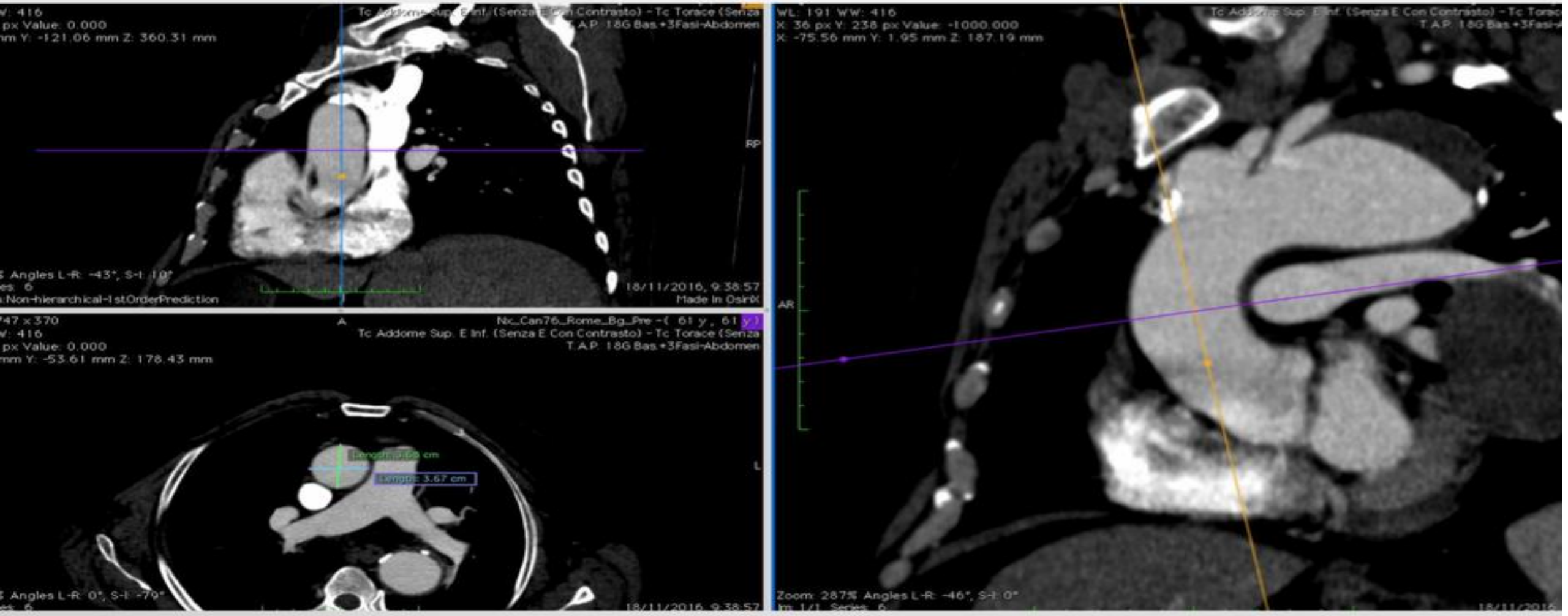
Gore tag- Distal landing zone



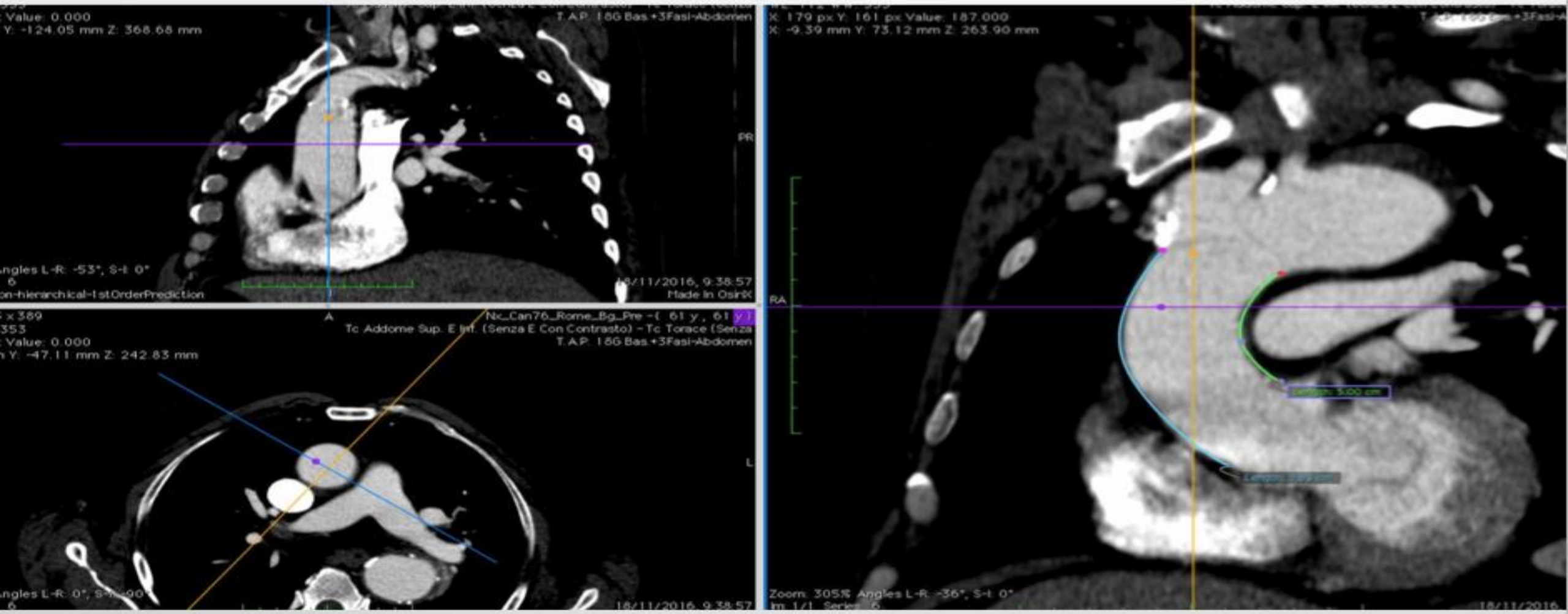
ASC 3


T.A.P. 18G Bas.+3Fasi-Abdomen
RP
AR
AS
18/11/2016, 9:38:57
Made In OsiriX
Nc_Can76_Rome_Bg_Pre -(61 y , 61
Tc Addome Sup. E Inf. (Senza E Con Contrasto) - Tc Torace (Senza
Length: 3.54 cm
LI
X: 95 px Y: 219 px Value: -793.000
X: -29.74 mm Y: 50.94 mm Z: 216.62 mm
Zoom: 331% Angles L-R: -46°, S-I: 0°

ASC 2

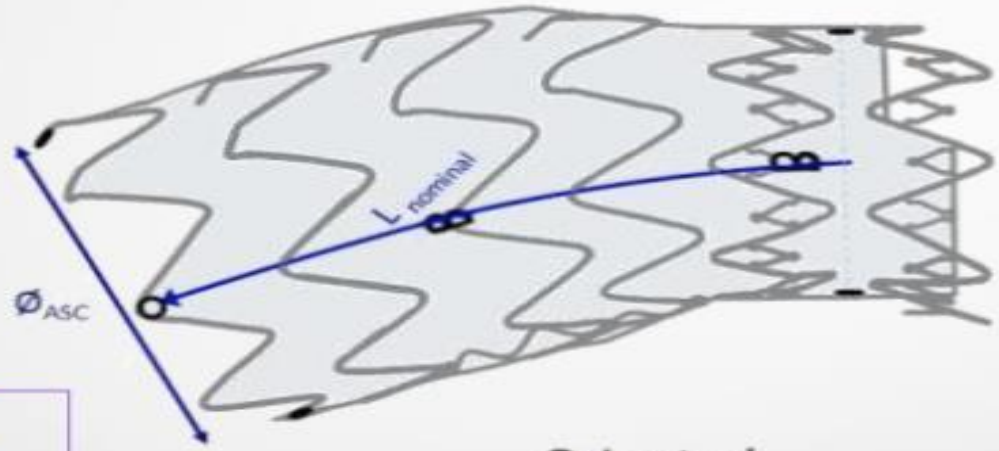

px Value: 0.000
mm Y: -121.06 mm Z: 360.31 mm
Angles L-R: -43°, S-I: 10°
Non-hierarchical-1stOrderPrediction
18/11/2016, 9:38:57
Made in OsiriX
RP
A
Nx_Can76_Rome_Bg_Pre -(61 y , 61 y)
Tc Addome Sup. E Inf. (Senza E Con Contrasto) - Tc Torace (Senza
T.A.P. 18G Bas.+3Fasi-Abdomen
px Value: 0.000
mm Y: -53.61 mm Z: 178.43 mm
Length: 3.67 cm
Angles L-R: 0°, S-I: -79°
L
WL: 191 WW: 416
X: 36 px Y: 238 px Value: -1000.000
X: -75.56 mm Y: 1.95 mm Z: 187.19 mm
AR
Zoom: 287% Angles L-R: -46°, S-I: 0°

L - Asc


Value: 0.000
Y: -124.05 mm Z: 368.68 mm
T.A.P. 18G Bas.+3Fasi-Abdomen
PR
Angles L-R: -53°, S-I: 0°
18/11/2016, 9:38:57
Made in OsiriX
A
Tc Addome Sup. E Inf. (Senza E Con Contrasto) - Tc Torace (Senza
T.A.P. 18G Bas.+3Fasi-Abdomen
Value: 0.000
Y: -47.11 mm Z: 242.83 mm
L
X: 179 px Y: 161 px Value: 187.000
X: -9.39 mm Y: 73.12 mm Z: 263.90 mm
RA
Zoom: 305% Angles L-R: -36°, S-I: 0°

ASC Module , Oriented -option A

recommended sizes (red circles ◯)



