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Overcoming highly angulated iliac limb anatomy

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For EVAR procedure success

- CT angiography 3D reconstruction
- Meticulous device selection
- Preprocedural planning
- Intraoperative measurements

EVAR procedure

- Perioperative complications & endoleaks
- Reintervention: high mortality
- 40% of patients with infrarenal AAA: involve one iliac artery
- 20% of reintervention: Unfavorable iliac anatomy (limb thrombosis, stenosis, and aneurysm formation)

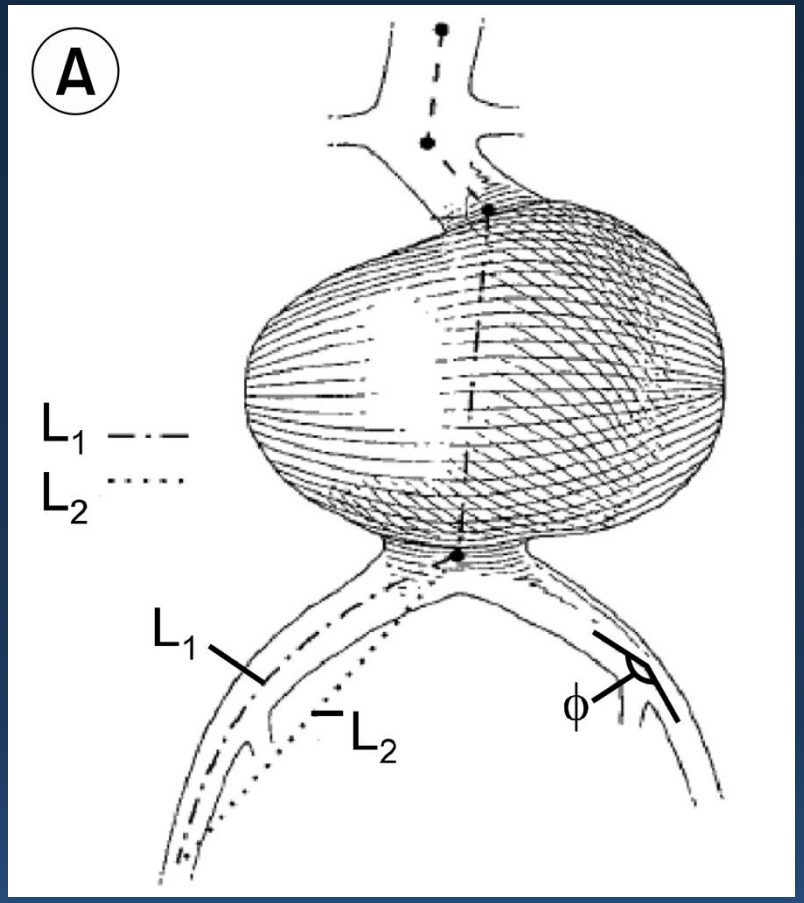
Iliac tortuosity

J Vasc Surg 20001;34:594-9

Preoperative planning: iliac anatomy

- Diameter
- Calcification
- Atherosclerotic lesions
- Tortuosity

Iliac tortuosity index



- 2007~2011
- 144 patients

- Iliac tortuosity index = L1 / L2

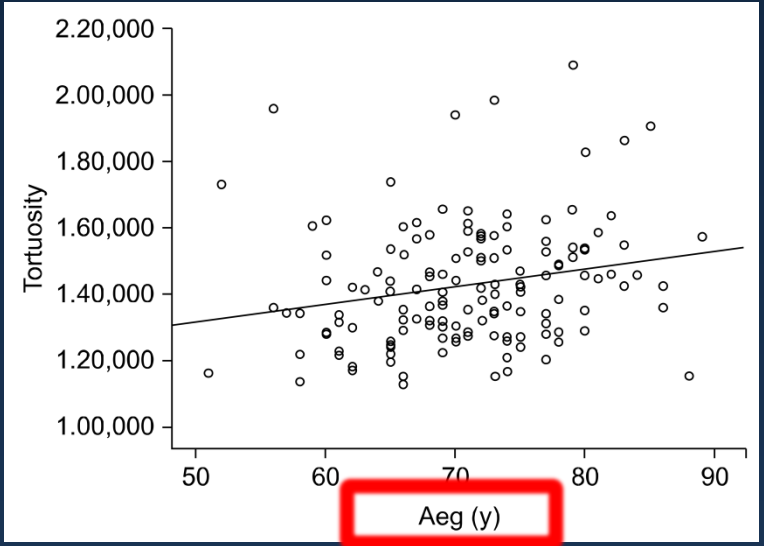
Mean tortuosity index:
1.4287±0.81808

