



# 23<sup>RD</sup> INTERNATIONAL EXPERTS SYMPOSIUM

## CRITICAL ISSUES in aortic endografting 2019

### LIVERPOOL UNITED KINGDOM MAY 23-24



The inner Branch approach:  
A versatile option for complex Aortic Endorepair



Nilo J Mosquera, MD.

[www.critical-issues-congress.com](http://www.critical-issues-congress.com)





## Disclosure

Speaker name:

Nilo J Mosquera, MD.

I have the following potential conflicts of interest to report:



**Consulting and Clinical Proctor: Lombard Medical, Cook Medical, WL Gore, Terumo Aortic, Cordis (Cardinal Health), JOTEC-Cryolife.**

Employment in industry

Stockholder of a healthcare company

Owner of a healthcare company



**Other(s): Spanish National Health Service Employee**

I do not have any potential conflict of interest

# Complex aortic aneurysm repair: The Endovascular Approach

## A Standardized Multi-Branched Stent-Gr...

Matthew P. S...  
Linda M. Reill...

<sup>1</sup>Department of...  
San Francisco...  
Surgery, Daeg...



EDUCATIONAL SERIES ON THORACIC AORTA (...)  
**Present and Future of Branched Thoraco-abdominal Aortic Single-centre Experience**

E.L. Verhoeven\*, I.F. Tielliu, W.T. B...

Department of Surgery, Division of Vascular Surgery, Univ...  
9700 RB Groningen, The Netherlands

Submitted 6 May 2009; accepted 6 May 2009  
Available online 11 June 2009

Current Treatment Options in Cardiovascular Medicine (2010) 12:205–213  
DOI 10.1007/s11936-010-0070-0

### Vascular Disease

## Endovascular Treatment of Thoracoabdominal Aneurysm

Tara M. Mastracci, MD, FRCSC, MSc

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Published online: 9 April 2010  
© Springer Science+Business Media, LLC 2010

### Opinion statement

The use of endovascular aneurysm repair has become a treatment option for...

Eur J Vasc Endovasc Surg (2010) 39, 537–544



## Fenestrated Multi-Branch Stent-Gr...

...the French...

...demin<sup>b</sup>, P.-E. Magnan<sup>c</sup>, P. Lermusiaux<sup>d</sup>,  
...F. Cochenne<sup>b</sup>, J.-P. Favre<sup>\*,</sup> Association  
...en Chirurgie Vasculaire (AURC)

...Cardiologique, CHRU de Lille 59037 Lille Cedex, France  
...Lille Cedex, France

## Pararenal aortic aneurysm repair using fenestrated endografts

Matteus A. M. Linsen, MD,<sup>a</sup> Vincent Jongkind, MD,<sup>b</sup> Denise Nio, MD,<sup>b</sup> Arjan W. J. Hoksbergen, MD,<sup>a</sup> and Willem Wisselink, MD,<sup>a</sup> Amsterdam and Hoofddorp, The Netherlands

**Objective:** We performed a systematic review of the current literature to analyze the immediate and follow-up results of fenestrated endovascular aortic aneurysm repair (F-EVAR) in patients with pararenal abdominal aortic aneurysms (AAAs).

**Methods:** The Medline, Embase, and Cochrane databases were searched to identify all studies reporting F-EVAR of pararenal AAAs published between January 2000 and May 2011. Two independent observers selected studies for inclusion, assessed the quality of the included studies, and performed the data extraction. Studies were selected based on specific predefined criteria. Outcomes were technical success (successfully completed procedure with endograft patency, preservation of target vessels, and no evidence of type I or III endoleak at postprocedural imaging), 30-day mortality, all-cause mortality, branch vessel patency, renal impairment, and secondary interventions. Between-study heterogeneity was calculated using I<sup>2</sup> statistics. Pooled estimates were calculated using a fixed-effects (I<sup>2</sup> <25%) or a random-effects (I<sup>2</sup> >25% to <50%) model.

**Results:** Nine studies were included reporting 629 patients who underwent F-EVAR for a pararenal AAA, of which 1622 target vessels were incorporated in an endograft design. Between-study heterogeneity was ≤41% for all outcomes. The pooled estimate (95% confidence interval [CI]) was 90.4% (87.7%–92.5%) for technical success, 2.1% (1.2%–3.7%) for 30-day mortality, and 16% (12.5%–20.4%) for all-cause mortality. Follow-up was 15 to 25 months. The pooled estimates (95% CI) during follow-up was 93.2% (90.4%–95.3%) for branch vessel patency, 22.2% (16%–30.1%) for renal impairment, and 17.8% (13.5%–22.6%) for secondary interventions.

**Conclusions:** Promising immediate and midterm results (up to 2 years) support F-EVAR as a feasible, safe treatment in a relatively high-risk cohort of patients with pararenal AAAs. (J Vasc Surg 2012;56:238–44)

## Circulation



## Repair of Juxtarenal Aortic Aneurysms in the Endovascular Era: A Systematic Review of the Global Collaborators on Techniques for Aneurysm Repair (GLOBALSTAR) Registry

Circulation. 2012;125:2707-2715

doi: 10.1161/CIRCULATIONAHA.111.070334

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Branched and fenestrated endografts ARE an established therapy: increasing evidence up to now



# Endo-optimism even from Andres Schanzer!!!

*Finally in 2017...*

## Outcomes of fenestrated and branched endovascular repair of complex abdominal and thoracoabdominal aortic aneurysms

Andres Schanzer, MD, Jessica P. Simons, MD, MPH, Julie Flahive, MS, Jonathan Durgin, BA, Francesco A. Aiello, MD, Danielle Doucet, MD, Robert Steppacher, MD, and Louis M. Messina, MD, Worcester, Mass

### ABSTRACT

**background:** More than 80% of infrarenal aortic aneurysms are treated by endovascular repair. However, adoption of fenestrated and branched endovascular repair for complex aortic aneurysms has been limited, despite high morbidity and mortality associated with open repair. There are few published reports of consecutive outcomes, inclusive of a fenestrated and branched endovascular repairs, starting from the inception of a complex aortic aneurysm program herefore, we examined a single center's consecutive experience of fenestrated and branched endovascular repair of complex aortic aneurysms.

**Methods:** This is a single-center, prospective, observational cohort study evaluating 30-day and 1-year outcomes in a consecutive patients who underwent fenestrated and branched endovascular repair of complex aortic aneurysm: fenestration requiring one or more fenestrations or branches). Data were collected prospectively through an Institutional Review Board-approved registry and a physician-sponsored investigational device exemption clinical trial (G130210).

**Results:** We performed 100 consecutive complex endovascular aortic aneurysm repairs (November 2010 to March 2017) using 58 (58%) commercially manufactured custom-made devices and 42 (42%) physician-modified devices to treat 49 common iliac, 42 (42%) juxtarenal, 18 (18%) pararenal, and 36 (36%) thoracoabdominal aneurysms (type I, n = 1; type II, n = 4; type III, n = 12; type IV, n = 18; arch, n = 1). The repairs included 309 fenestrations, branches, and scallops (average 3.1 branch arteries/case). All patients had 30-day follow-up for 30-day event rates: three (3%) deaths; six (6%) target artery occlusions; five (5%) progressions to dialysis, paralysis, or stroke. Of 10 type I or type III endoleaks, 8 resolved (7 with secondary intervention, 1 without intervention). Mean follow-up time was 563 days (interquartile range, 156-862), with free (3%) patients lost to follow-up. On 1-year Kaplan-Meier analysis, survival was 87%, freedom from type I or type II endoleak was 97%, target vessel patency was 92%, and freedom from aortic rupture was 100%. Average lengths of intensive care unit stay and inpatient stay were 1.4 days (standard deviation, 3.3) and 3.6 days (standard deviation, 3.6), respectively.