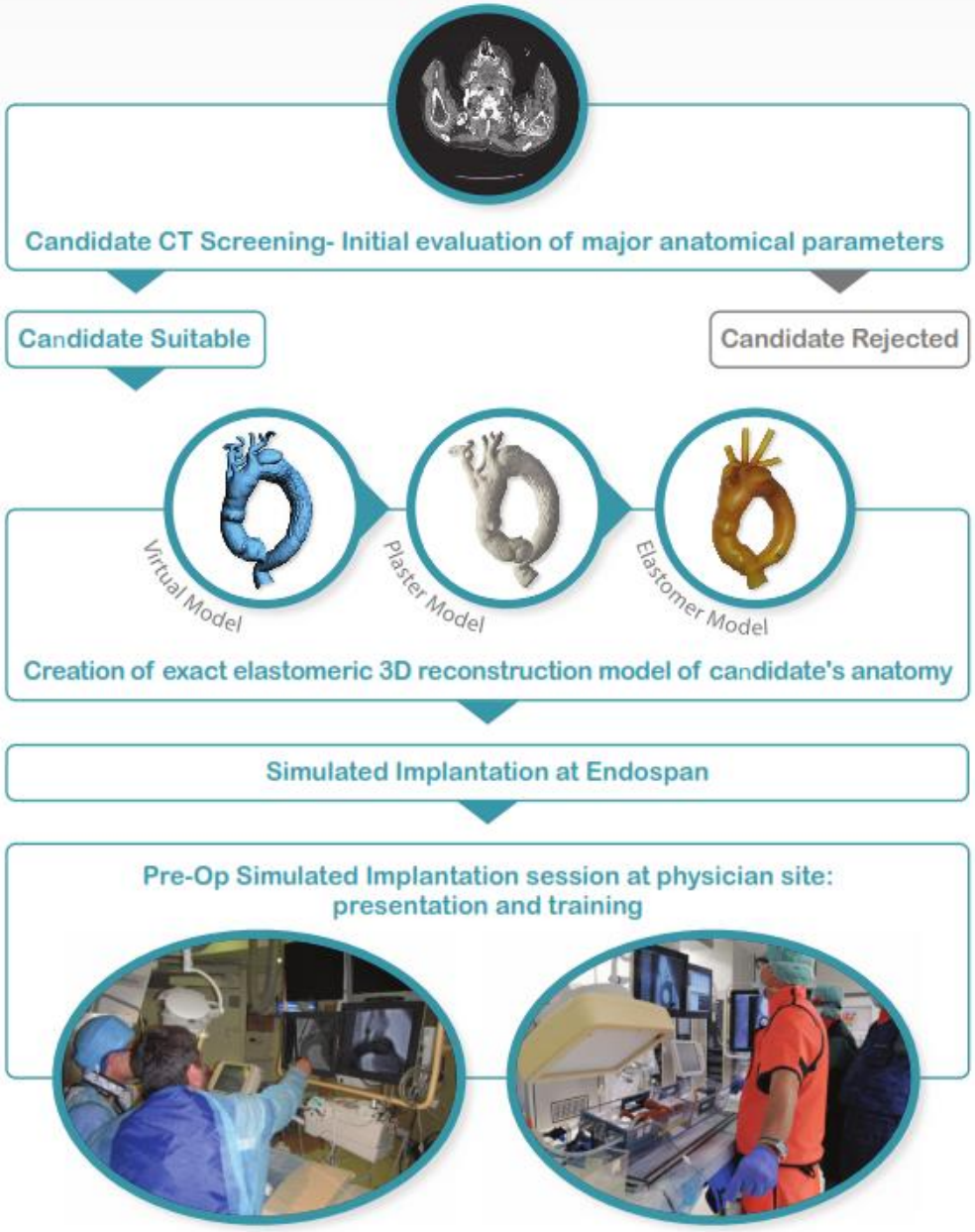
Lnom – 40/55/70

ØASC – 36/40/43 mm

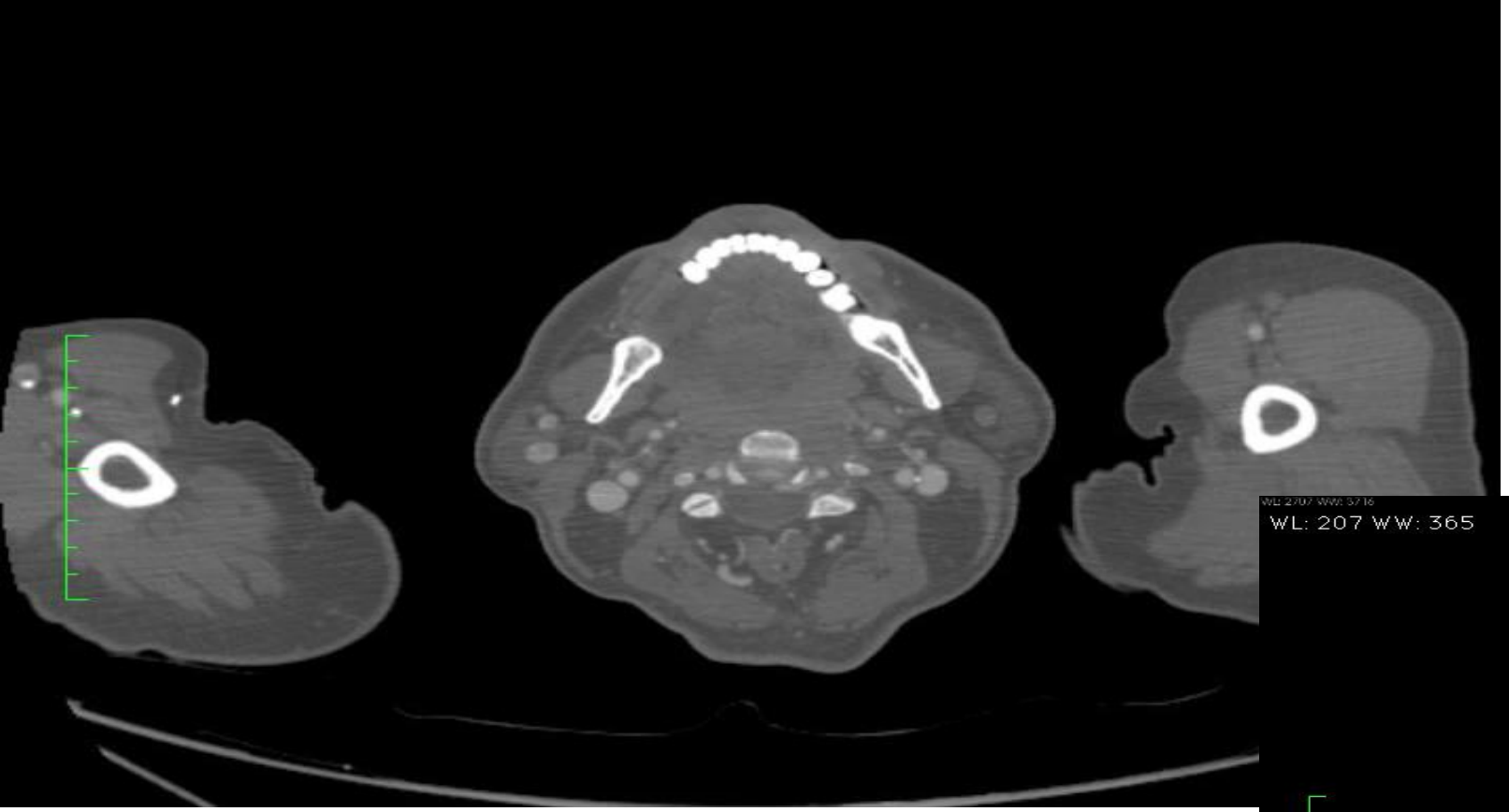
Oriented

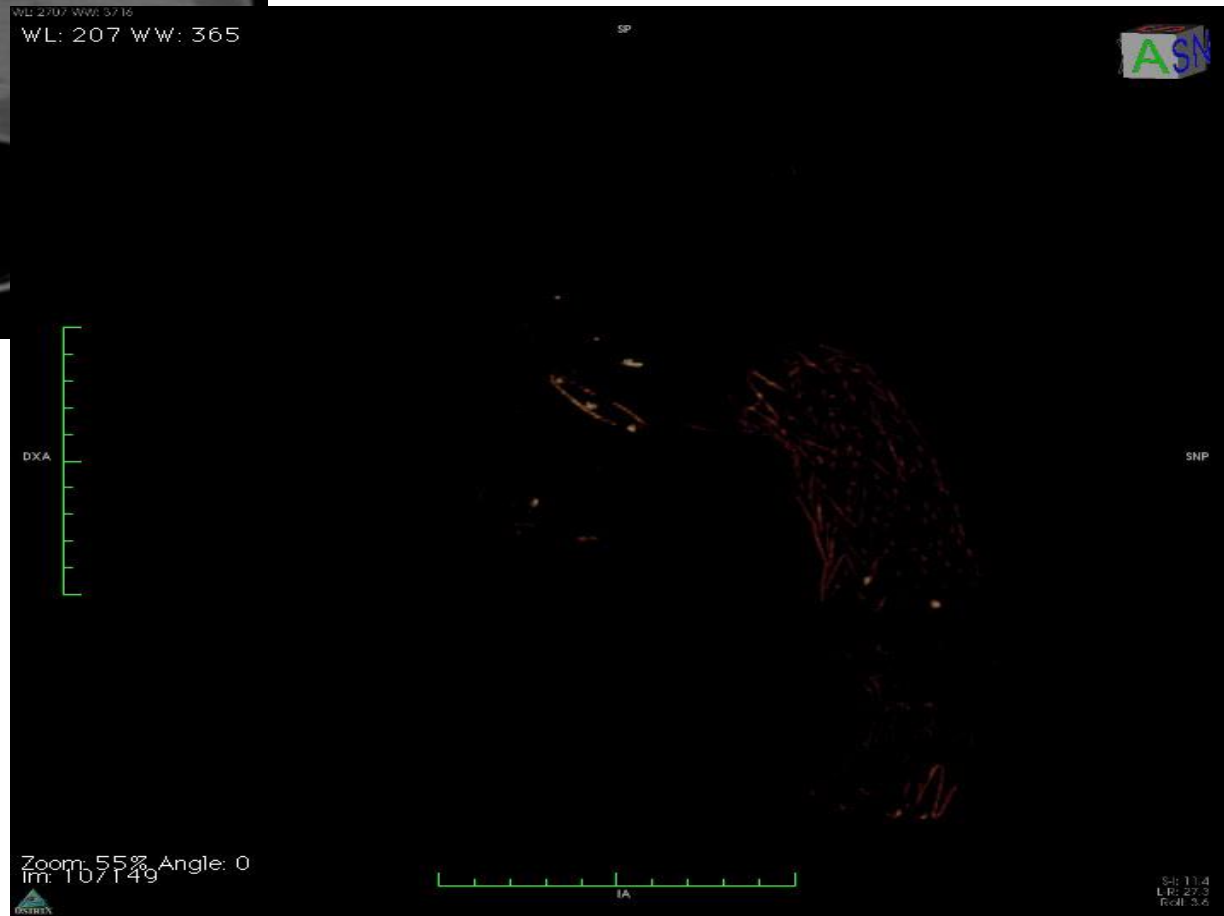
TBD

From screening to Implantation




WL: 127 WW: 254
Zoom: 140% Angle: 0
Im: 1767425




WL: 207 WW: 365
SP
ASN
DXA
SNP
Zoom: 55% Angle: 0
Im: 107149
IA

Patients (31)

- Male 25 (80%)
- Age 73 years (52-85, SD:9)

Aortic pathology

- Aneurysm 17 (55%)
- Dissection 14 (45 %, all chronic)
  - Type A 10 (9 post ascending repair)
  - Type B 3
  - Non-A-Non-B 1
- Max Aneurysm Diameter: 63 mm (46-105; SD:13)

Patients @ our center 5

- 4 monobranch
- Male 100 %
- Age 69 years

Aortic pathology

- Aneurysm 3
- Dissection 2
  - Type A 1 (post ascending repair)
  - Type B 1

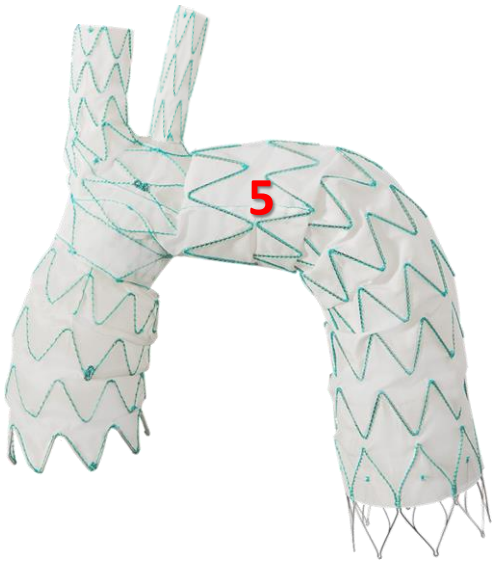
1 Paraparesis (regressive)

1 Type II Endoleak (Uneffective LSA occl)

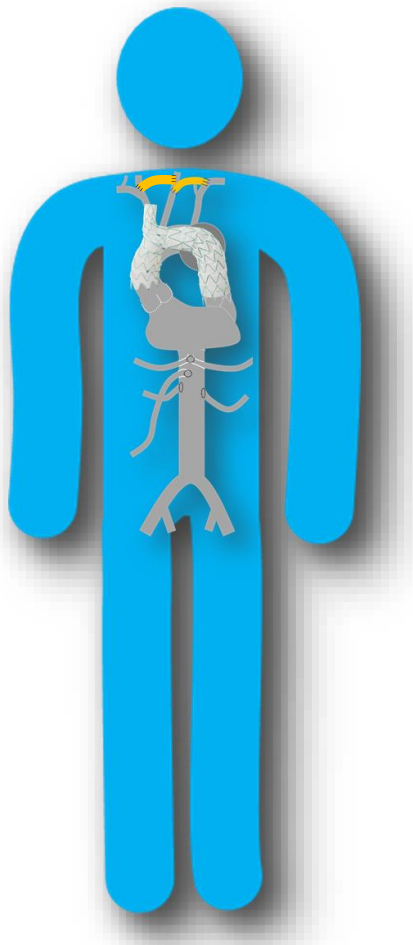
Mortality 0%

Type I EL 0%

N (31)



