AAA with Large IIA: Can a Bifurcated Stent a Solution

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Iliac Artery Aneurysm

- IAA associated with AAA: 15~40% of AAA
  - CIA aneurysm ~70%
  - IIA aneurysm 10~30%
- Isolated IAA (IIAA): 0.9~2%
- Bilateral IIAA ~30%
- Internal iliac artery aneurysm: 0.03~0.4%

Cardiovasc Intervent Radiol 2011;34:3

Definition of Iliac Artery Aneurysms

Artery	Normal diameter (cm)	Aneurysmal diameter (cm)
CIA	0.97–1.02 ± 0.15 (female)	≥1.5
	1.17–1.23 ± 0.2 (male)	≥1.7
IIA	0.54 ± 0.15	≥0.8

- Expansion rates:
  - IIAA <3cm: 1.1 mm/y
  - IIAA 3-5 cm: 2.6 mm/y
- IIAA 3-3.5 cm: US or CT follow-up at 6-month-intervals
- IIAA ≥ 3.5 cm: elective repair

Occlusion of IIA

Eur J Vasc Endovasc Surg (2017) 53, 534–548

REVIEW

Systematic Review and Meta-analysis of the Effect of Internal Iliac Artery Exclusion for Patients Undergoing EVAR

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WHAT THIS PAPER ADDS

Internal iliac artery (IIA) embolisation is frequently required prior to EVAR in order to achieve a suitable landing zone. However, patients can experience considerable morbidity following this, which in part has driven the introduction of iliac branched devices. This systematic review was undertaken to determine pooled complication rates of IIA coverage as derived from a comprehensive literature review. Buttock claudication occurs in approximately one third of patients, although this resolves in half of those affected. New onset erectile dysfunction occurs in approximately 10% of males. Major ischaemic complications, such as buttock, colonic and spinal ischaemia were all very rare, and reporting of such events was much more likely from older publications. In general, all complications were worse after bilateral than unilateral IIA occlusion. Coils were generally associated with poorer outcomes than plug occlusion. Coverage alone, without prior embolisation, was associated with improved outcomes; however, data for this were generally scarce, and confounding factors may account for these reduced rates of complications. Where coiling and plugging are both available, these data would suggest plugging is preferable. Should neither be possible, consideration can be given to IIA coverage alone.

Objective: Endovascular abdominal aortic aneurysm repair (EVAR) sometimes requires internal iliac artery (IIA) coverage to achieve a landing zone in the external iliac artery. The aim of this study was to determine complication rates following IIA exclusion.
Materials and methods: A systematic review of key journals was undertaken from January 1980 to April 2016. Studies detailing occlusion (using coils or plugs) or coverage of the IIA with outcome data were included. Weighted means were calculated for continuous variables. Meta-analysis was performed when comparative data were available. Quality was assessed using the GRADE system.
Results: Sixty-one non-randomised studies (2671 patients; 2748 IIAs) were analysed. Fifteen per cent of EVARs require IIA sacrifice. Buttock claudication (BC) occurred in 27.9% of patients, although 48.0% resolved after 21.8 months. BC rates were 32.6% with coils, 23.8% with plugs, and 12.9% with coverage alone, and less with unilateral (vs. bilateral) IIA treatment (OR 0.57, 95% CI 0.36–0.91). More proximal coil placement resulted in lower rates of BC (OR 0.12, 95% CI 0.03–0.48). Erectile dysfunction occurred in 10.2% of males, with higher rates after coiling. Type II endoleaks were more frequent after covering alone; however re-interventions were rare. Significant ischaemic events (bowel/gluteal/spinal ischaemia) were very rare. Plugs were quicker to place and required less radiation ($p < .001$) than coils. GRADE scoring was very low for all outcomes.
Conclusion: Overall the quality of reported data on IIA sacrifice is poor. Buttock claudication and erectile dysfunction occurred frequently after IIA sacrifice. Where both options are technically possible, plugs could be considered preferential to coils, and placed as proximally in the IIA as possible.

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Keywords: Endovascular aneurysm repair, EVAR, Internal iliac artery, Hypogastric artery

- Buttock claudication: ~28%
- Erectile dysfunction: ~10%

  - no difference between unilateral and bilateral IIA occlusion

- Ischemic colitis/bowel: 0.6%/0.5%

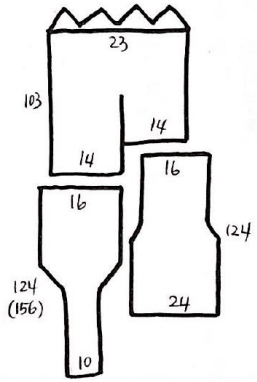
  - The risk doubles, if bilateral IIA are occluded.