**Conclusions:** These results show that complex aortic aneurysms can now be treated with minimally invasive fenestrated and branched endovascular repair. Endovascular technologies will likely continue to play an increasingly important role in the management of patients with complex aortic aneurysm disease.

*These results show that **complex aortic aneurysms can now be treated with minimally invasive fenestrated and branched endovascular repair.***

*Endovascular technologies will likely continue to play an increasingly important role in the management of patients with complex aortic aneurysm disease.*

# so.. Do we have ultimate solution? Not really

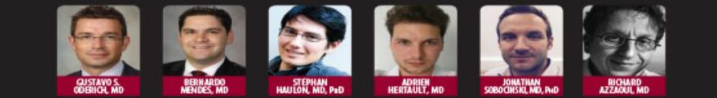
Supplement to Sponsored by Cook Medical

## Endovascular TODAY

November 2015

### BRANCHING OUT

Experts share their views on advancing endovascular technology.



## Visceral Branch durability still a issue

BRANCHING OUT

### Is Renal Branch Occlusion the Achilles Heel of Endovascular TAAA Repair?

A look at the causes of and possible solutions to this lingering complication.

BY TIMOTHY A.M. CHUTER, MD



There is no shortage of candidates for the title "Achilles heel of endovascular thoracoabdominal aortic aneurysm (TAAA) repair." For all of its advantages, endovascular TAAA repair has many potential failure modes. However, the

artery to the flexible unstented portion, and stabilize branch attachment by providing a site for arterial ingrowth. Commonly used covered stents include iCast (Maquet; balloon expandable), Jostent (Abbott Vascular; balloon expandable), Viabahn (Gore & Associates; self-expanding), and Fluency (Bard Peripheral Vascular,

type those parap (thro diffic threa depe meth Alt of ren repai a stea impla appli risin

could become a limiting factor. It is still difficult to advocate endovascular TAAA repair in patients who are healthy enough to undergo open repair, and the prospect of long survival after endovascular repair

## Mostly related to Branch Devices but also relevant in fenestrated

others\* use terms like "branched stent graft" or "a stent graft with cuff-based branches) a stent grafts" (meaning a stent graft with based branches).



# We have learned a lot from fenestrated and outer branch experience

## Fenestrated and branched endovascular aneurysm repair outcomes for type II and III thoracoabdominal aortic aneurysms

Matthew J. Eagleton, MD, Matthew Follansbee, BS, Katherine Wolski, MPH, Tara Mastracci, MD, and Uki Kuramochi, BScN, Cleveland, Ohio

**Objective:** Thoracoabdominal aortic aneurysm (TAAA) repair remains a challenging clinical pathology. Endovascular technology, in particular the evolution of fenestrated and branched (F/B) endografts used in endovascular aneurysm repair (EVAR), has provided a less invasive method of treating these complex aneurysms. This study evaluated technical and clinical outcomes of F/B-EVAR for extensive type II and III TAAA.

**Methods:** Data from 354 high-risk patients enrolled in a physician-sponsored investigational device exemption trial (2004-2013) undergoing F/B-EVAR for type II and III TAAA were evaluated. Technical success, perioperative clinical outcomes, and midterm outcomes (36 months) for branch patency, reintervention, aneurysm-related death, and all-cause mortality were analyzed. Data are presented as mean  $\pm$  standard deviation and were assessed using Kaplan-Meier, univariate, and multivariate analysis.

**Results:** F/B-EVARs incorporating 1305 fenestration/branches were implanted with 96% of target vessels successfully. Completion aortography showed 2.8% patients had a type I or III endoleak. Procedure duration ( $6.0 \pm 1.7$  v  $5 \pm 1.6$  hours;  $P < .01$ ) and hospital stay ( $13.1 \pm 10.1$  vs  $10.2 \pm 7.4$  days;  $P < .01$ ) were longer for type II TAAA. Perioperative mortality was greater in type II repairs (7.0% vs 3.5%;  $P < .001$ ). Permanent spinal cord ischemia occurred in 1% and renal failure requiring hemodialysis occurred in 2.8% of patients. Twenty-seven branches (7.6%) required reintervention for stenosis or occlusion; and celiac artery, superior mesenteric artery, and renal artery secondary patency at 36 months was 96% (95% confidence interval [CI], 0.93-0.99), 98% (95% CI, 0.97-1.0), and 98% (95% CI, 0.96-1.0), respectively. Eighty endoleak repairs were performed in 67 patients, including 55 branch-related endoleaks, 4 type Ia, and 15 type II endoleaks. At 36 months, freedom from aneurysm-related death was 91% (95% CI, 0.88-0.95) for type II TAAA and freedom from all-cause mortality was 57% (95% CI, 0.50-0.63). The treatment of type II TAAA with F/B-EVAR is a robust treatment option for patients at increased risk for conventional open repair, including those with chronic obstructive pulmonary disease ( $P < .05$ ) negatively affected survival.

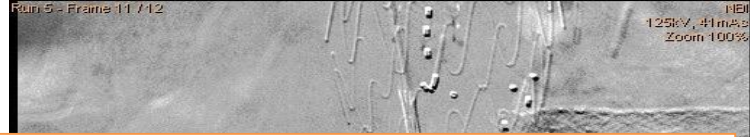
**Conclusions:** F/B-EVAR is a robust treatment option for patients at increased risk for conventional open repair, including those with chronic obstructive pulmonary disease ( $P < .05$ ) negatively affected survival. Technical success and branch patency are excellent, but some patients will require reintervention for stenosis or occlusion. Aneurysm extent portends a higher risk of perioperative and long-term morbidity. Additional efforts are needed to improve outcomes and understand the utility of this treatment in the TAAA population. (J Vasc Surg 2016;63:930-42.)

These outcomes are similar to those reported by others, with perhaps a slight patency advantage for reinforced fenestrations compared with directional branches when targeting the Renal arteries

**Fens seem to perform better than branches for the renals**

J Vasc Surg 2016;63:930-42.

# Learning curve lessons learned: Indication



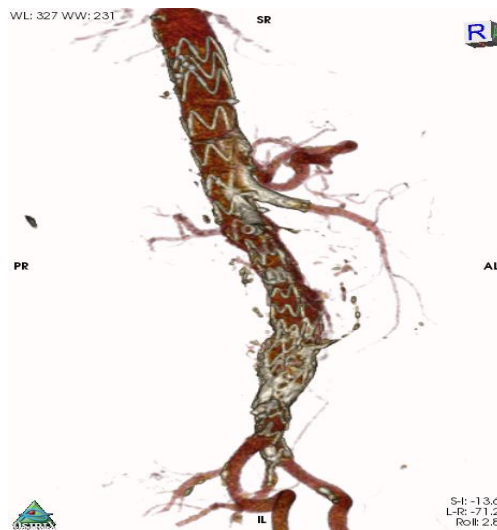
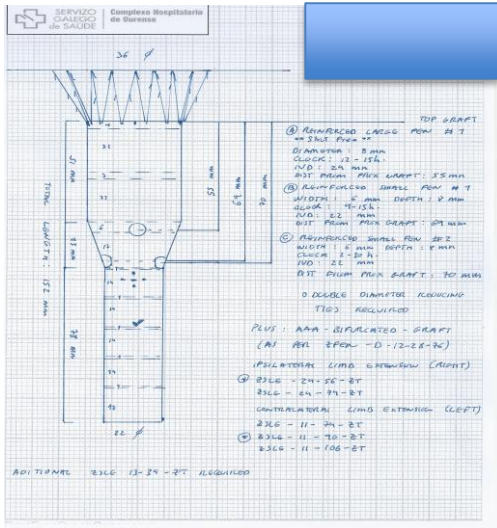
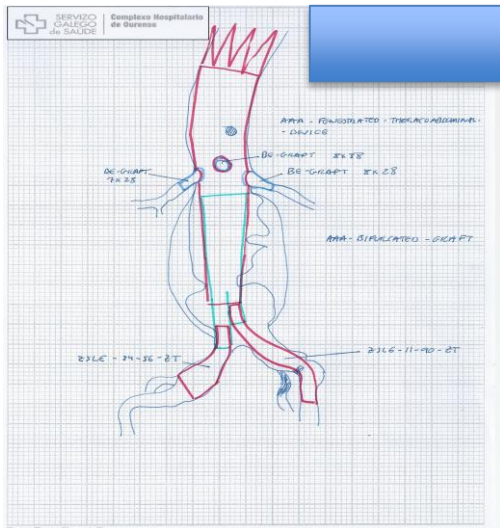
1 *Almost all the target vessel complications are renal issues*