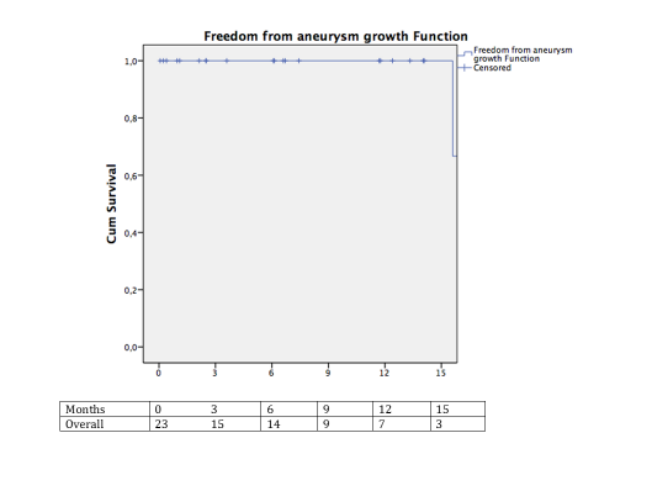
Results



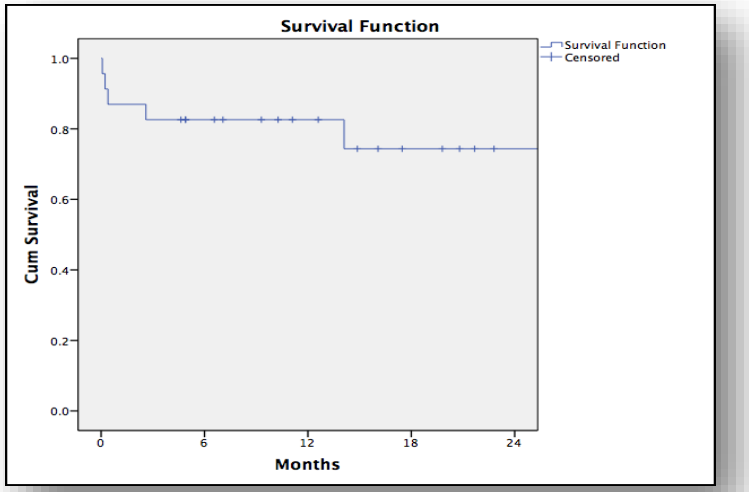
n	30d mortality	30d CVA/SCI	30d EL I/III
31 (Z0)	13%	10%	13%

100% technical success rate (conversion free implantation)

Mean FUP 12 months (SD9; 1-29)



Aneuryms sac behavior



Survival

Nexus - Conclusions

- Nexus is a promising alternative for total EV aortic arch repair
- Good Technical Outcomes and clinical outcomes
- Branch + Fen design is more challenging
- Precannulated fenestration could be an alternative

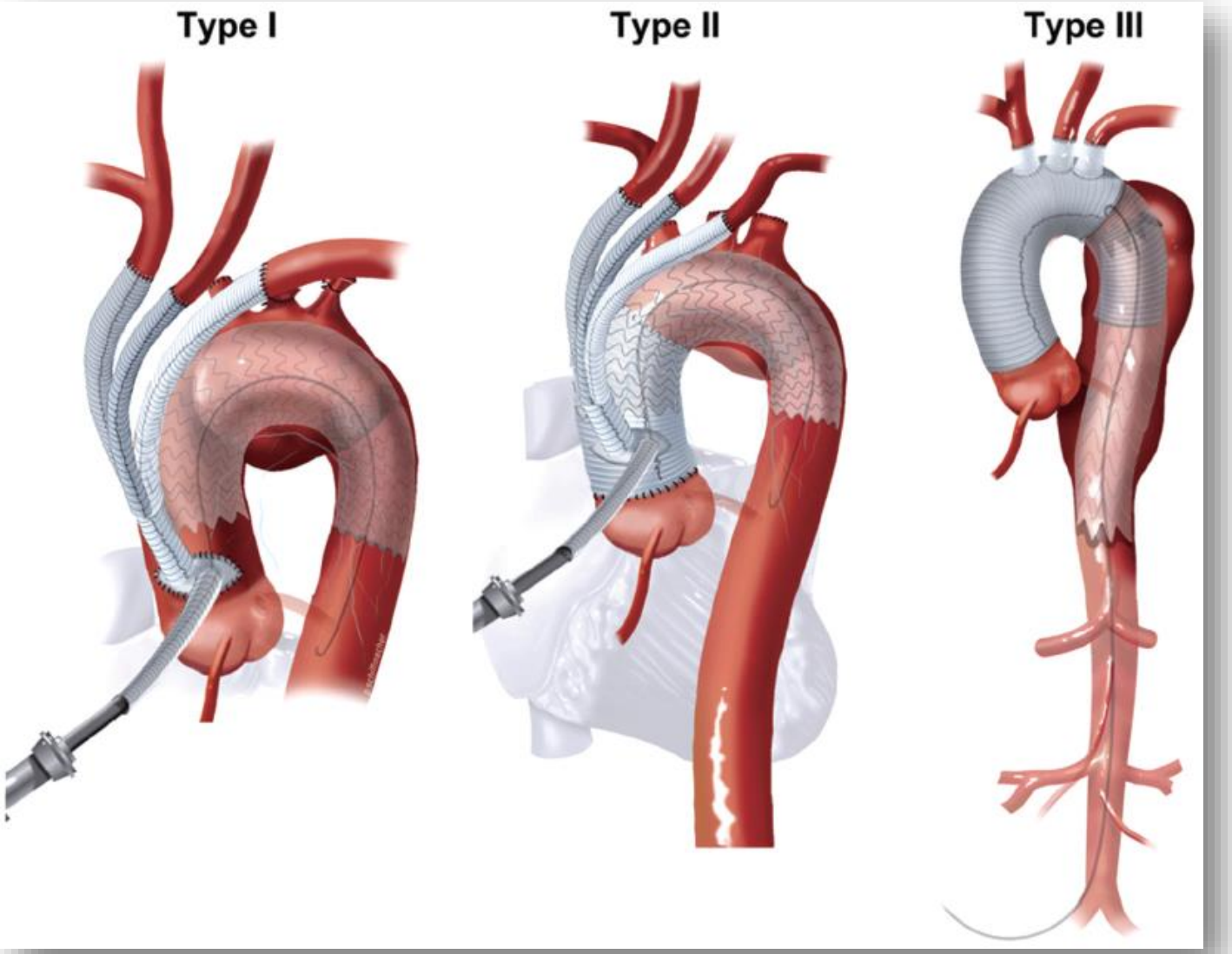
Hybrid Repair

Patient selection

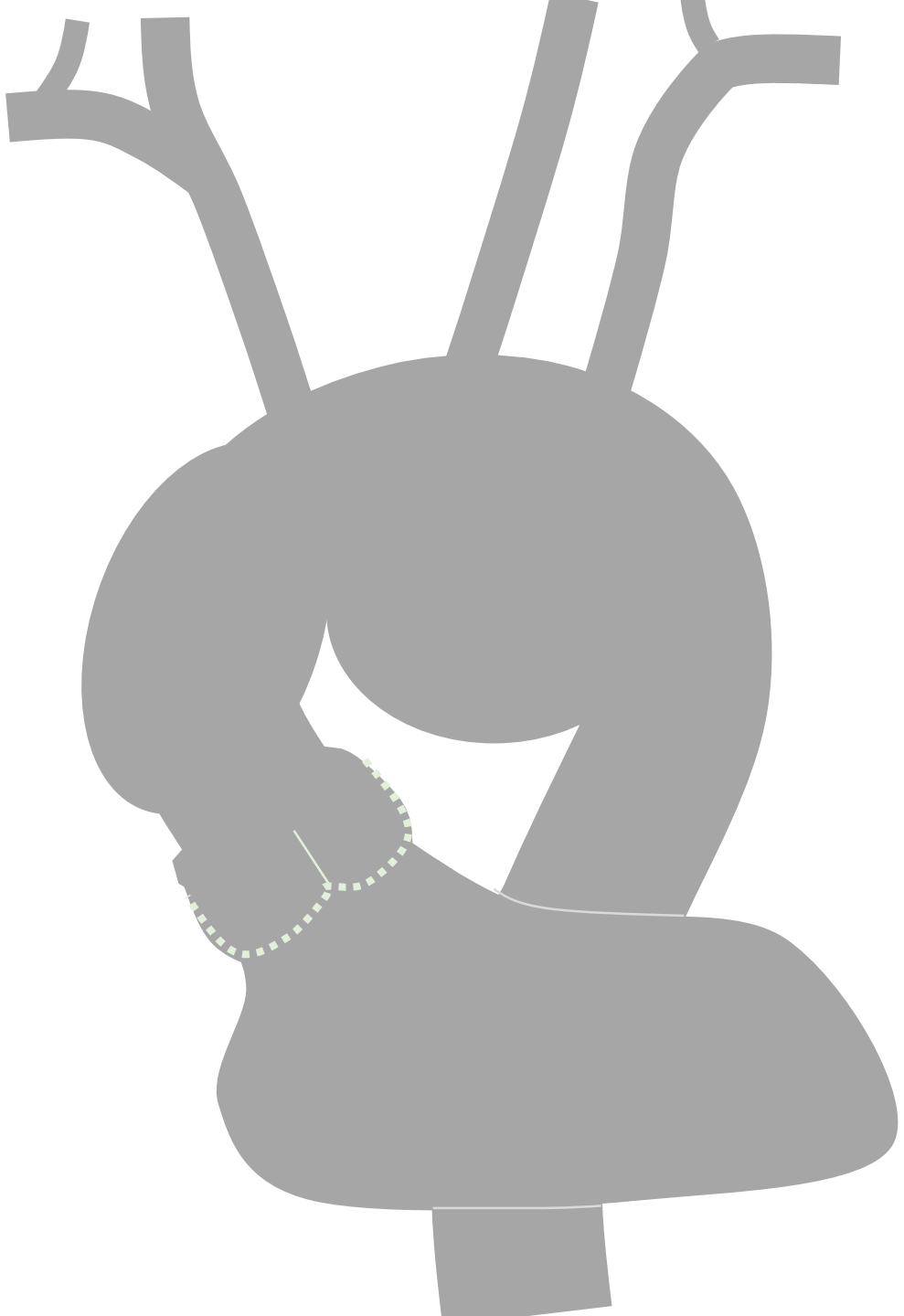
Stépan Haulon. EVT Nov. 2014

ANATOMIC AND PHYSIOLOGIC CRITERIA FOR ENDOVASCULAR ARCH REPAIR	
Anatomic Criteria: • Arch aneurysms and chronic dissections, no previous mechanical aortic valve replacement • Ascending aortic length ≥ 50 mm (measured from sinotubular junction to origin of innominate artery) • Sealing zone in the ascending aorta ≥ 40 mm in length and ≤ 38 mm diameter • Sealing zone in the innominate artery ≥ 20 mm in length and ≤ 20 mm in diameter • Access able to accommodate 22- or 24-F sheaths	**Physiologic Criteria:** • Minimum of 2-year life expectancy • Negative stress test (cardiology clearance required in the setting of positive stress test) • No class III or IV congestive heart failure • No stroke or myocardial infarction in the last year • No significant carotid bifurcation disease (≥ 75% stenosis by North American Symptomatic Carotid Endarterectomy Trial criteria) • Estimated glomerular filtration rate by modification of diet in renal disease method ≥ 45 mL/min/1.73 m^2