- Pelvic or gluteal necrosis: 0.5%
- Spinal chord ischemia: 0.75% (permanent 0.25%)

Techniques for Preserving IIA Flow

- Bell bottom
- Sandwich/Parallel graft
- Iliac branch device (IBD)

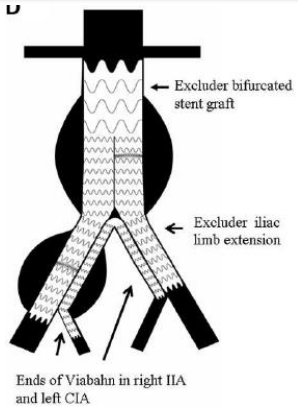
Bell Bottom Technique

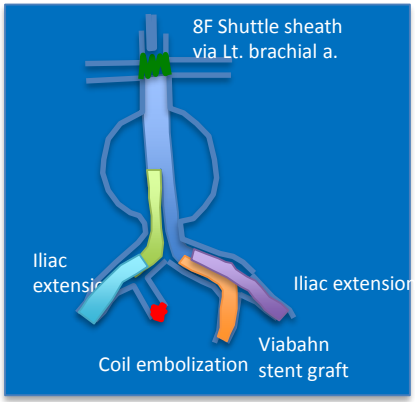


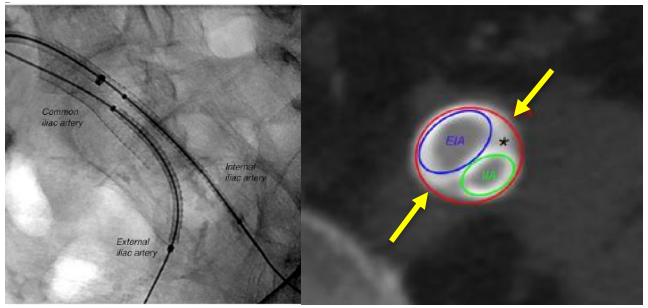
Study	N.	Mean CIA diameter (range)	Mean follow-up time	Technical success	Aneurysm sac regression	Aneurysm sac dilation	Freedom from secondary intervention	Endoleak rate
Torsello *et al.*[18] (2010)	89	22.1±3.0 mm (20-30 mm)	56.5±2.1 months	97.8%	Not significant	4.4%	91.6% at 5 years	Type I: 3.4% Type II: 2.2%
Naughton *et al.*[15] (2012)	166	20 mm (20-28 mm)	22 months (9-38)	–	–	–	89%	–
Alverez *et al.*[17] (2013)	19	20 mm (18-25 mm)	35 months	94.7%	Not significant	–	72.6% at 4 years	Type II: 21%
Telles *et al.*[19] (2016)	38	21±4 mm (15-32 mm)	25.8±14.9 months	–	64.7% unchanged or reduced up to 20%	35.3%	84.3% at median follow-up time	Type Ib: 7.8% Type II: 9.8%
Gray *et al.*[20] (2017)	128	14 mm	53 months	–	–	–	–	Type Ib: 18% in CIA >20 mm and 3.9% in CIA <20 mm

Robalo C, Int Angiol 2018;37:346

Sandwich/Parallel Graft Techniques







Massmann et al.

Study	N.	Mean CIA diameter (range)	Mean follow-up	Technical success	Graft patency	Branch occlusion	Aneurysm sac regression	Aneurysm sac dilation	Buttock claudication	Freedom from secondary intervention	Endoleak rate
Wu *et al.*[36] (2015)	14	36±4 mm (N.=7) 54±22 mm (N.=6) 12 mm (N.=1)	14.3 months (6-21)	100%	92.8%	7%	21.4%	0%	14.3%	–	Type I or III: 0% Type II: 21.4% at follow-up
Lobato and Camacho-Lobato[37] (2013)	40	56.2±6.4 mm (N.=33) 30.6±7.1mm (n=6) 57 mm (N.=1)	12 months (6-30)	100%	93.8%	–	34.8%	2.2%	0%	100%	Type I or III: 0% Type II: 2.5%
Lim *et al.*[33] (2016)	21	Left: 40.0 mm (24-81) Right: 37.6 mm (35-87)	17.2 months (5-40)	100%	90.5%	–	66.7%	0%	–	–	–
Massmann *et al.*[38] (2016)	24	43±15 mm	15.0 months (1-40)	100%	84.2% in 1 year	–	61.5%	0%	–	–	Type Ib: 6.5%