2 *Renal complications less frequent in more stable procedures*

3 *More aggressive approach with 3 or 4 vessel designs to achieve more stable and durable repair*

# So: Let's Be Agresive!

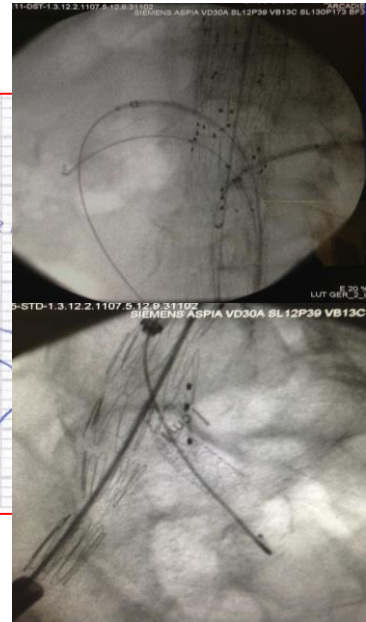
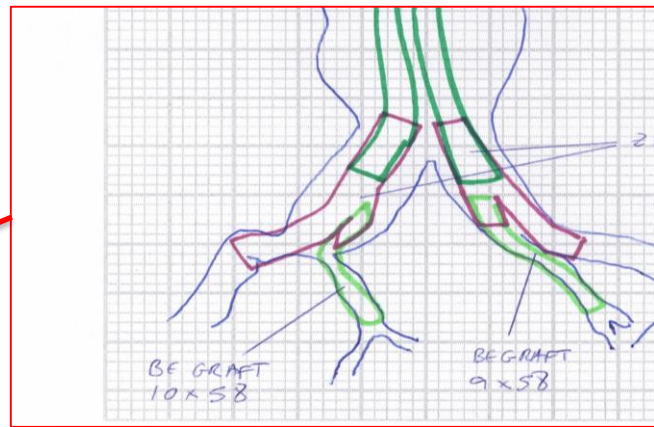
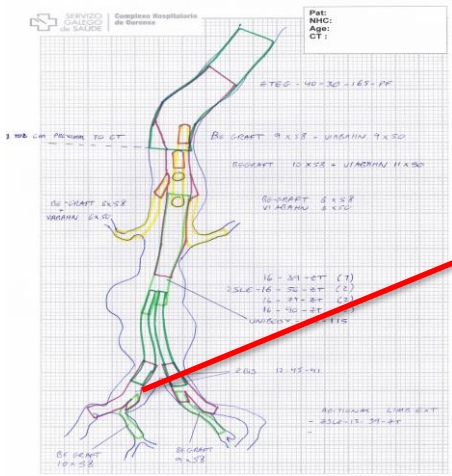
- Means...If you go for complex do not cheat on landing zone





# To Be Agresive

- Means... If you go for complex PRESERVE to the maximum to prevent neurological complications



# But Take it easy

- Use best approach to reduce the impact of the procedure

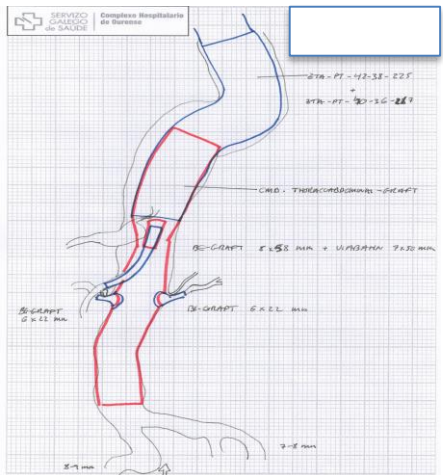
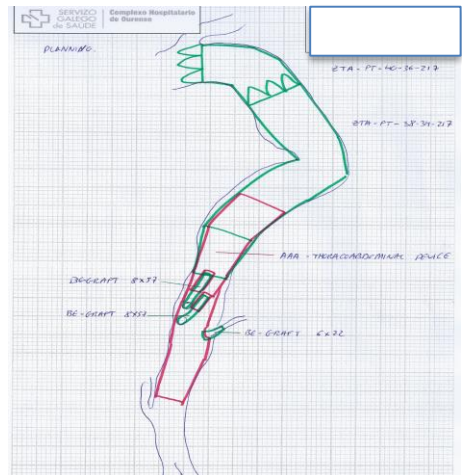
*On you!!!!*



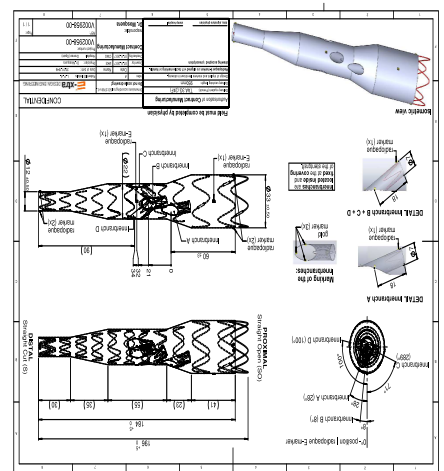
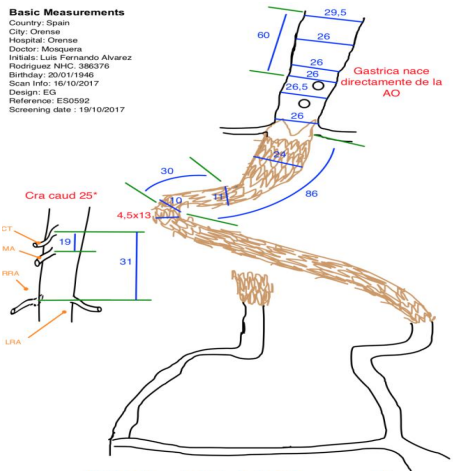


# Take it easy

- Plan the complex case to make it simple: use combinations of branches, fenestrations, scallops... to simplify the problems.