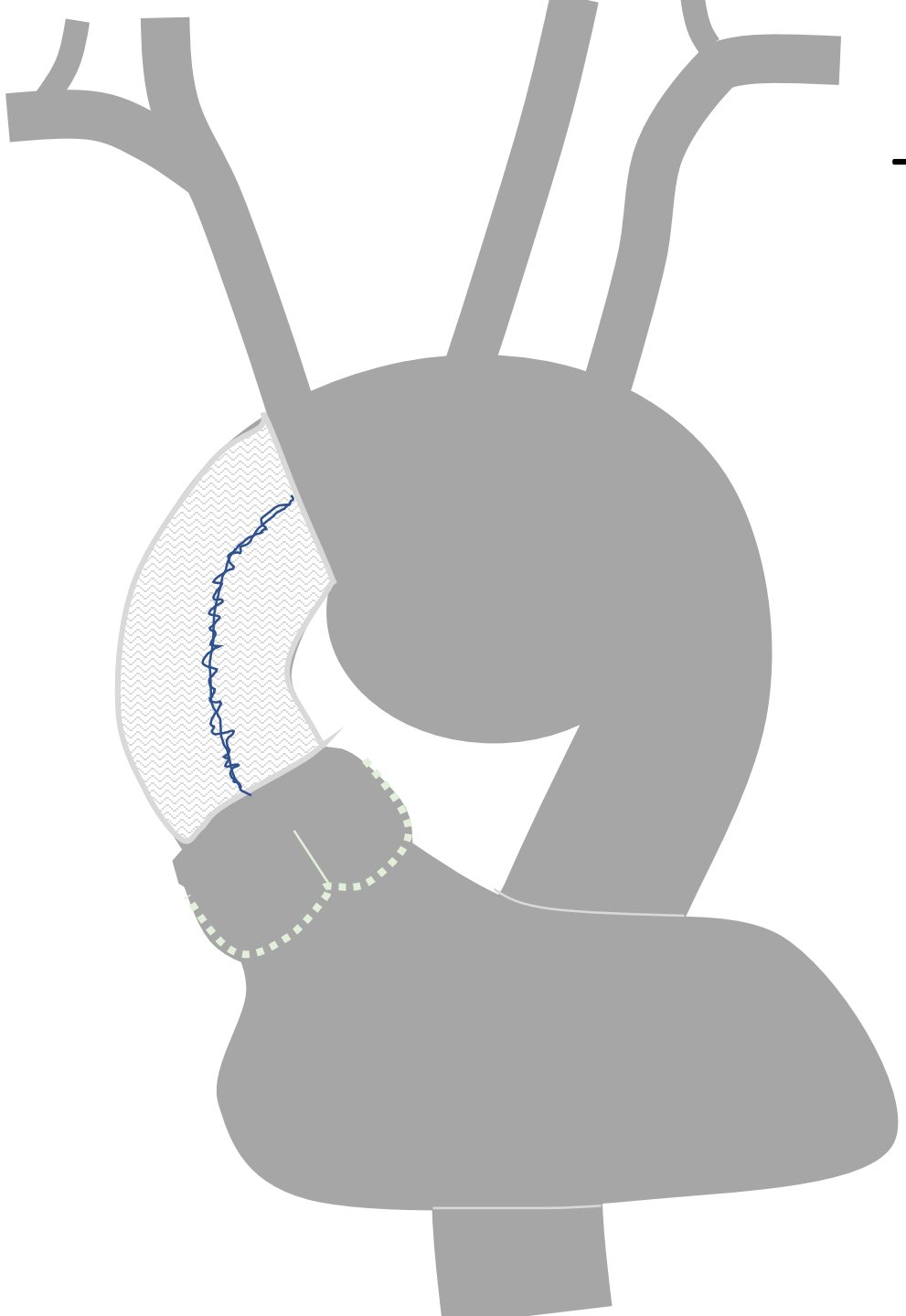
Vallabhajosyula et al. Type II arch hybrid debranching procedure



Zone Zero unfit for TEVAR (ectasy)



Ascending TD >35mm



The wrapping TECH

Prolen mesh premarked to circumference

= π x intended diameter

11cm for ID of 35mm

Treatment of isolated ascending aortic aneurysm by off-pump epiaortic wrapping is safe and durable

Felice Pecoraro*, Masami Shingaki, Johnny Steuer, Lyubov Chaykovska, Zoran Rancic, Alberto Weber, Thi Dan Linh Nguyen-Kim, Dominique Bettex, Frank J. Veith and Mario Lachat

Clinic for Cardiovascular Surgery, University Hospital Zurich, Zurich, Switzerland

* Corresponding author. Via L. Guffrè 5, 90100 Palermo, Italy. Tel: +39-328-2141849; fax: +39-091-6552648; e-mail: felicepecoraro@libero.it (F. Pecoraro).

Received 19 October 2015; received in revised form 17 February 2016; accepted 8 March 2016

Abstract

OBJECTIVES: Isolated ascending aortic aneurysm (iAA) is usually treated by open graft repair requiring sternotomy, cardiopulmonary bypass (CPB) and cardioplegia. This approach carries significant mortality in older patients or those presenting with comorbidities. We report an original series of patients presenting with iAA and treated with epiaortic wrapping by using a synthetic mesh. This less invasive aortic repair technique allows reducing the aortic diameter to a predefined value and is performed without CPB.

METHODS: Data from patients presenting with an iAA and treated with the wrapping technique (WT) by polypropylene/polyester mesh from November 2006 to July 2015 were collected. The end-points that were analysed included maximal aortic transverse diameter, perioperative mortality and morbidity, survival, freedom from reinterventions and aortic valve function during follow-up. The maximal aneurysm transverse diameter was analysed based on contrast-enhanced computed tomography (CTA) or magnetic resonance (MR) performed preoperatively, and during the follow-up.

RESULTS: The off-pump WT was used in 33 cases with no perioperative mortality. The median radiological follow-up was 33.47 (range: 1–106) months. Overall, the WT achieved a 30% diameter reduction. The mean preoperative and postoperative ascending aortic transverse diameter was 5.5 cm [standard deviation (SD): 0.6] and 3.7 cm (SD: 0.30), respectively ($P = 0.001$). In addition, CTA or MR follow-up showed stable diameters at the level of the aortic root and the distal ascending aorta. No death occurred during the follow-up. At 5 years, the estimated freedom rate from reinterventions of the aortic root and ascending aorta was 94%.

CONCLUSIONS: This series shows that the WT with a polypropylene/polyester mesh allows safe off-pump treatment of patients with iAA. Mid- and long-term results are promising. This technique could be an attractive alternative, especially for patients unfit for aortic surgery with CPB and cardioplegia.

Keywords: Off-pump • Ascending aorta • Graft repair • Mesh (polypropylene/polyester) • Wrapping girdling • Aortic valve insufficiency

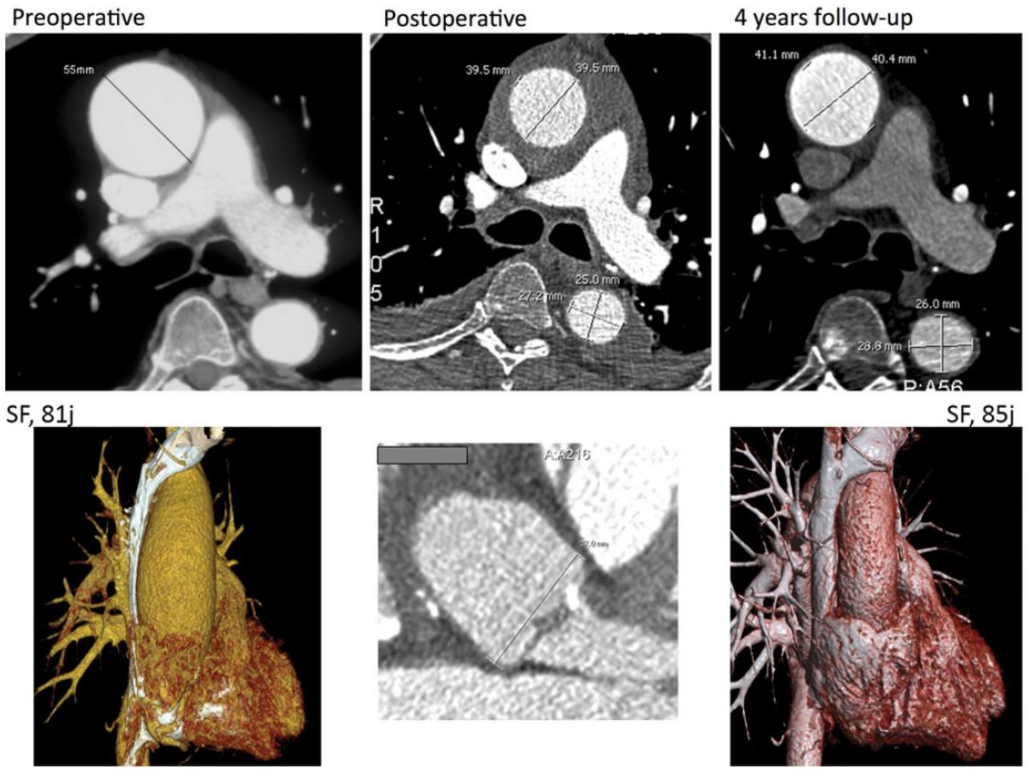


Figure 3: CT findings. (**A**) Preoperative 5.5 cm ascending aortic aneurysm. (**B**) Ascending aortic postoperative transverse diameter measurement. (**C**) Four-year ascending aorta and aortic root transverse diameter measurement showing no significant variation in size with postoperative findings. CT: computed tomography.