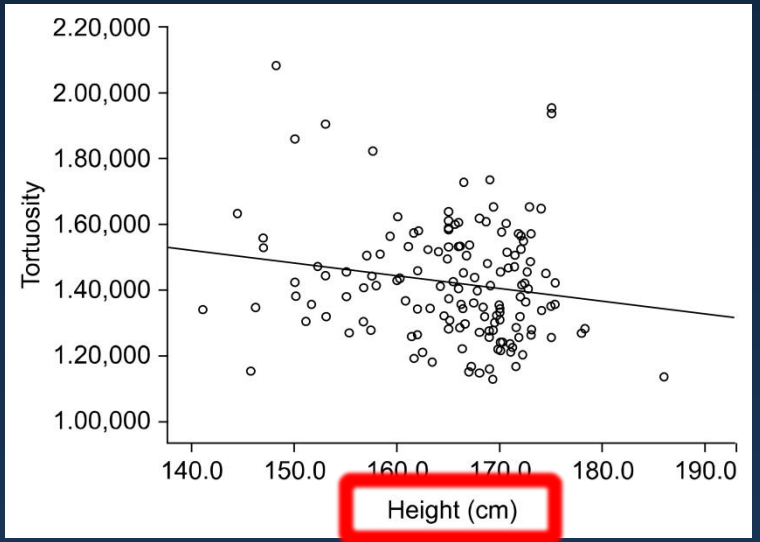
EVAR-related complication:
70 cases

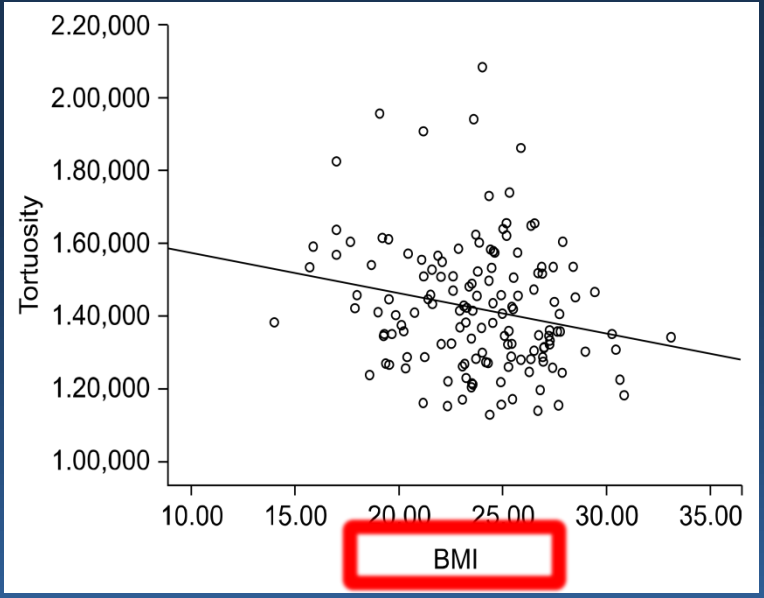
Graft-related complication:
19 cases

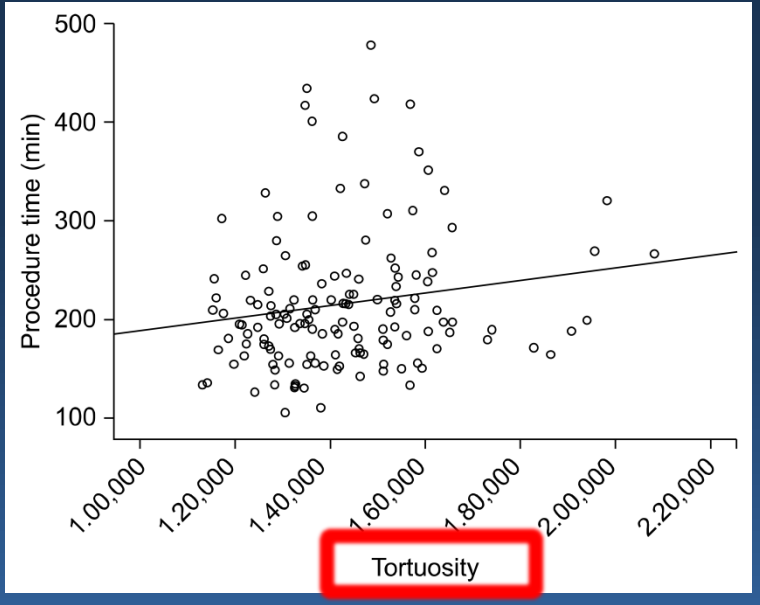
Korean J Vasc Endovasc Surg 2013;29:121-127, J Vasc Surg 2001;34:594-599

Iliac tortuosity index





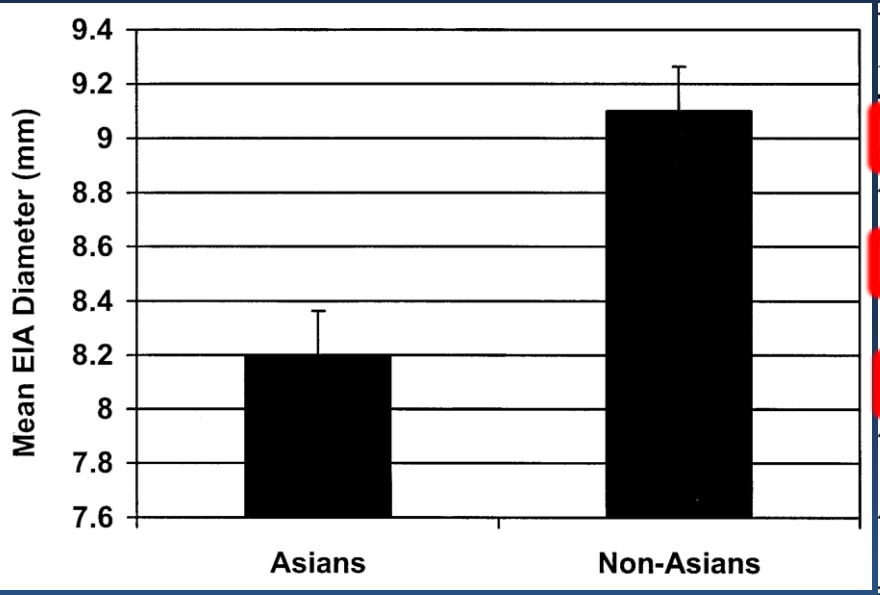




Korean J Vasc Endovasc Surg 2013;29:121-127

Iliac access related complications

- 1996~2003, Hawaii
- Retrospective study
- 11/92 (12%)