Robalo C, Int Angiol 2018;37:346

Iliac Branch Devices

Cook

Gore

Jotec

S&G Bio

IBD Studies

Endoleaks: type 1 - up to 5%
type 2 - 0 ~15.8%
type 3 – up to 7.1%

Favorable graft patency 74 ~100%

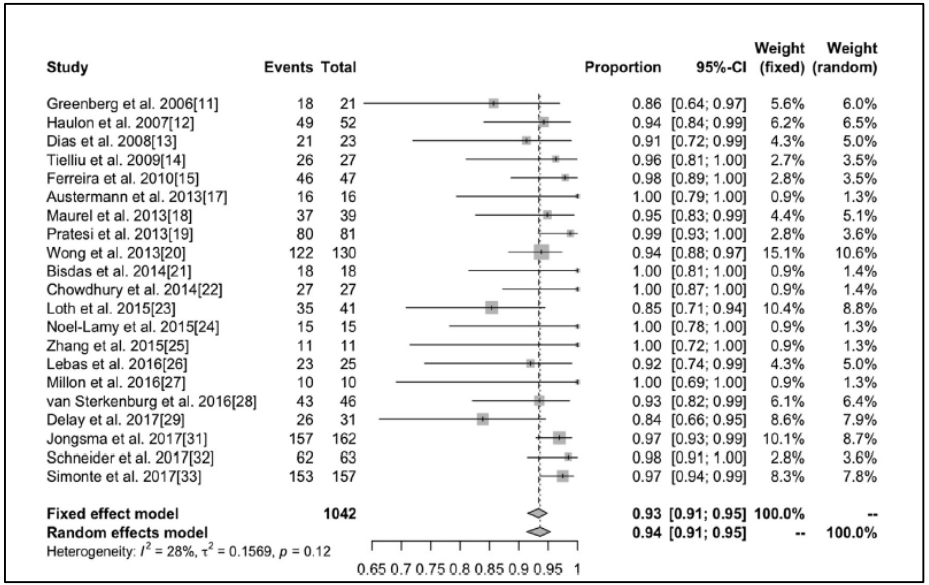
Study	N.	Mean CIA diameter (range)	Mean follow-up	Technical success	Graft patency
Dias *et al.*[22] (2008)	22	34 mm (27-41)	20 months (8-31)	91%	74%
Vernizi *et al.*[29] (2009)	32	40.2±7.9 mm	9.8 months (1-24)	94%	–
Tielliu *et al.*[30] (2009)	27	–	16±14 months	96%	–
Karthikesalingam *et al.*[13] (2010)	196 (9 series)	31.5-39 mm (15-78 mm)	6-24 months	85-100%	–
Pua *et al.*[8] (2011)	14	39 mm (34-57 mm)	18.7 months (6-35)	86%	100%
Parlani *et al.*[26] (2012)	100	40 mm (35-44)	17 months (1-60)	95%	91,4% at 5 years
Wong *et al.*[31] (2013)	130	34.6 and 31.2	20.3 months (1-72)	94%	81.6% at 5 years
Férnandez-Alonso *et al.*[7] (2013)	9	34.8 mm (29-50 mm)	14.7 months (9-29)	100%	100%
Jongsma *et al.*[27] (2017)	140	37.0-41.4 mm	26.6±24.1 months	96.9%	–
Simonte *et al.*[23] (2017)	149	37.0±8.1 mm	44.2±35.1 months	97.5%	90.4% at 10 years
Donas *et al.*[28] (2017)	575	Left: 30.1±11.9 mm Right: 32.6±12.3 mm	32.6±9.9 months	97.6%	94.8%