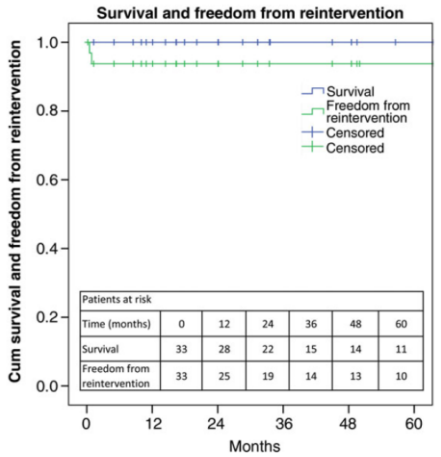
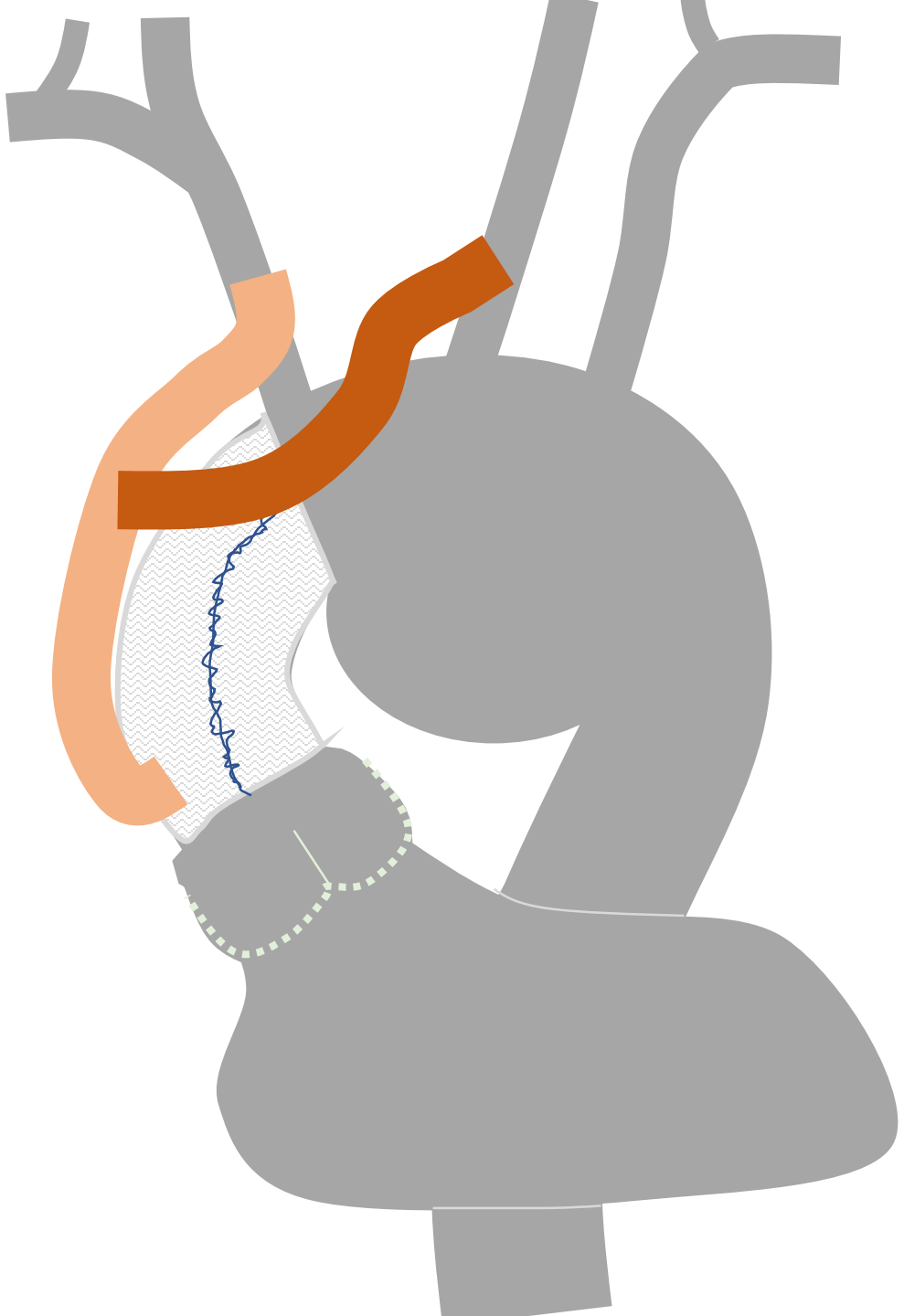
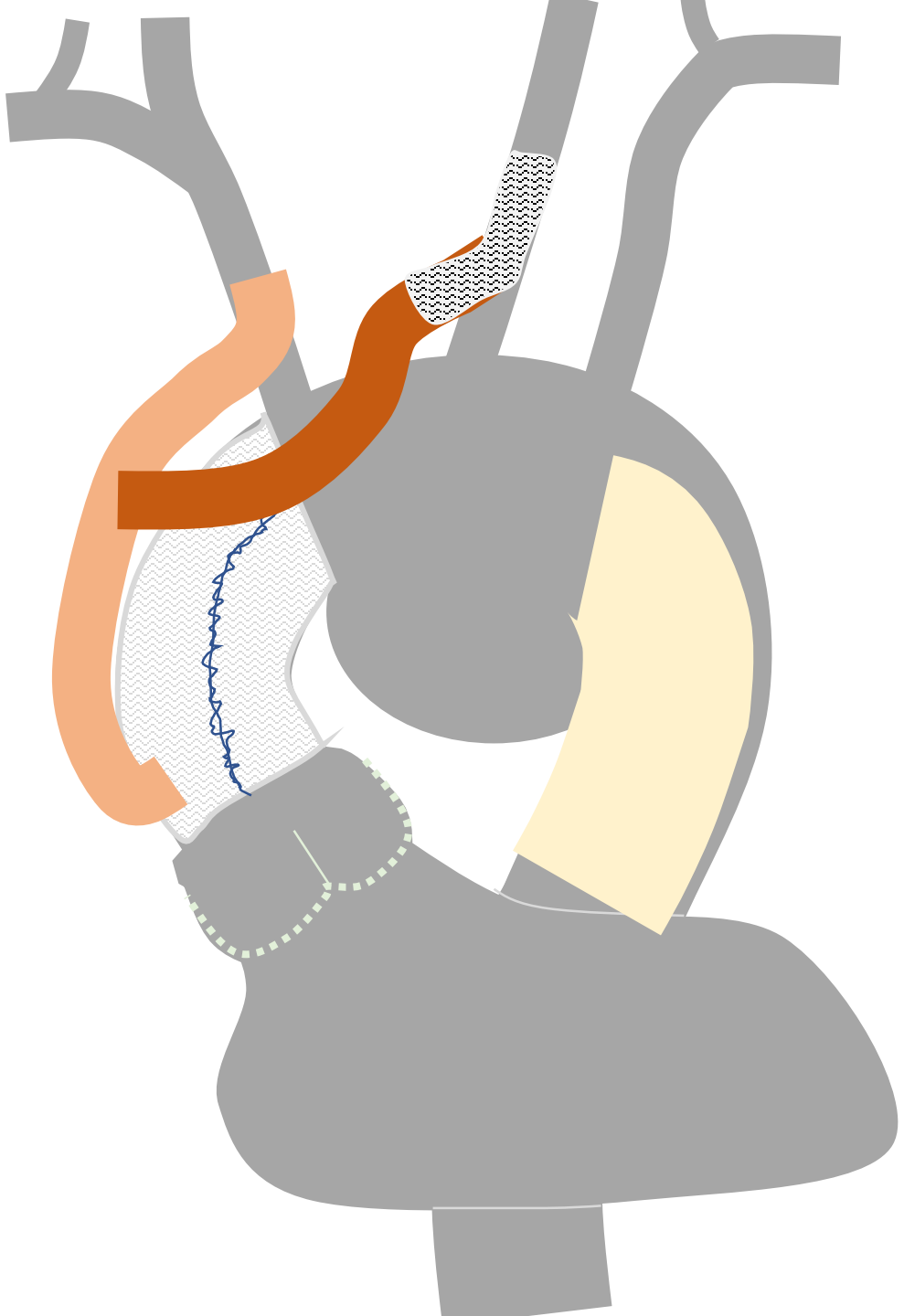


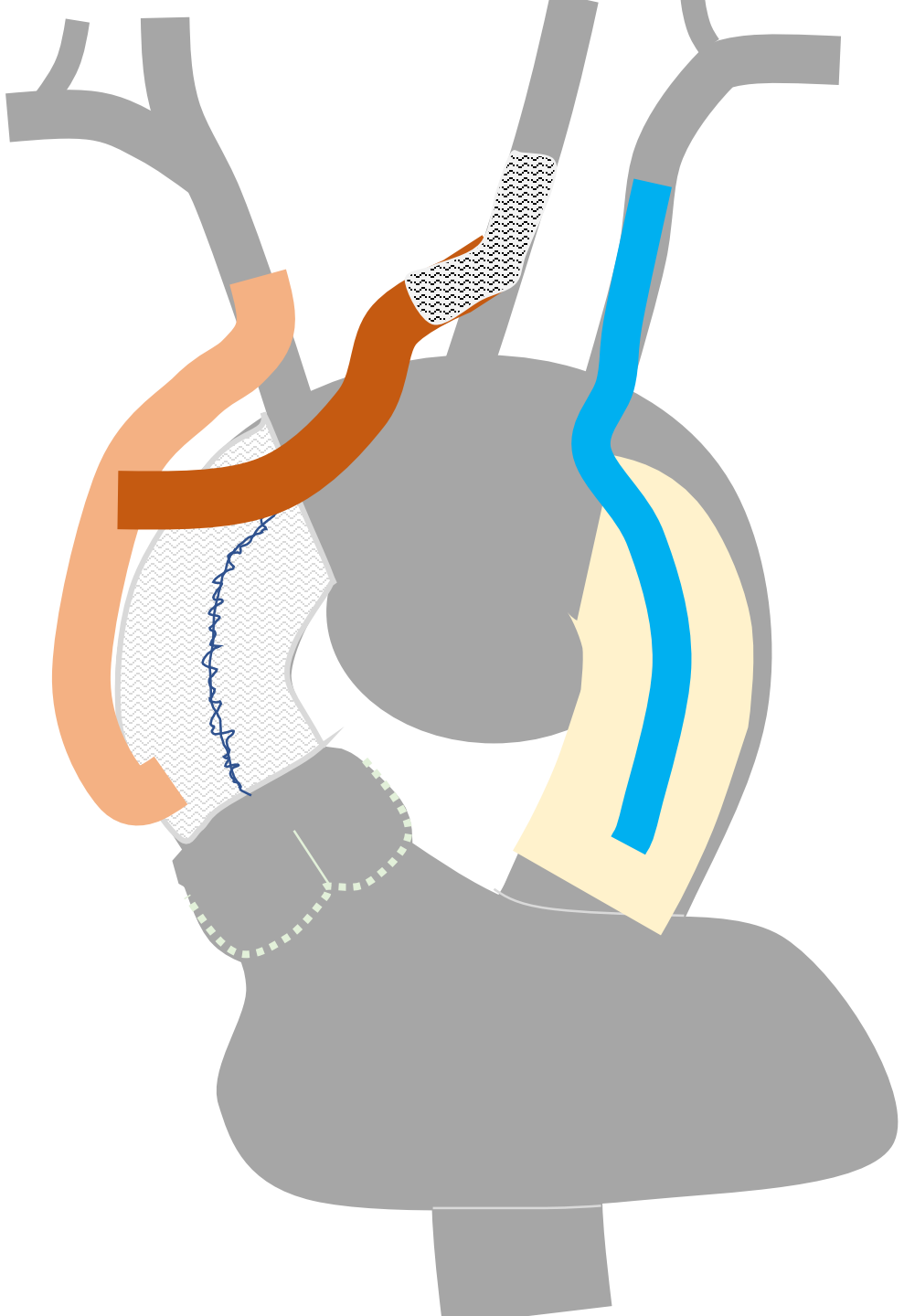
Figure 4: Survival and freedom from reintervention. SE does not exceed 10% at 5 years for the survival curve (SE: 1.7; CI: 101–109) and the freedom from reintervention curve (SE: 4.5; CI: 91–109). SE: standard error; CI: confidence interval.