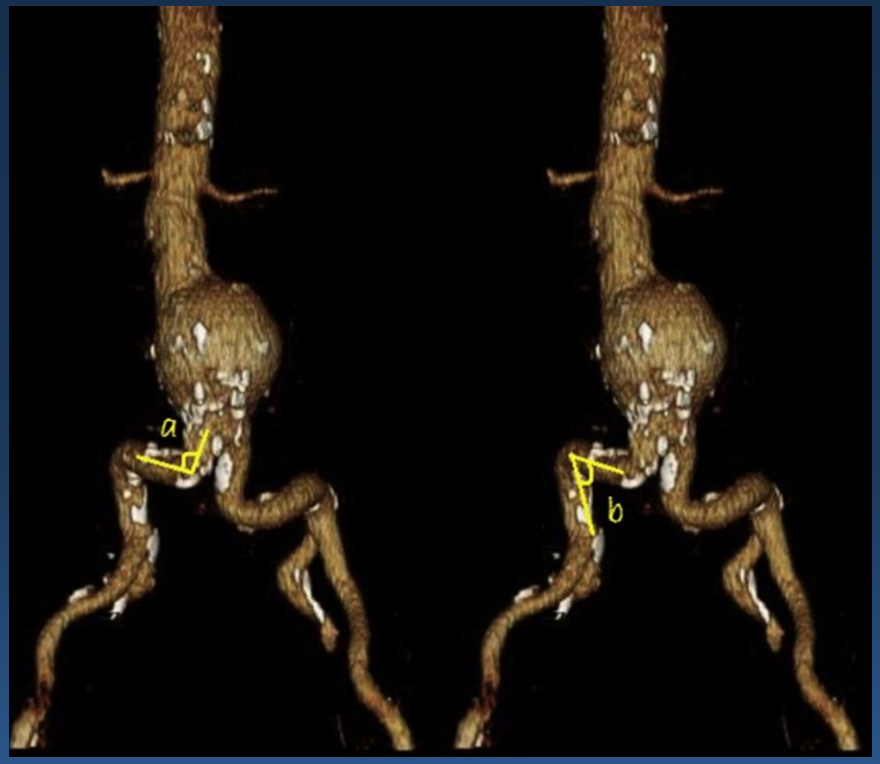


Model	*OR*	*95% CI*	P
Asian ethnicity	7.3	1.5, 35.8	.015
Asian ethnicity adjusted for each of the following alone			
Center	6.9	1.4, 34.5	.018
Age >80 years	6.0	1.2, 30.4	.032
Gender	6.7	1.3, 33.8	.022
EIA diameter <7.5 mm	5.5	1.1, 28.3	.043
Iliac tortuosity moderate/severe	6.5	1.3, 32.8	.024
Asian ethnicity adjusted for EIA diameter and iliac tortuosity	4.7	0.9, 25.6	.074
Asian ethnicity adjusted for all of the above	3.8	0.7, 21.9	.13

J Vasc Surg 2004;40:24-9

Severe aortoiliac tortuosity: graft shortening

- 2008~2014
- 469 patients underwent EVAR with Endurant endograft
- Severe aortoiliac tortuosity: 36%



Age, years	75 ± 5.7
Male	16 (94)
Hypertension	12 (71)
Dyslipidemia	10 (59)
Diabetes mellitus	5 (29)
Coronary artery disease	12 (71)
Atrial fibrillation	3 (18)
Smoking	
Current	3 (12)
Former	8 (47)
Chronic obstructive pulmonary disease	3 (18)
Chronic kidney disease	1 (6)
Antiplatelet	12 (71)
Anticoagulation	1 (6)