Robalo C, Int Angiol 2018;37:346

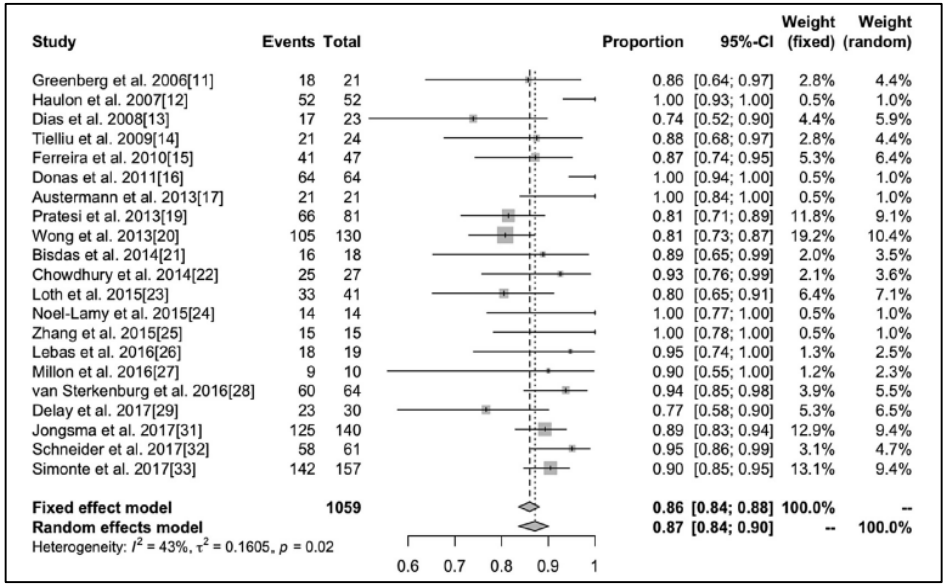
IBD Metaanalysis

N = 1064 (22 EVAR studies for Aortoiliac aneurysms)

Technical Success: 93%



Patency Rate: 86%



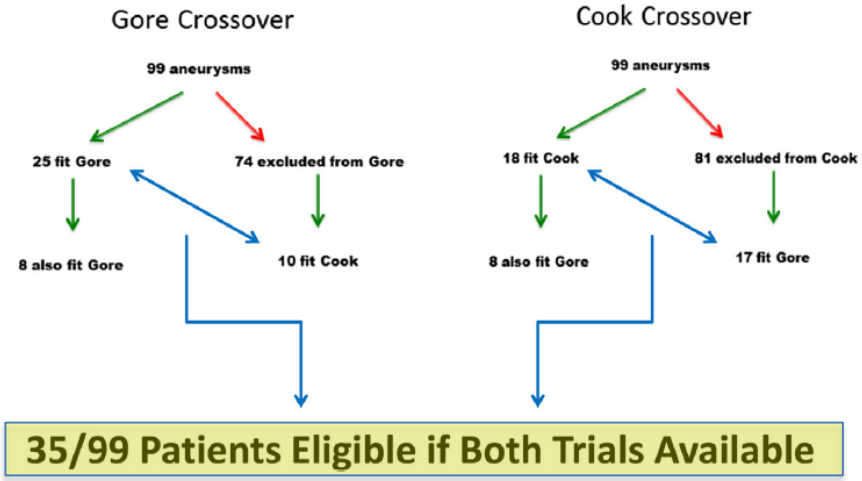
Li Y, Ann Vasc Surg 2019;56:303

Anatomical Suitablity for IBDs

N = 99 (Common iliac aneurysm)

Exclusion criteria	Number (%) excluded (n = 99)
Cook IBD	
IIA diameter <6 or >9 mm	68 (68.7%)
IIA aneurysm distal to landing zone	11 (11.1%)
EIA diameter <8 mm	10 (10.1%)
CIA length <50 mm	9 (9.1%)
EIA length <20 mm	7 (7.1%)
CIA diameter <20 mm	6 (6.1%)
IIA occluded or >50% stenosis	1 (1.0%)
IIA length <10 mm	1 (1.0%)
Gore IBE	
Proximal CIA diameter <17 mm	39 (39.4%)
IIA diameter <6.5 or >13.5 mm	37 (37.3%)
Aorta-hypo length <165 or CIA length <40 mm	24 (24.2%)
CIA diameter <25 mm	16 (16.2%)
Distal CIA diameter <14 mm	13 (13.1%)
EIA diameter <6.5 or >25 mm	1 (1.0%)
IIA length <10 mm	1 (1.0%)
EIA length <10 mm	0 (0%)