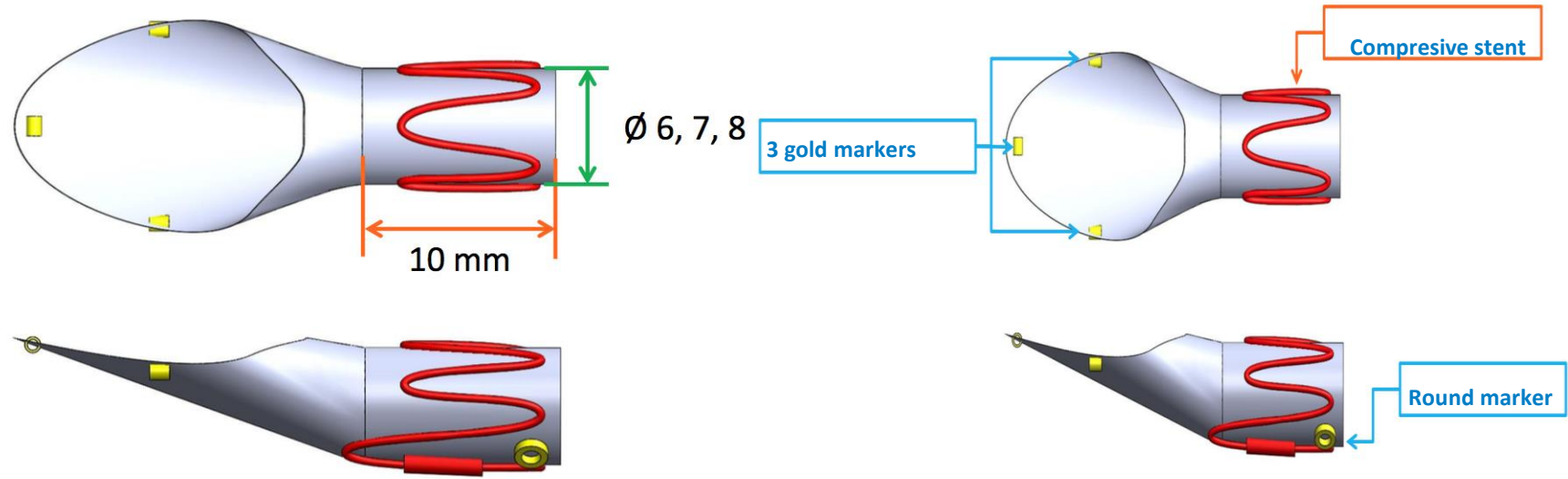
**Basic Measurements**  
Country: Spain  
City: Orense  
Hospital: Orense  
Doctor: Mosquera  
Initials: Luis Fernando Alvarez  
Rodriguez NHC: 386376  
Birthday: 20/01/1946  
Scan Info: 16/10/2017  
Design: EIG  
Reference: ES0592  
Screening date: 19/10/2017



# The role for Inner branches: best of both worlds?

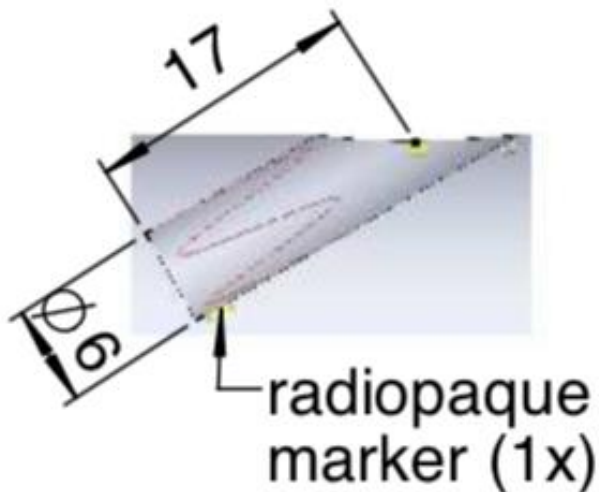
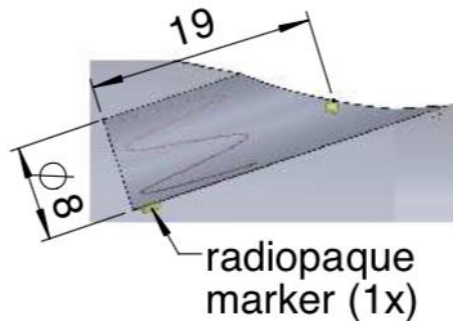
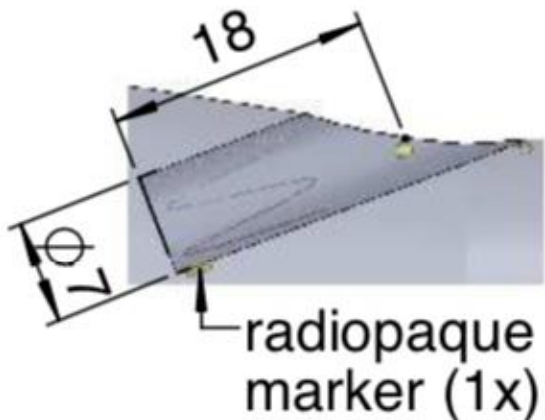


# Inner branches: design features



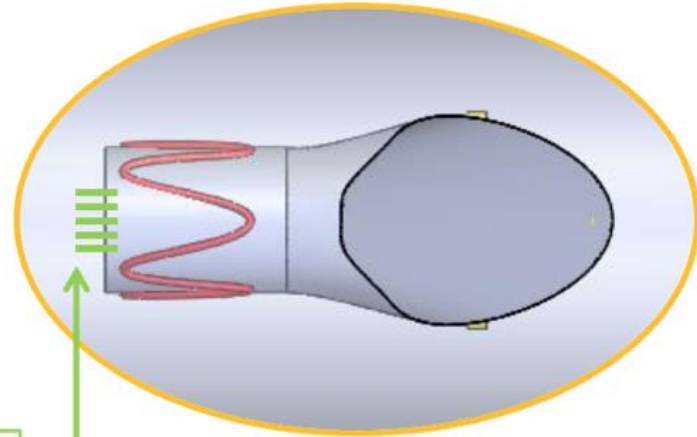
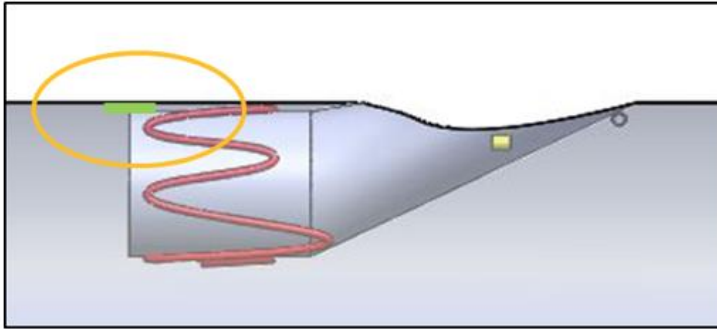
## Inner branches: design features

*Branch length depends on  
chosen diameter*



# Inner branches: design features

*Proximal branch to graft suture to facilitate cannulation and provide more stability*

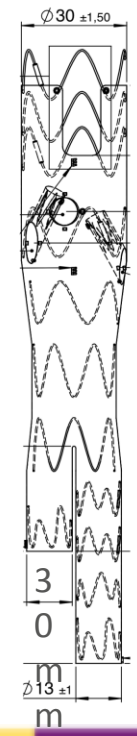
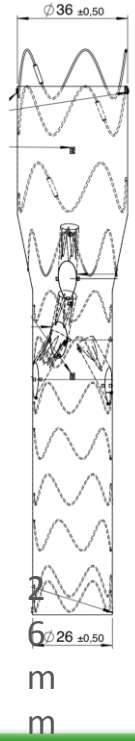
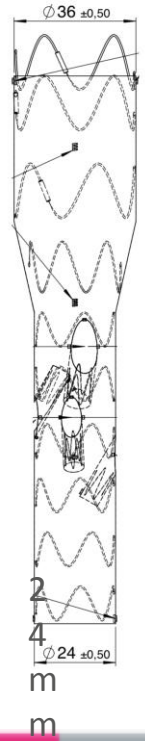
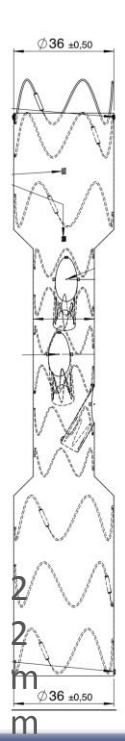