J Vasc Surg 2017;65:1297-304

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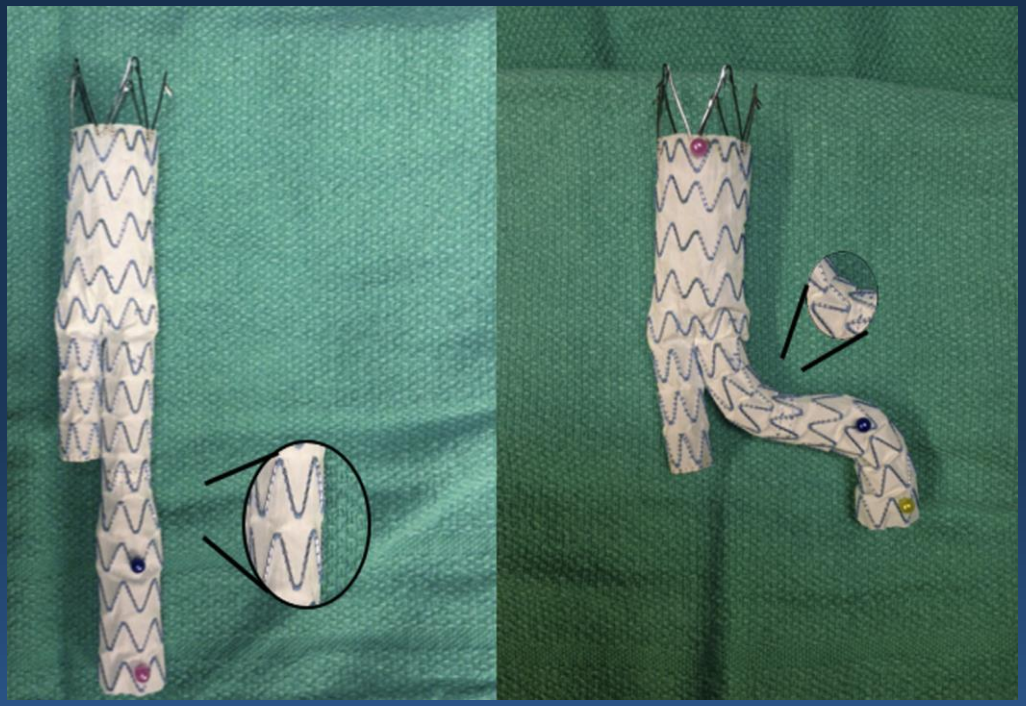

J Vasc Surg 2017;65:1297-304

Severe aortoiliac tortuosity: graft shortening

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	Before EVAR	After EVAR	Difference	*P* value
Main body length of endograft at severe tortuosity, mm	169 ± 2	147 ± 4	22 ± 4	<.01
Treatment length of severe tortuosity, mm	179 ± 14	170 ± 14	9 ± 8	<.01
Maximum angulation of severe tortuosity, degrees	86 ± 7	114 ± 13	28 ± 12	<.01
Treatment length of nonsevere tortuosity, mm	170 ± 11	170 ± 12	0 ± 6	.859
Maximum angulation of nonsevere tortuosity, degrees	145 ± 14	148 ± 11	3 ± 9	.195

Intraoperative endoleaks	No. (%)
Type Ia	0
Type Ib	1 (6)[a]
Type II	7 (41)
Type III	0
Intraoperative internal iliac artery occlusion	1 (6)
In-hospital mortality rate	0
In-hospital reintervention rate	0

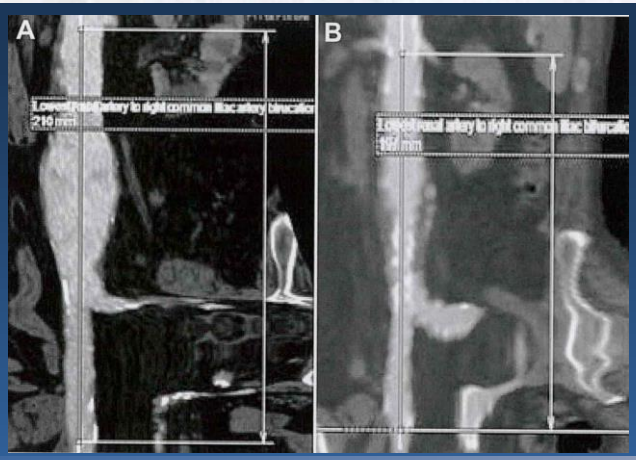
Length of follow-up, months	27 ± 18
Lost to follow-up	0
Endoleaks	
Type II	3 (18)
Other	0
Reintervention rate	1 (6)[a]
Mortality rate	3 (18)
Cause of death	Sepsis, cancer, aortoenteric fistula from diverticulitis