Cook IBD exclusions	Gore IBE exclusions
CIA length <50 mm	Aorta-hypogastric length <165 or CIA length <40 mm
CIA diameter <20 mm	CIA diameter <25 mm
EIA length <20 mm	Proximal CIA diameter <17 mm
EIA diameter <8 mm	Distal CIA diameter <14 mm
IIA occluded or >50% stenosis	EIA length <10 mm
IIA aneurysm distal to landing zone	EIA diameter <6.5 or >25 mm
IIA length <10 mm	IIA length <10 mm
IIA diameter <6 or >9 mm	IIA diameter <6.5 or >13.5 mm



35/99 Patients Eligible if Both Trials Available

Pearce BJ, Ann Vasc Surg 2015;29:69

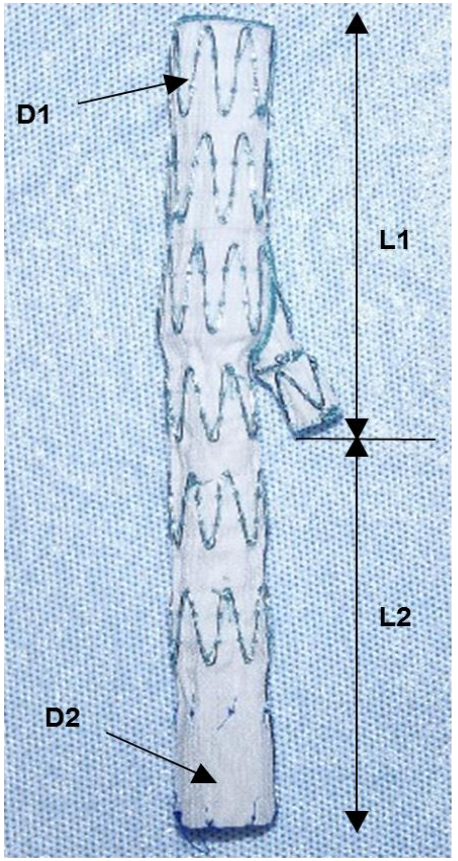
Zenith Iliac Branch, Cook

IFU criteria

CIA length <50 mm
CIA diameter <20 mm
EIA length <20 mm
EIA diameter <8 mm
IIA occluded or >50% stenosis
IIA aneurysm distal to landing zone
IIA length <10 mm
IIA diameter <6 or >9 mm

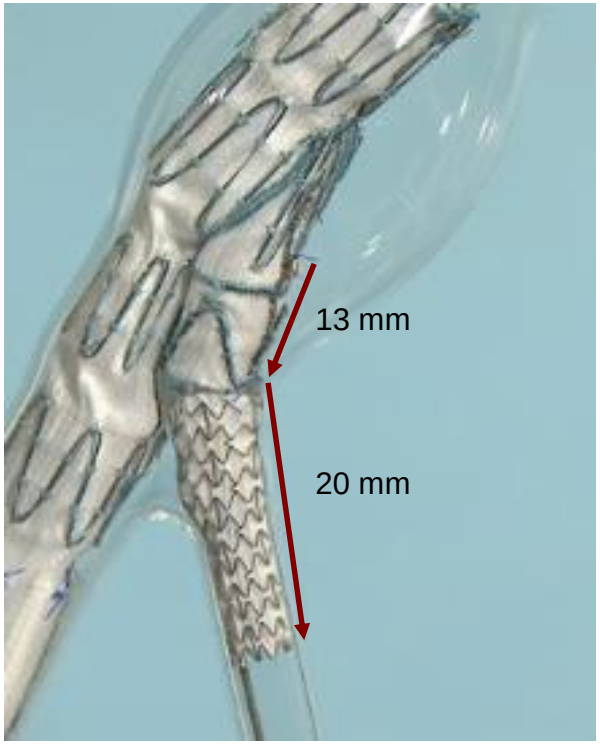
Available sizes:

- Common iliac segment:
  - L1 = 45 or 61 mm
  - D1 = 12 mm
- External iliac segment:
  - L2 = 41 or 58 mm
  - D2 = 10 or 12 mm
- Sidebranch segment:
  - Length = 14 mm
  - Diameter = 8 mm