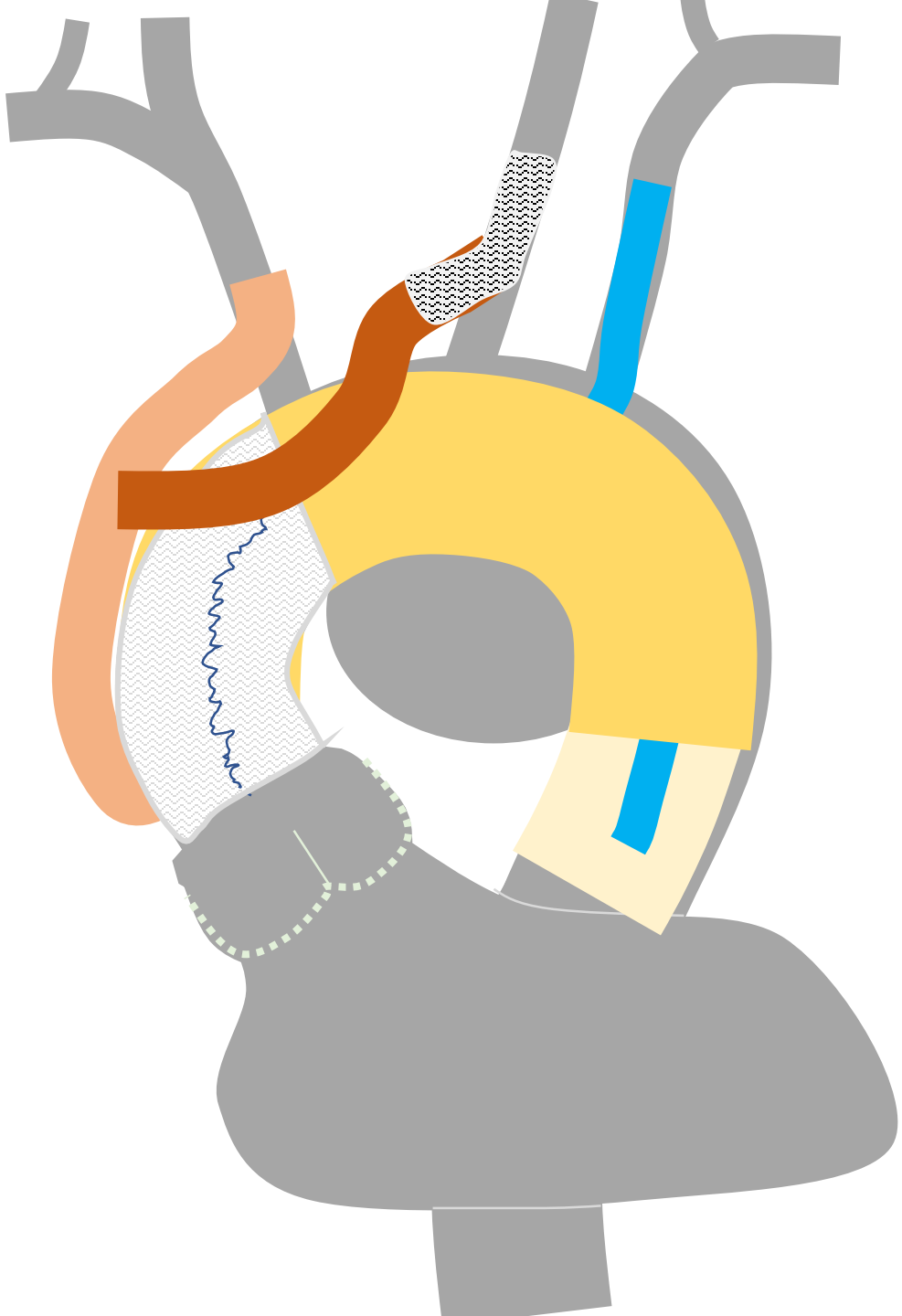
SA debranching
-Generally BCT and LCCA



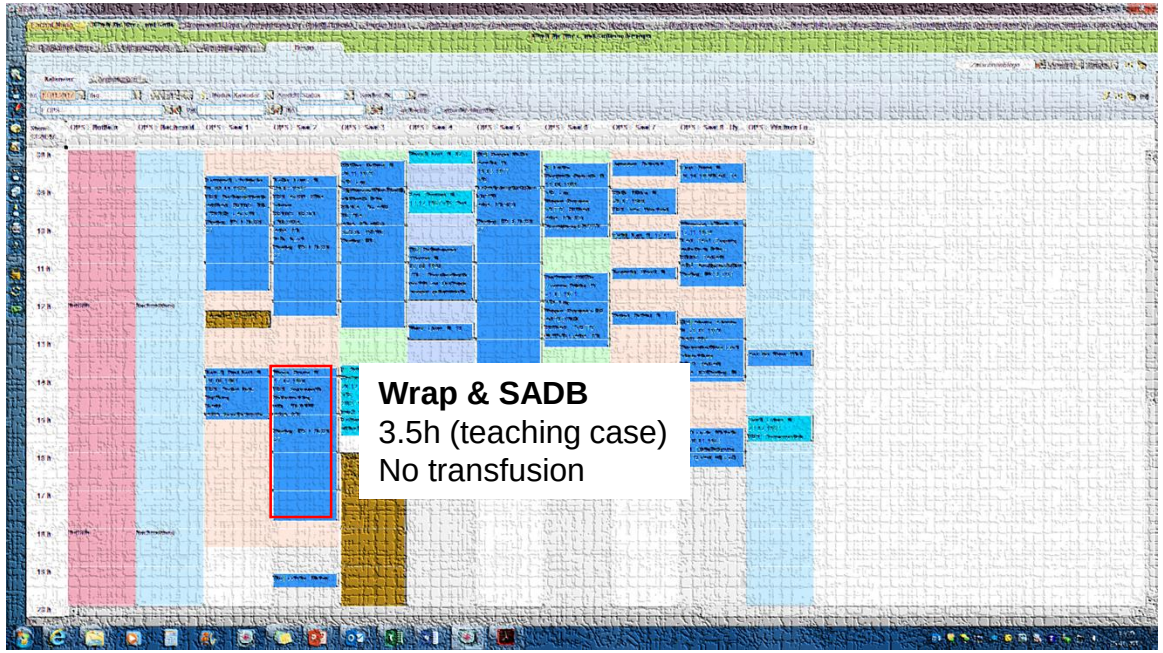
SA debranching
-Generally
- BCT E/E or E/S running suture
- LCCA with VORTEC

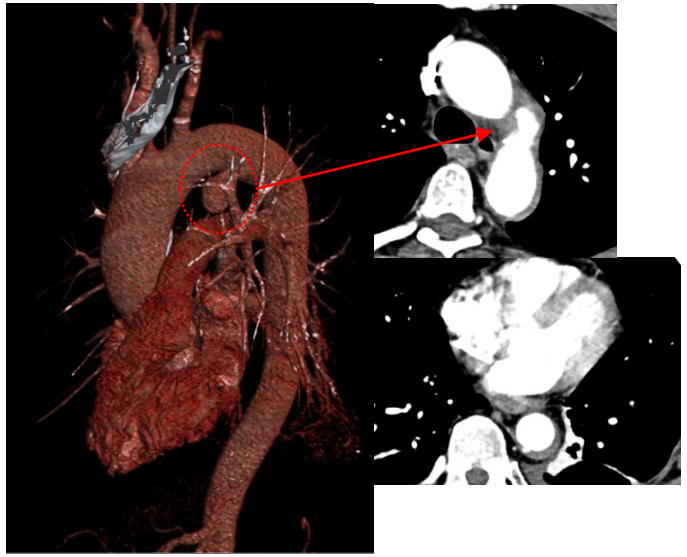


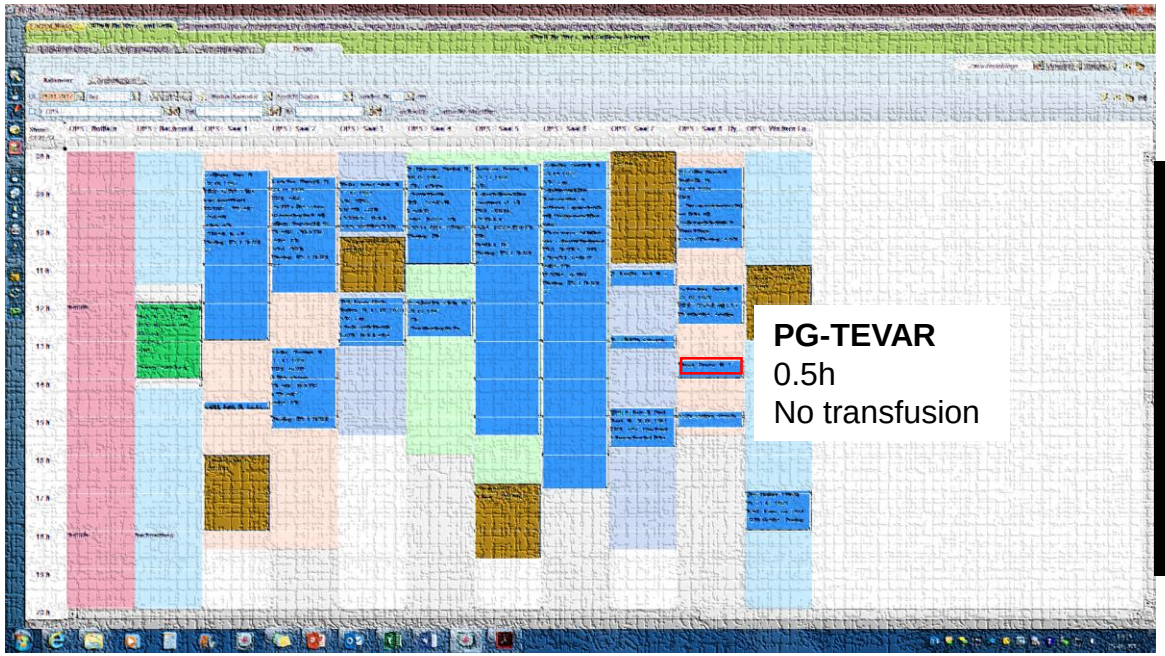
TAG Zone 4
And
LSA PG sandwich

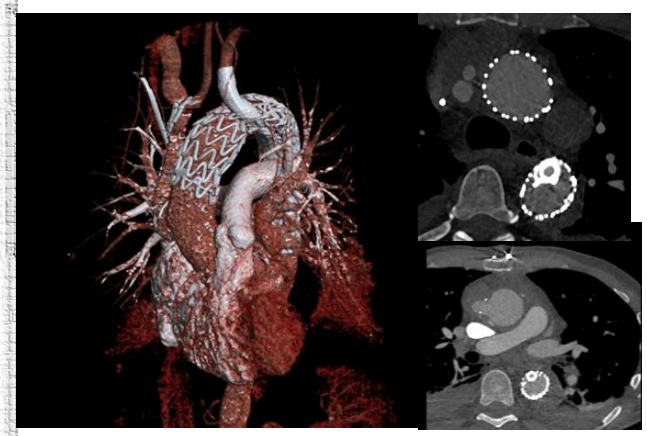


66yo male


Wrap & SADB
3.5h (teaching case)
No transfusion




PG-TEVAR
0.5h
No transfusion



Hybrid TEVAR w. PG

Interactive CardioVascular and Thoracic Surgery (2017) 1–8
doi:10.1093/icvts/ivx016

ORIGINAL ARTICLE

Cite this article as: Pecoraro F, Lachat M, Hofmann M, Cayne NS, Chaykovska L, Rancic Z *et al.* Mid-term results of zone 0 thoracic endovascular aneurysm repair after ascending aorta wrapping and supra-aortic debranching in high-risk patients. Interact CardioVasc Thorac Surg 2017; doi:10.1093/icvts/ivx016.

Mid-term results of zone 0 thoracic endovascular aneurysm repair after ascending aorta wrapping and supra-aortic debranching in high-risk patients

Felice Pecoraro[a,b,*], Mario Lachat[a], Michael Hofmann[a], Neal S. Cayne[c], Lyubov Chaykovska[a], Zoran Rancic[a], Gilbert Puippe[d], Thomas Pfammatter[d], Nicola Mangialardi[e], Frank J. Veith[a,c], Dominique Bettex[f],

[a] Cardiovascular Surge
[b] University of Palerm
[c] New York University
[d] Interventional Radiol
[e] Department of Vascu
[f] Institute of Anesthesi
[g] Department of Anest

* Corresponding autho

Received 2 September

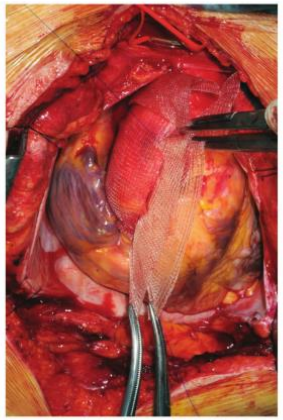


Figure 1: Wrapping technique. The polypropylene mesh is placed around the ascending aorta after its fixation to the posterior aortic wall with two proximal anchoring stitches (Ticron 4.0). The first polypropylene 3.0 running suture (Blalock suture technique) is placed.

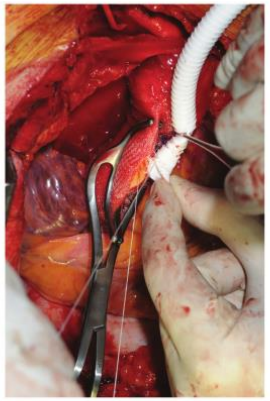


Figure 2: Supra-aortic debranching. A De Bakey multipurpose clamp is placed along the anterior or lateral wall of the ascending aorta to perform the proximal anastomosis.

Figure 3: A computed tomography angiogram after TEVAR showing the proximal landing zone in relation to the ascending aorta, a periscope graft in the left subclavian artery and regular patency of the supra-aortic debranching.

ind
ice.pecoraro@unipa.it (F. Pecoraro).