Continuous suture

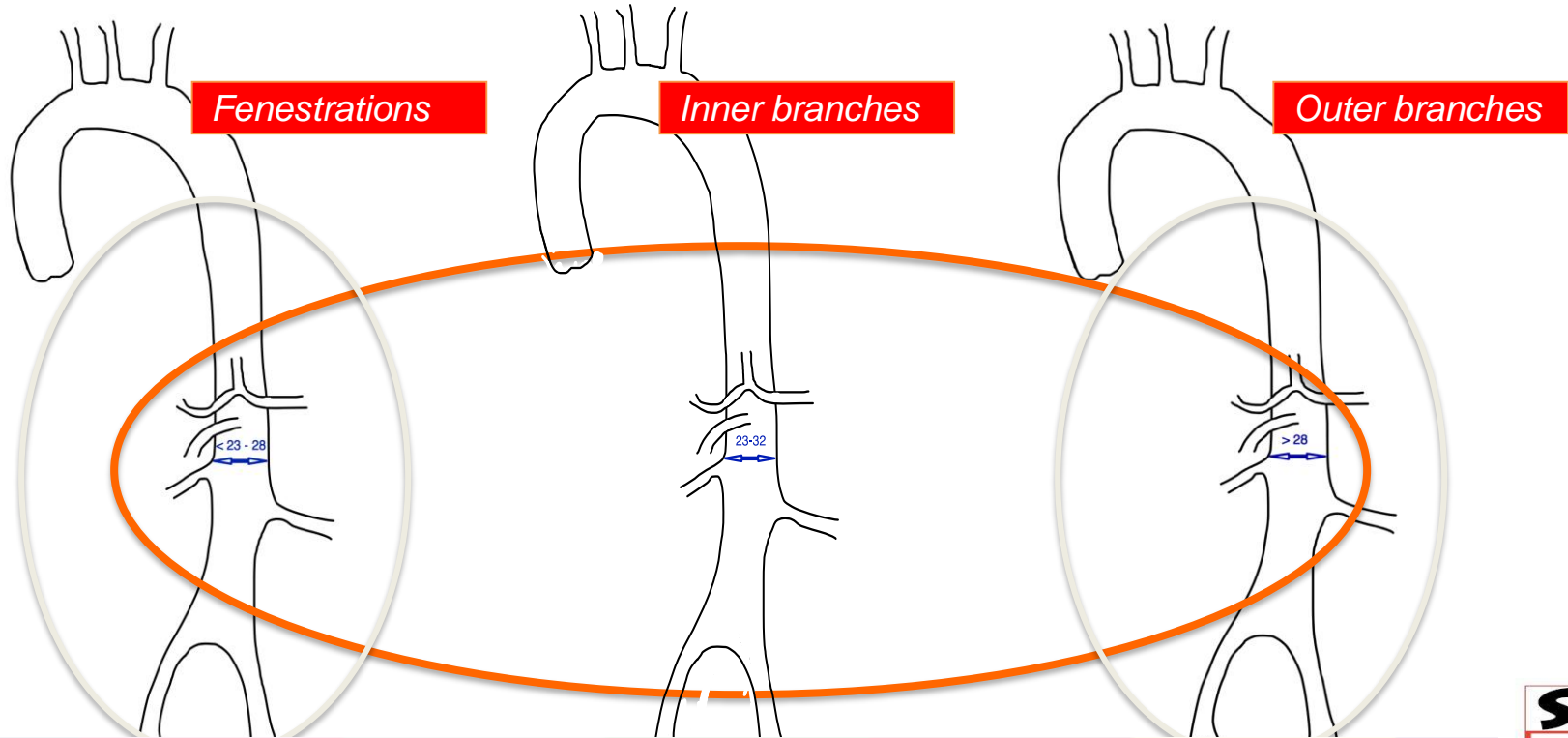


# Inner branches: design features

## Manufacturing options



# Inner branches: inner lumen is not a major limitation

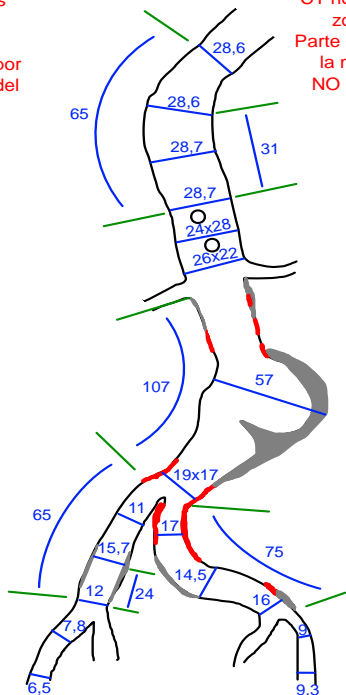


# Inner branches: comparative features

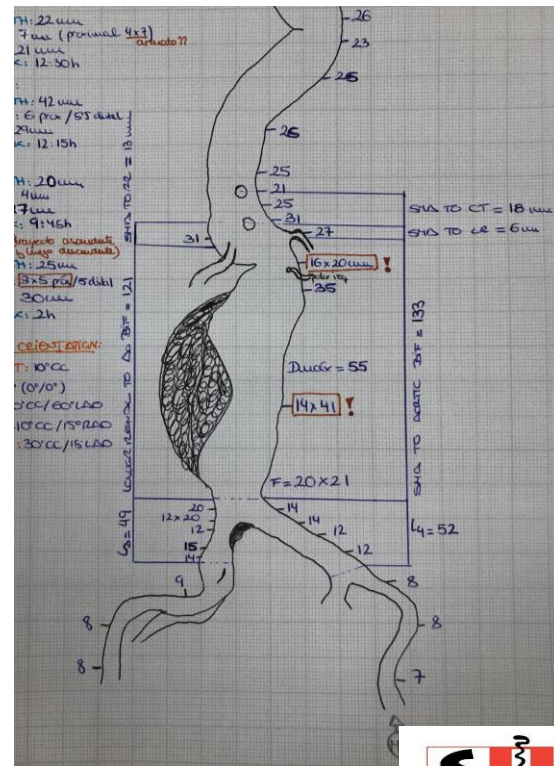
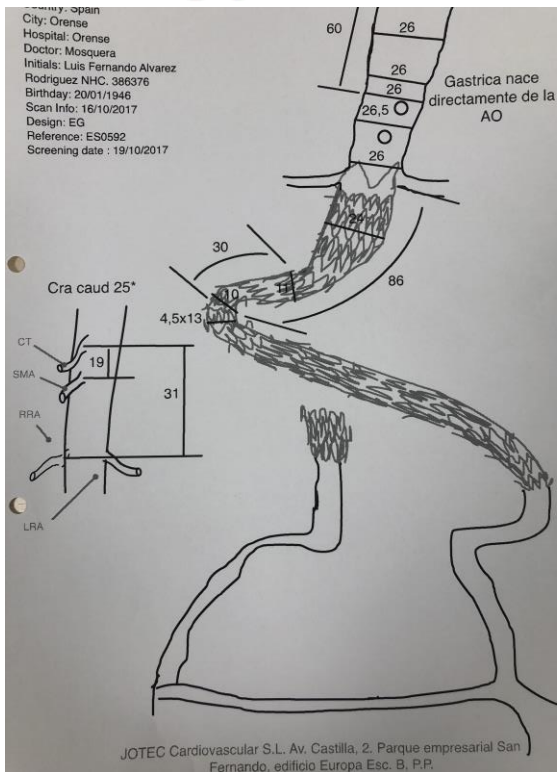
	OUTER BRANCHES	FENESTRATIONS	INNER BRANCHES
NATURAL FLOW	✓	✗	✓
AORTA COVERED	✗	✓	✓
VERSATILITY	✓	✗	✓
ORIENTATION	✓	✗	✓
HEIGHT	✓	✗	✓
OVERLAPING	✓	✗	✓
FREE LUMEN	✗	✓	✓
FRENCH	✗	✓	✗
PROCEDURE STAGES	✓	✗	✓
COMPLEX ANATOMIES	✓	✗	✓
PERMEABILITY	✓	✓	✓