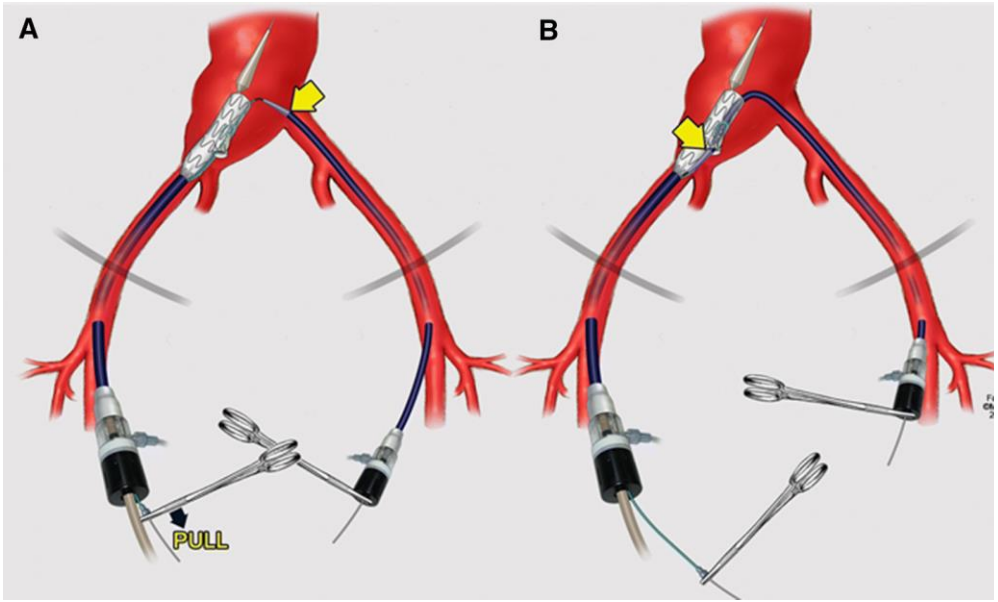


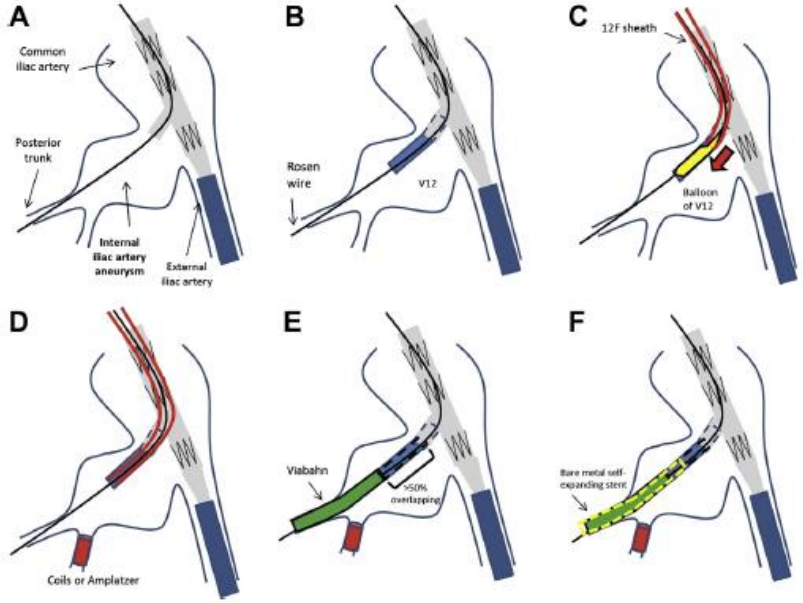
Internal Iliac Artery Sealing Zone

- To secure a sufficient landing zone in the internal iliac artery, a minimum length of the covered balloon-expanded bridging stent of about 35 mm is preferred.
- 20 mm sealing zone + 13 mm overlap