Abstract

OBJECTIVES: Surgi
erally associated wi
aortic vessel debra
risk in these patient

METHODS: During
tients were conside
aortic transverse di
freedom from occl
ation (SD) = 20] mo

RESULTS: Twenty-
patient was debran
TEVAR was associa
formed in 6 (23%)
vention was require
mean follow-up, si
5 years, the rates o
respectively.

ally the descending aorta is gen-
rapping technique (WT), supra-
eloped to reduce the associated

in zone 0 were included. All pa-
deaths and morbidity, maximal
ovascular reinterventions, SADB
34; range, 0–65; standard devi-

2.9 supra-aortic vessels (75) per
was 29 (r = 0–204; SD = 48) days.
supra-aortic bypasses were per-
in 3 (11.5%) cases, and a reinter-
follow-up period in all cases. At
endoleak occurred in 3 cases. At
lusion were 71.7, 82.3 and 96%,

CONCLUSIONS: The use of the ascending WT, SADB and TEVAR in selected patients with complex thoracic aorta disease is safe and shows promising mid-term results at 3 years. The combination of these techniques could represent an alternative to the standard open surgical repair, especially in older patients or in patients unfit for cardiopulmonary bypass.

Keywords: Debranching • TEVAR • Wrapping • Ascending • Arch • Aneurysm

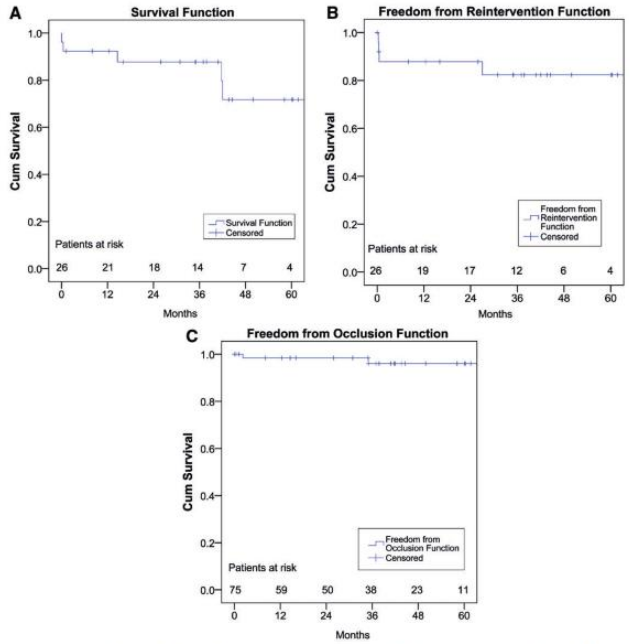
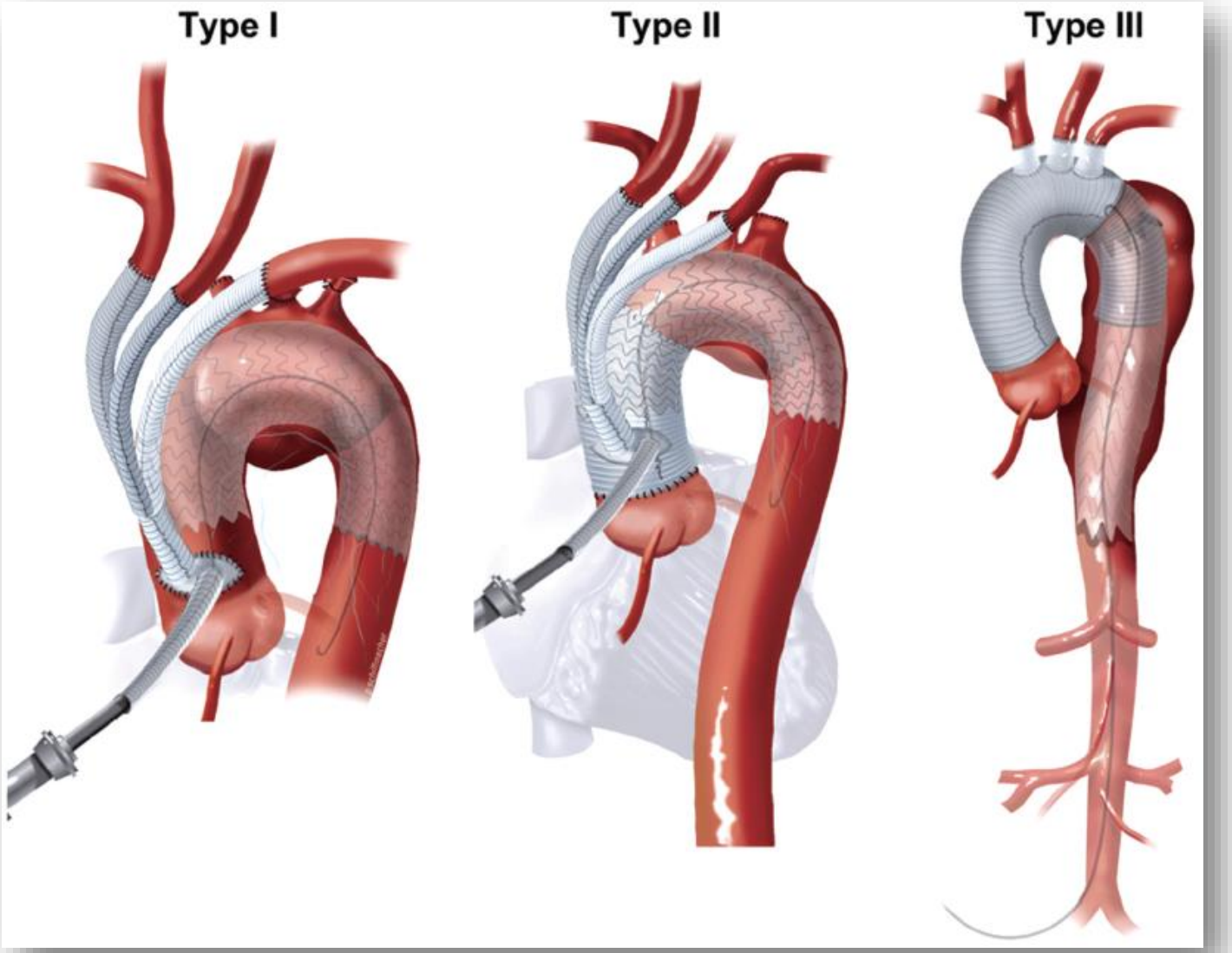
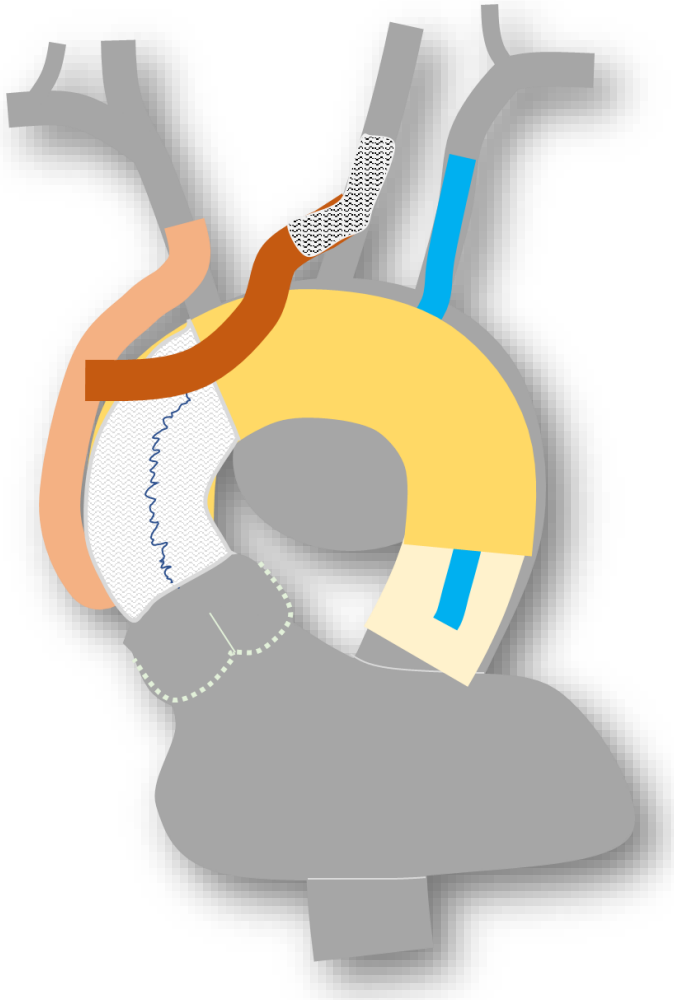


Figure 4: Estimated 5-year Kaplan–Meier curves. (**A**) Survival. SE does not exceed 10% at 5 years for the survival curve (SE = 4.9; CI = 45–64). (**B**) Freedom from reintervention. SE does not exceed 10% at 5 years for the freedom from reintervention curve (SE = 4.6; CI = 46–65). (**C**) Freedom from occlusion. SE does not exceed 10% at 5 years for the freedom from occlusion curve (SE = 1.2; CI = 61–66). SE: standard error; CI: confidence interval.

N= 26
30d M: 8%
Mean follow-up 34 (SD 20] months

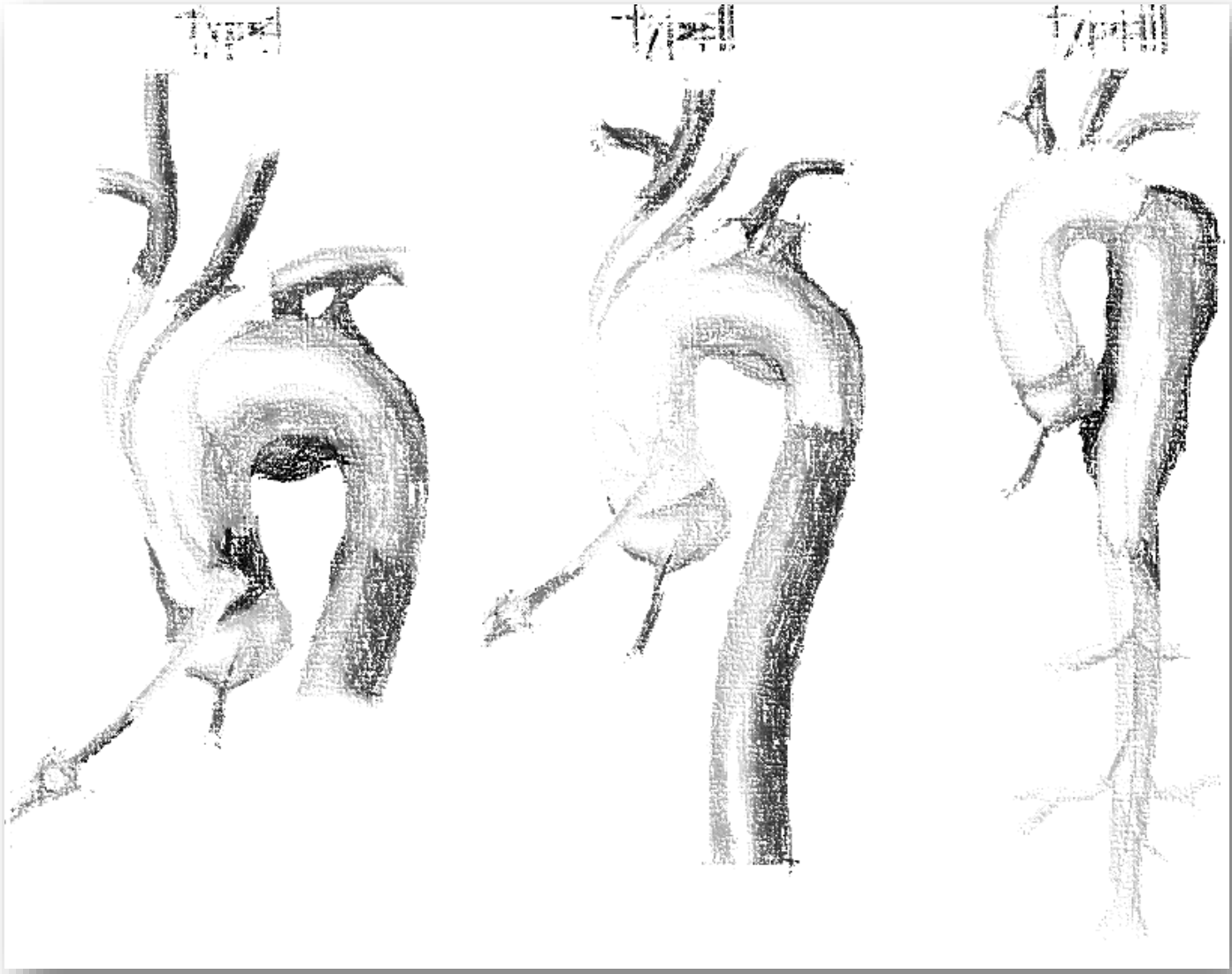
Vallabhajosyula et al. Type II arch hybrid debranching procedure