# Our initial experience with Inner branches: The good, the bad, the ugly

4 pares lumbares permeables  
AMI permeable  
Acceso izquierdo por diámetro y forma del aneurisma

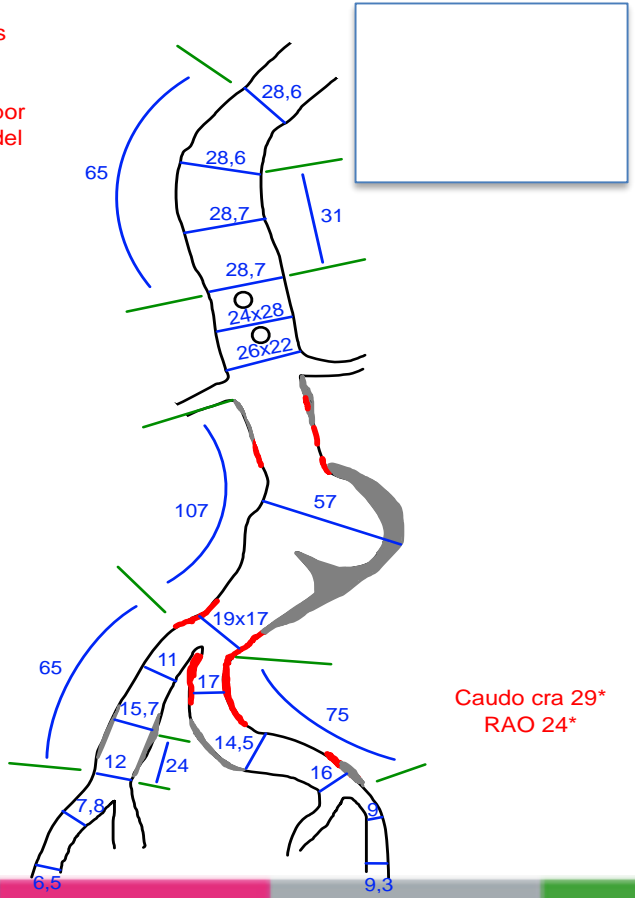


CT no tiene cortes de zona torácica.  
Parte distal llega hasta la mitad de AIE,s  
NO información de SFA,s



# The good

4 pares lumbares permeables  
AMI permeable  
Acceso izquierdo por diámetro y forma del aneurisma



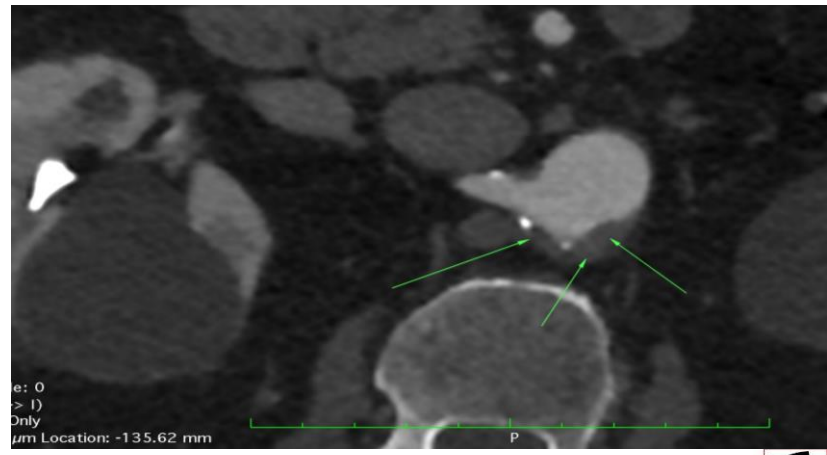
Cauda cra 22\*  
LAO 20\*

Cauda cra 29\*  
RAO 24\*

78 years old CRF patient

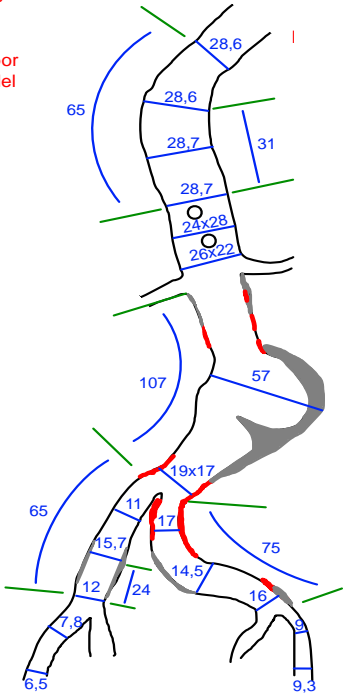
57 mm AAA

25 mm infrarenal neck with posterior thrombus and ulceration at renal level extending to SMA



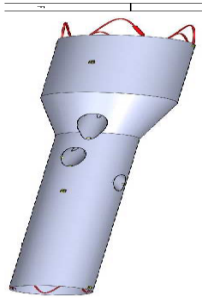
# 4 vessel inner branch CMD device from JOTEC

4 pares lumbares permeables  
AMI permeable  
Acceso izquierdo por diámetro y forma del aneurisma