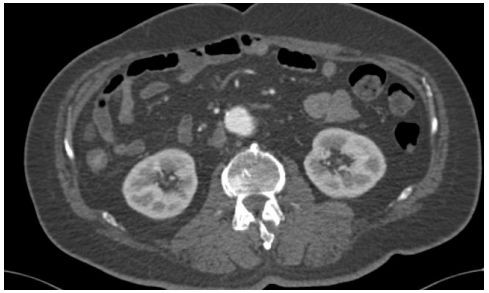


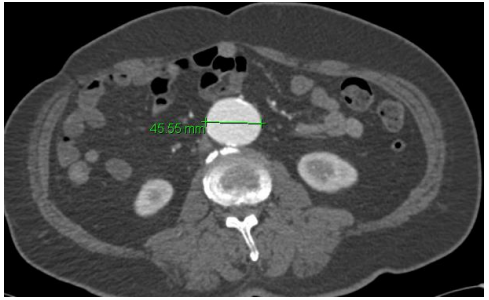
IBD Deployment Sequence

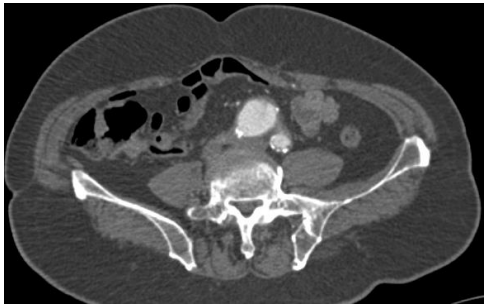




AAA with CIA aneurysm







Hospital:
Physician Name:
Physician Phone #:
Physician E-mail:
Physician Signature:

Step 1: Anatomical Measurements

	Length mm	Outer Wall Diameter mm
Common Iliac Artery (CIA)	69	
External Iliac Artery (EIA)	43	Diameter External Iliac (DEI) 10

Step 2: Choose Graft Diameter

D2	Distal Body Diameter (DBD) mm
8 - 9	10 ☐
10 - 11	12 ☑

Step 3: Choose Common Iliac Segment Length (CISL)

CIA	CISL mm
≥ 55 (50 mm minimum)	45 ☑
≥ 71 (66 mm minimum)	61 ☐

Step 4: Choose External Iliac Segment Length (EISL)

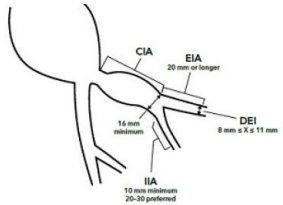
EIA	EISL mm
> 20	41 ☐
> 31	58 ☑

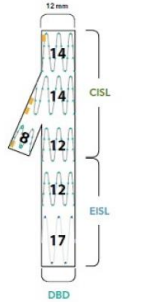
ZBIS - 12 (DBD) - 45 (CISL) - 58 (EISL)

Step 5: Bridging Stent/Select TFLE

Choose length to provide sufficient overlap with Zenith AAA graft and Zenith Branch graft.