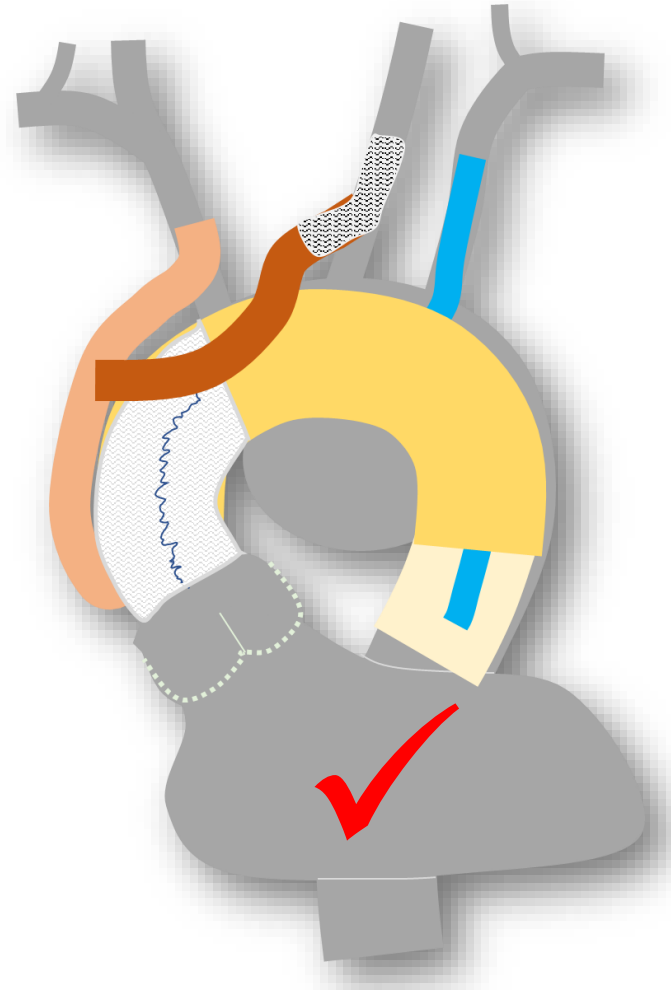




Modified less invasive Type II HR

Vallabhajosyula et al. Type II arch hybrid debranching procedure





When ever possible!!!

-»Normal root»

-»normal» AV function

-Ascending diam < 7omm

Author	Year	Pts (n)	30-day results		Long-term results	
Hybrid Repair			mortality (%)	Stroke (%)	Mean (months)	Survival
Tokuda	2016	58	2 (2.6)	-	52	79% reinterv-free at 2 years
Canaud	2016	7	0 (0)	1 (14.3)	41	No complication
Kang	2016	35	2 (5.7)	2 (5.7)	35.4	Surv: 83.3% at 3 years
Ren	2015	45	1 (2.2)	1 (2.2)	26	Surv 93.2% at mean fup
Ockert	2015	47	6 (12.8)	-	50.5	secondary EL 8.5%, Survival 70%
Iba	2014	50	1 (2)	3(6)	24	Surv 81% & 80% FFR at 3 years
Chiesa	2014	179	8 (4.5)	6 (3.4)	27.3	Clinical success 92.2%
De Rango	2013	104	6	4	30	Survival 71% t 5 years
Bavaria	2013	36	3 (8)	3 (8)	30	Surv 48% at 5 years
Canaud	2013	11	0	-	31	Surv: 71.8 at 2 y
Andersen	2013	67	11 (16)	3 (4.5)	28.5	Reintervention in 10 cases.
Vallejo	2012	38	9 (23.7)	2(4.2)	28.1	Surv 50% ay 2 y
Czerny	2012	66	6 (9.1)	3(4.5)	25	Surv 72% at 5 y
Ma	2011	24	5 (2)	5(2)	33.3	-
Gelpi	2010	15	1 (7)	0(0)	31.4	31m OK
Canau	2010	34	20 (7)	2(5.9)	29.9	30 m: surv 70%
Gottardi	2008	73	5 (6.8)	1(1.4)	37	Surv 72% at 5 years
Total		**889**	**5%**	**2.6%**	**33±8**	**72±12%**

Literature review ARCH Repair

			30d Results				FUP	
Repair type	Patients	Study	Death (%)	CVA/SCI (%)	EL (%)	Redos (%)	Redos (%)	Survival (%)
Open	2131	31	10	9	N/A	8	2	79%@4y
Hybrid	1714	40	11	9	10	4	6	76%@3y
F/B EVAR	899	20	2	5	6	3	9	86%@2y
Chimney	433	26	5	3	16	6	8	94%@1y

Conventional Open Repair

Author	Year	Patients	30d Results				FUP	
			death	stroke and/or paraplegia	EL	reintervention	reintervention	survival
Usui	2002	24	0	4		-	-	96%@1year
Flores	2006	25	3	8		-	-	-
Baraki	2007	39	5	5		0	3	87@1.9Y
Shimamura	2008	126	4	11		3	0	63%@5y
Kawaharada	2009	31	2	1		0	4	73%@5Y
Pochettino	2009	36	5	1		-	-	-
Shimamura	2009	69	5	6		2	6	89%@3Y
Chen	2010	28	4	6		1	0	88%@5y
Jakob	2011	270	41	35		38	0	74%@5y
Jim	2011	10	1					
Lee	2011	21	4					
Nishi	2011	61	2					
Shi	2011	46	1					
Uchida	2011	80	3					
Andersen	2012	20	2					
Hofferberth	2012	19	1					
Hoffmann	2012	32	1					
Lima	2012	50	4					
Shen	2012	38	3					
Shrestha	2012	34	3					
Zhao	2012	24	1					
Di eusanio	2013	122	21					
Ius	2013	131	20					
Leontyev	2013	46	4					
Roselli	2013	17	0					
Sun	2013	398	31					
Xiao	2013	33	6					
Total		**1830**	**176**					
%			**10**					

Hybrid Repair

Author	Year	Patients	30d Results				FUP	
			death	stroke and/or paraplegia	EL	reintervention	reintervention	survival
Bergeron	2006	25	2	3	3	0	3	88%@1.3y
Saleh	2006	15	1	1	0	0	0	-
Chan	2008	16	5	4	2	3	1	100%@1.2Y
Gottardi	2008	73	5	1	18	0	2	72%@5Y
Hughes	2009	28	5	2	2	4	2	70%@3Y
Weigang	2009	26	4	1	1	1	0	-
Antoniou	2010	33	7	6	6	-	-	-
Bavaria	2010	23	3	5	-	-	-	-
Canaud	2010	34	7	3	7	-	-	70%@2.4Y
Chiesa	2010	116	5	7	9	0	2	89%@2y
Donas	2010	20	2	3	0	0	1	-
Gelpi	2010	15	1	1	0	1	1	93%@5Y
Holt	2010	78	6	7	8	3	9	-
			17	1	2	2	0	-
			9	6	7	0	13	59@3y
			6	4	3	4	0	-
			5	4	0	-	-	-
			1	1	-	-	-	-
			10	7	11	3	11	51%@5y
			6	5	9	9	10	96%@5y
			7	2	-	-	-	-
			3	2	1	0	0	74@1.4Y
			1	1	0	-	-	-
			5	8	3	6	3	73%@2Y
			1	4	-	-	-	86%@2Y
			9	6	4	-	-13	50%@4Y
			11	3	11	6	4	51%@5y
			0	0	1	-	-	72%@2Y
			3	5	0	0	1	48%@5Y
			9	6	5	5	2	50%@4Y
			8	6	9	1	10	-
			1	3	4	4	1	81%@3Y
			6	-	9	-	-	70%@4Y
			1	2	2	1	1	93.2%@2Y
			7	6	10	0	10	-
			2	2	-	-	-	83.3%@3Y
			1	0	2	0	1	91%@1Y
			4	4	-	-	-	28%@7Y
			0	2	1	0	0	100%@3.5Y
			2	13	3	6	2	80%@2Y
			188	147	153	59	77	
			11	9	10	4	6	73%@3Y

F/BEVAR

Author	Year	Device	Patients	30d Result					
				death					
Inoue K	1999	Inoue	15	0					
McWilliams	2004	cook	1	0					
Saito N	2005	Inoue	17	0					
Chuter T	2003	Cook and Vascutek	1	0					
Brar R	2008	cook	1	0					
Sonesson	2009	cook	1	0					
Manning	2010	cook	10	0					
Yusa	2011	Najuta	10	0					
Ahanchi	2012	-	6	0					
Lioupis	2012	cook	6	0					
Yuri	2013	-	24	1					
Redlinger	2013	DuPont	22	1					
Spear	2013	cook	1	0					
Azuma	2013	Najuta	393	6					
O'Callaghan,	2014	-	15	0					
Yunoki	2014	Bolton	13	0	0	0	-	-	-
Haulon	2014	cook	38	5	6	11	4	3	
Anderson	2015	cook	2	0	0	0	0	0	100%@0.5 years
Matsuyama	2015	cook	37	1	2	1	0	11	65%@5years
Mangialardi	2015	Najuta	1	0	0	0	0	0	-
Iwakoshi	2015	Najuta	29	0	2	0	0	2	67%@3y
Tse	2015	Valiant & Cook	6	0	1	0	0	0	100%@12m
Lu	2015	MiniPort	52	1	0	0	0	0	-
Kurimoto	2015	Najuta	37	0	5	12	0	4	86%@2years
Riambau	2015	Bolton	26	1	1	2	-		
Abdallah	2016	Bolton	10	1	1	1	0	0	-
Joseph	2016	Medtronic-HomieMade	2	0	0	2	0	1	100%@6m
Spear	2016	cook	27	0	3	3	4	2	-
Total			**803**	**17**	**37**	**58**	**14**	**37**	
%				**2**	**4.6**	**7.2**	**1.8**	**4.7**	**"89%"@"2years"**

			30d Results				FUP	
			death	stroke and/or paraplegia	EL	reintervention	reintervention	survival
			0	0	2	0	0	-
			0	0	0	0	0	-
			0	0	0	0	0	-
			0	1	1	0	0	-
			0	0	2	1	2	
			2	1	2	0	1	-
			1	1	0	1	3	100%@0.4years
Yoshida	2011	2	0	0	2	0	1	-
Shu	2011	8	0	0	0	0	0	100%@1year
Feng	2011	1	0	0	0	0	0	100%@1year
Gehringhoff	2011	9	1	0	1	0	1	79%@1year
Vallejo	2012	8	1	1	0	3	5	-
Akchurin	2012	10	0	0	1	0	0	100%@0.5years
Synoviecz	2013	1	0	0	0	0	0	-
Shahverdyan	2013	6	1	0	3	2	1	83%@0.2years
Samura	2013	2	0	0	2	0	0	100%@0.5years
Zhu	2013	34	0	0	2	4	4	94%@1year
Chang	2013	1	0	0	0	0	0	100%@1year
Zhou	2013	1	0	0	2	0	0	100%@1year
Mangialardi	2014	26	1	2	6	3	-	80%@3years
Vicente	2014	1	0	0	0	0	0	100%@0.8years
Total		**152**	**7**	**6**	**26**	**14**	**18**	
%			**5**	**4**	**17**	**9**	**12**	**"94%"@"1y"**

Hybrid Tech- Conclusions

- HR techniques and results significantly improved during last years
- More recent series show lower mortality & morbidity rates and repair durability
- Valuable option in selected patients

Conclusions

- Hybrid, PG tech & Arch devices are three safe means to treat arch pathology
- Superiority cannot be shown for none of them due to different target population
- Wise indication selection/ capability to combine the technique is probably the way to go