Cauda cra 22\*  
LAO 20\*

Cauda cra 29\*  
RAO 24\*

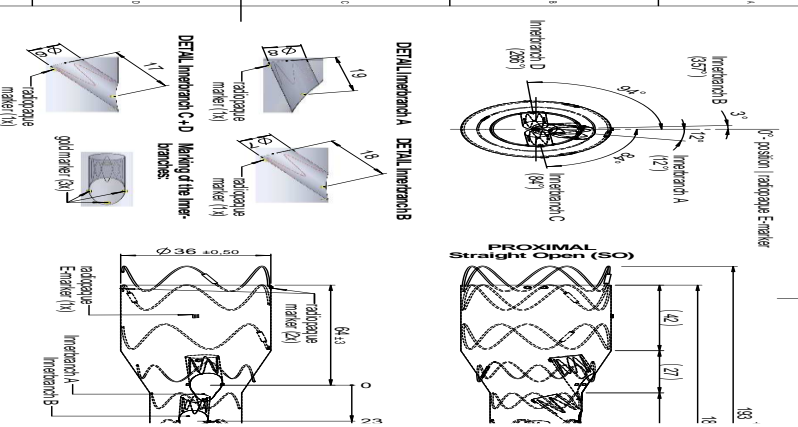


Isometric view

Interbranches covered inside the filter  
Material: Recovering the structure

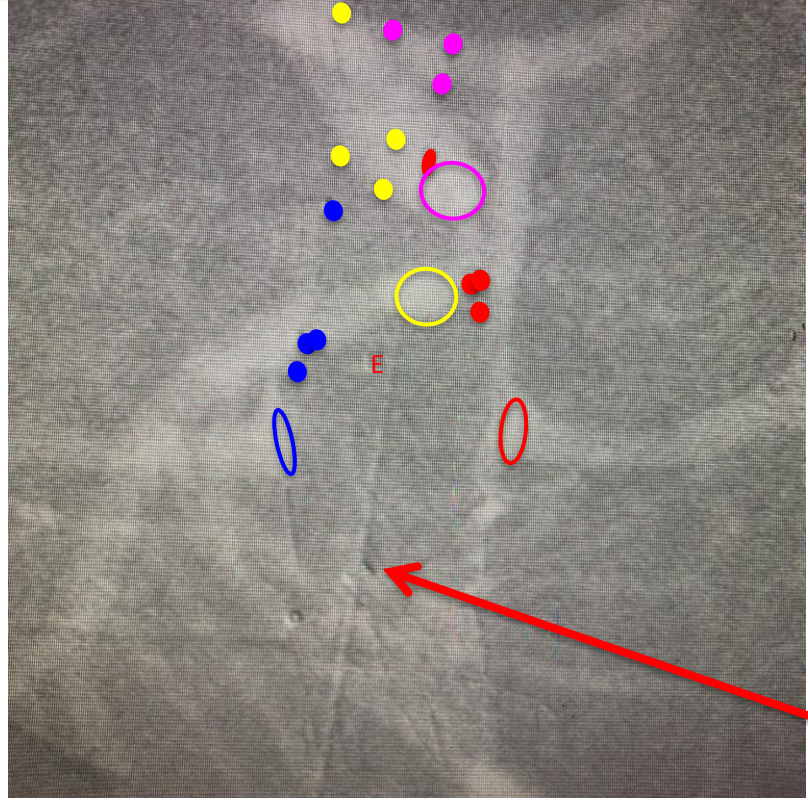
Filter made by physician

Author/Doctor/Contract/Manufacturing	
Order reference code	714.55.028
Order reference name	35787
Order reference number	35787
Order reference description	Interbranches covered inside the filter
Order reference date	15/05/2018
Order reference location	Interbranches covered inside the filter
Order reference status	Interbranches covered inside the filter



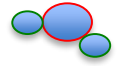
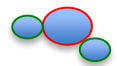
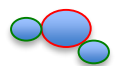
# Check position after branch deployment

# Procedure



Graft in position:  
EVAR/FEVAR CO2 protocol



-  **Pressure** → 650
-  **Volume** → 100 ml.
-  **Flush** →

6F 55cm Flexor as "Pig tail" for CO2



## Remarks

1. Zero Iodine procedure is possible today even in complex aortic repair

2. Inner branch allowed a “easy procedure”

3. Inner branch allow room for cannulation even in relatively narrow lumen



## The bad

US: 2 cm sac diam increase confirmed by CT Scan



72 years old male

2008 Ruptured AAA treated with AUI + fem-fem by pass

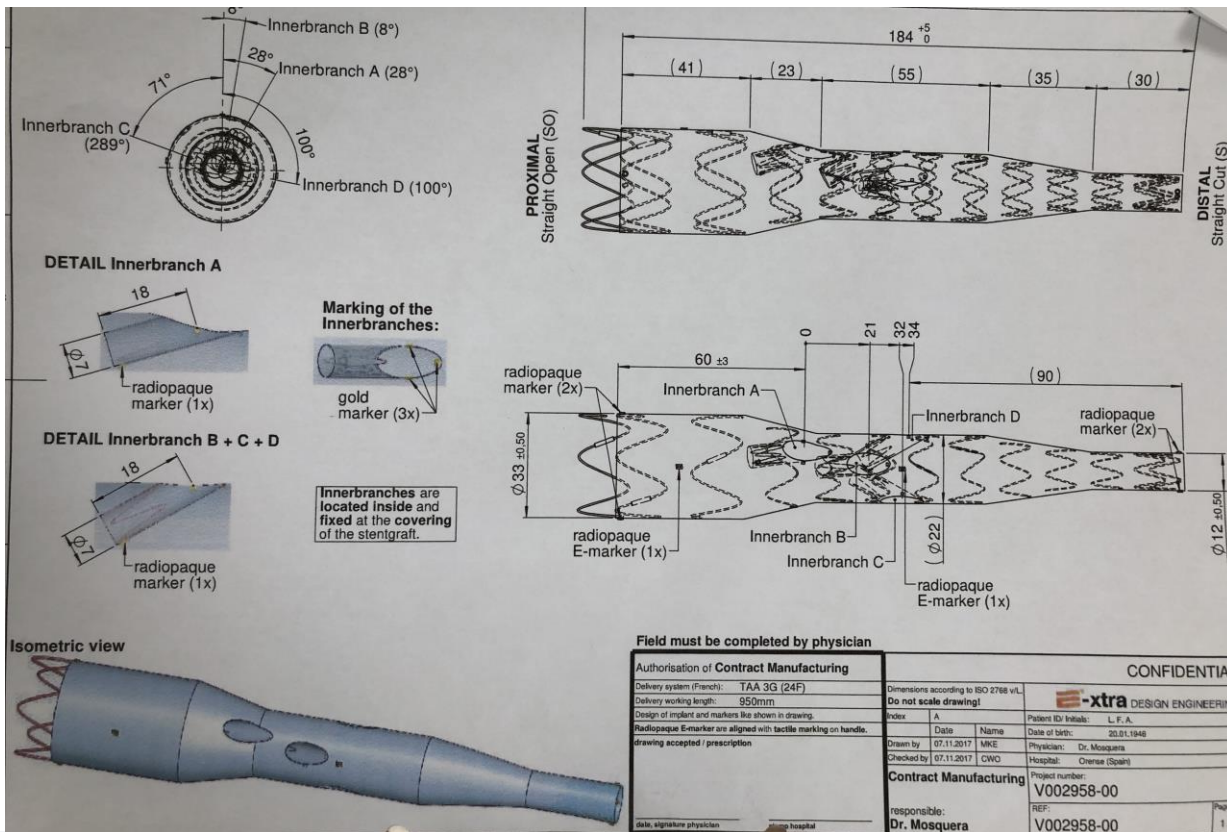
Postop compartment syndrome and 15 days ICU survival

10 years FU with exclusion and sac stability, no redo, no complications. Senior Tennis player