TFLE - 16 (Graft Diameter) - 73 (Graft Length) - ZT

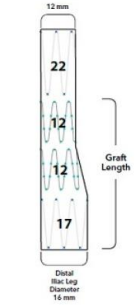




CISL	
45	☑
61	☐

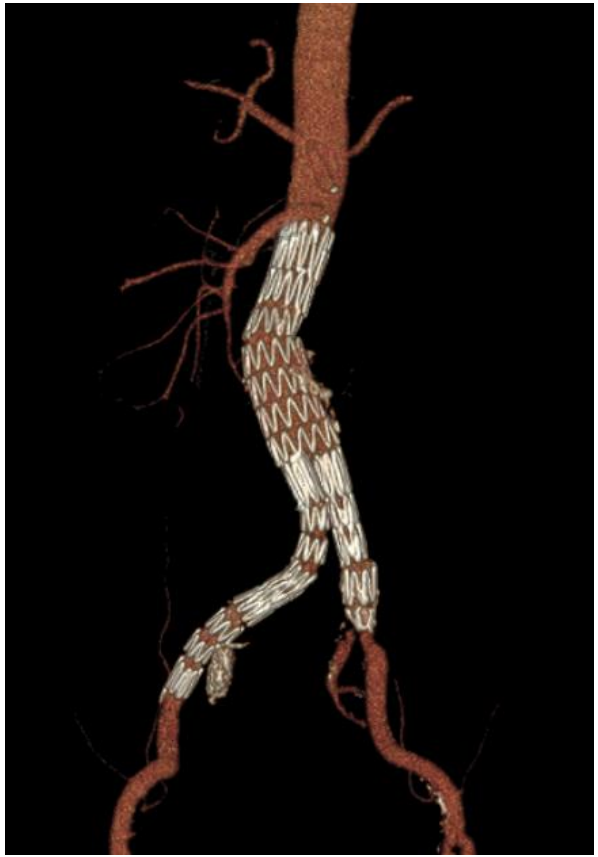
EISL	
41	☐
58	☑

DBD	
10	☐
12	☑



Graft Length	
39	☐
56	☐
73	☑
90	☐

Follow-up CT

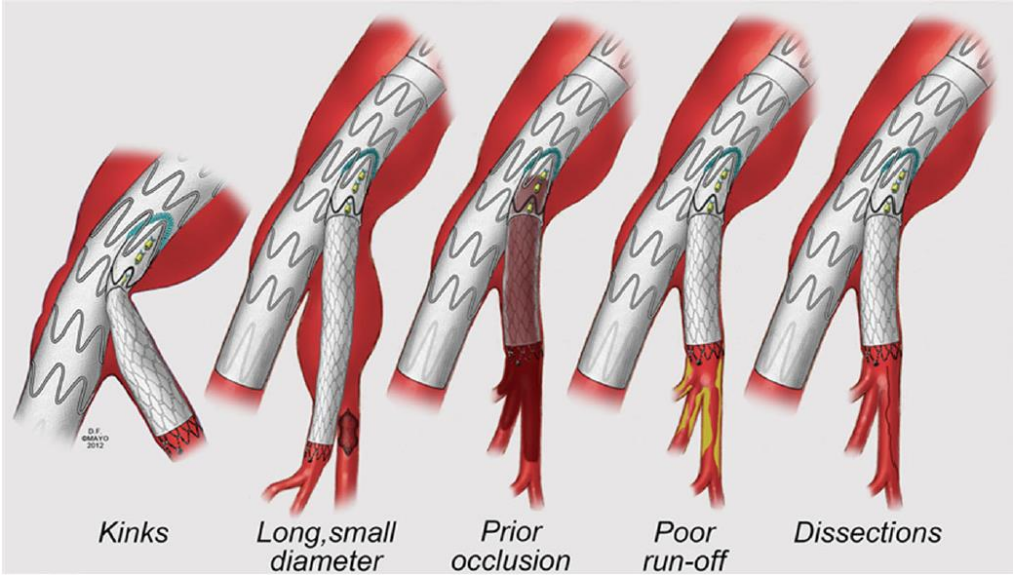


Factors Associated with Technical Difficulties

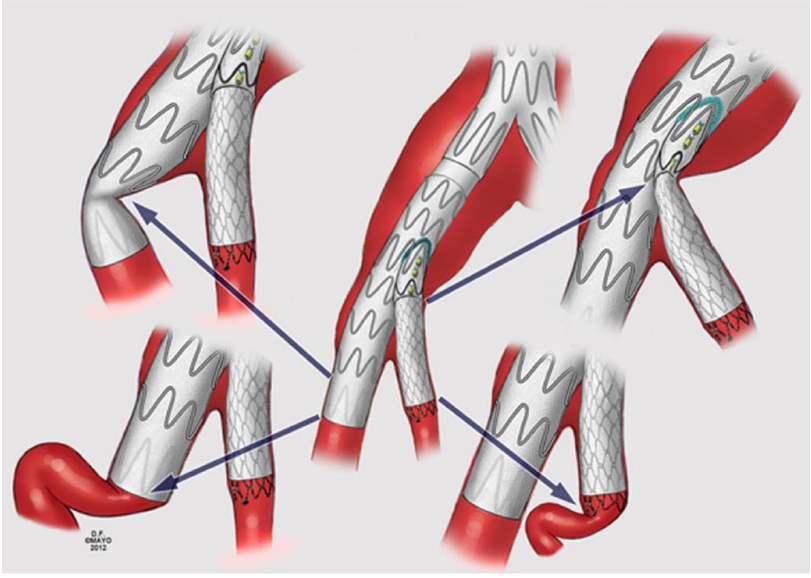
- Excessive iliac tortuosity
- Calcifications
- IIA aneurysm or stenosis
- Poor runoff
- Sharp aortic bifurcation
- Intraluminal CIA thrombus
- Severe external iliac artery kinking
- Wide angle (>50°) of the IIA branch and IIA artery

Mechanisms of Occlusion of Iliac Branch Bridging Stents

Common Mechanisms of occlusions



Locations of vessel kinking



D'Oria M, Cardiovasc Intervent Radiol, 2019

Take Home Messages

- The IBD showed more favorable results regarding endoleak rates and pelvic ischemic symptoms than other techniques.
- Due to the great short and long-term results reported, iliac branches may be considered as the first-line approach for CIA aneurysms with >30 mm of diameter, with or without concomitant AAA, if the anatomy meet the IFU criteria.


Thank You for Your Attention!
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