# The bad



*4 Inner branch custom made device*

*Designed to match the AUI device*

*Long 26F sheath needed to provide torque and prevent torsion*

*And...*

# The bad



*...additional support requested before starting in the OR.*

## The bad



*4 Inner branch custom  
made deployed*

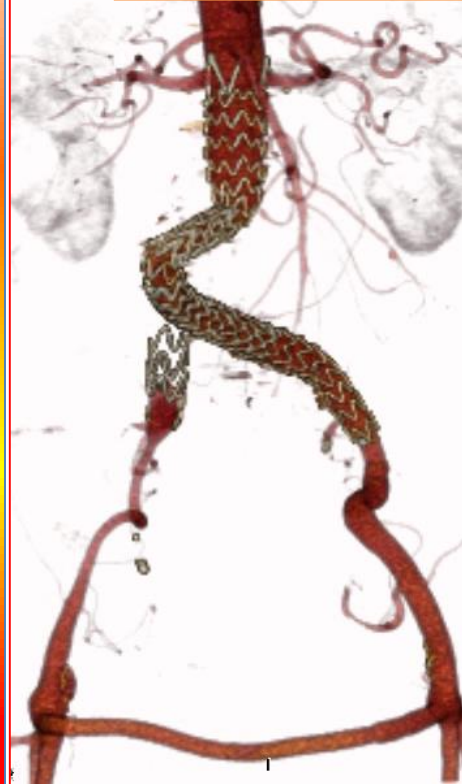
*1 cm Sac reduction at 1  
month*

*Kink corrected*

*No complications  
postop or at the FU SO  
FAR*

3 WW: 378

AP view  
Pre/POST



LAT view  
Pre/POST



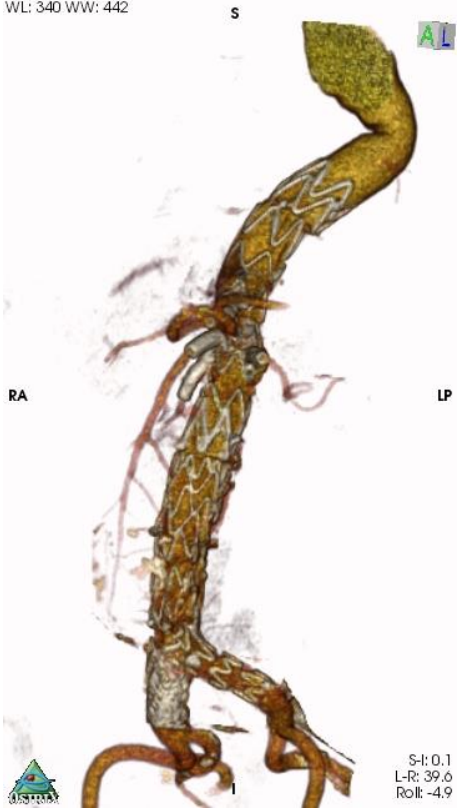




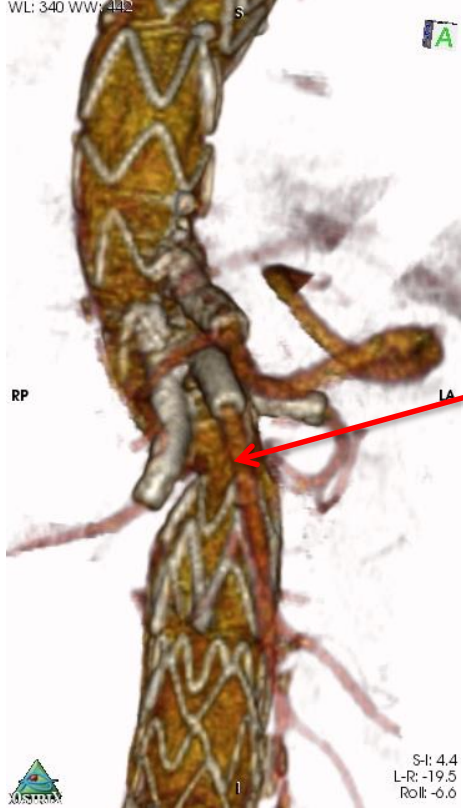


# The Ugly finally looked good

WL: 340 WW: 442



WL: 340 WW: 442



1 month FU looks OK

Adapted to IR angulation

And...

No complications postop or at the FU SO FAR





# E-side „first off the shelf device with inner branches precannulated"

- 4 INNER BRANCHES PRECANNULATED
- 4 different choices
- Availability
- High feasibility for TAAA treatment
- Based on Extra Design technology



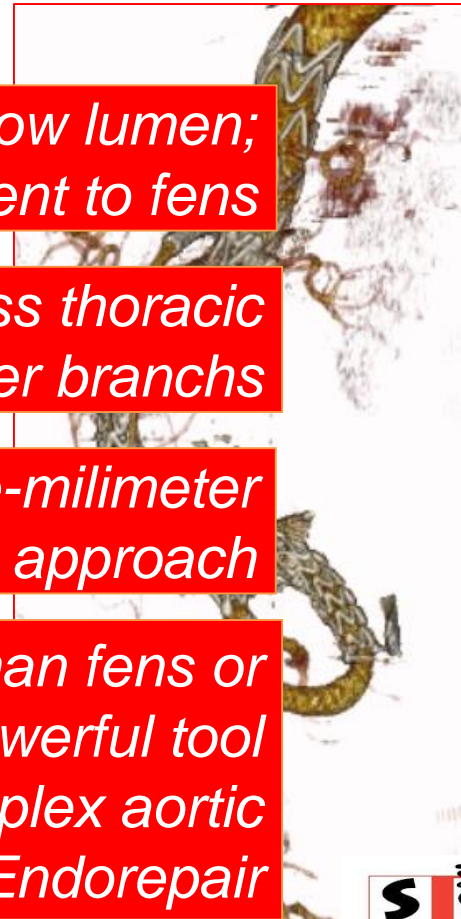
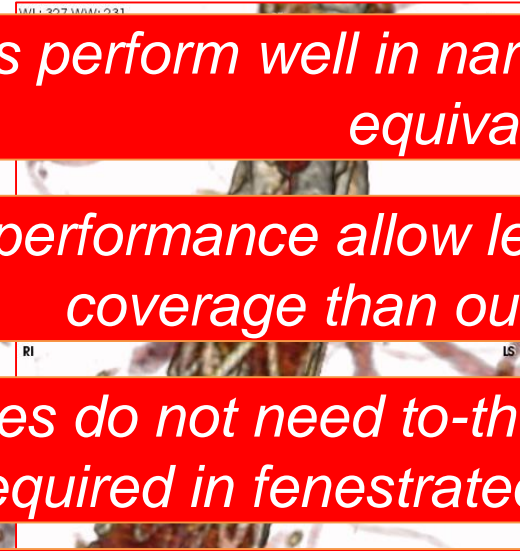
## Inner branches: conclusions

*Inner branches perform well in narrow lumen;  
equivalent to fens*

*Inner branches performance allow less thoracic  
coverage than outer branches*

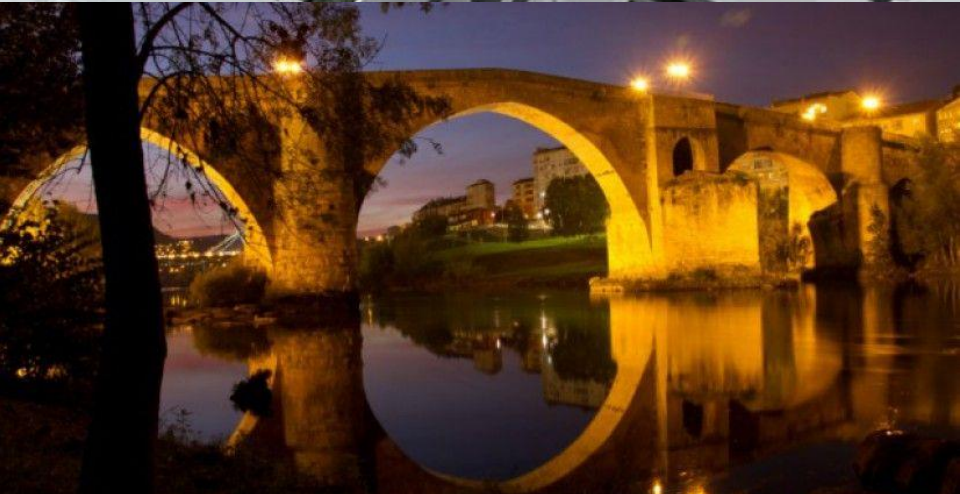
*Inner branches do not need to-the-milimeter  
precision required in fenestrated approach*

*Inner branches are more versatile than fens or  
outer branched grafts; could be a powerful tool  
for off the shelf solution to complex aortic  
Endorepair*





Thanks for  
your attention!



ENDOASCULAR  
FOUNDATION