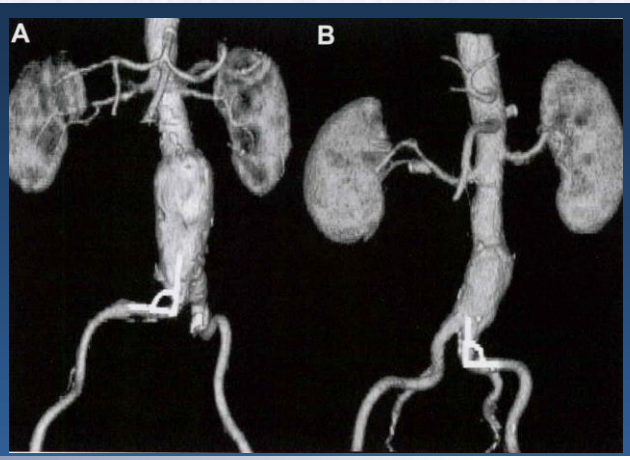
J Vasc Surg 2017;65:1297-304

Endograft conformability & tortuosity

- 2012~2013
- **111 patients** underwent EVAR
- Endurant I, II, Zenith Flex, LP, and Sprial Z stent graft

	Length Difference, mm					
	Endurant I	Endurant II	Zenith Flex	Spiral Z	Zenith LP	p
Overall	3.8±6.2 (n=99)	4.1±7.3 (n=20)	6.2±8.7 (n=32)	7.2±8.1 (n=42)	4.3±9.4 (n=6)	0.115
Severe aortoiliac tortuosity	15.3±5.7 (n=13)	14.4±2.4 (n=5)	17.4±5.6 (n=7)	16.8±6.5 (n=14)	*	0.737
No severe aortoiliac tortuosity	2.1±4.1 (n=87)	0.7±4.5 (n=15)	1.7±4.3 (n=23)	2.8±3.5 (n=29)	1.2±6.0 (n=5)	0.550





J Vasc Surg 2014;21:728-734

Risk factors for intraoperative adjunctive maneuvers

- 2010~2015
- 94 patients
- Fenestrated & branched EVAR (FB-EVAR)

Multivariate analysis	OR	95% CI	*P*
Diameter of external iliac artery <7 mm	12.5	2.2-71.4	**.01**
External iliac artery calcification	4.1	0.5-33.4	.18
Common and external iliac artery calcification	8.3	1.4-50.0	**.02**
Stenosis-obstructive disease	8	0.1-4.4	.85
Severe angle **(>90-degree)**	1.1	0.2-4.3	.90
Previous graft	0.3	0.6-1.9	.08
TAAA	2.3	0.8-6.7	.12

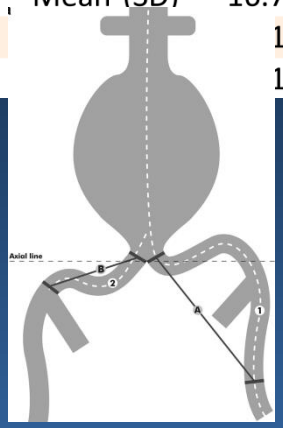
CI, Confidence interval; *OR*, odds ratio; *TAAA*, thoracoabdominal aortic aneurysm.
Boldface indicates statistically significant difference.

J Vasc Surg 2017;66:1659-67

Endograft limb occlusion in EVAR

- 2000~2010
- Zenith bifurcated stent grafts
- 503 patients
- **Limb graft occlusion: 17 patients (3.4%)**

		Patients with limb graft occlusion ($n = 17$)	Control patients ($n = 34$)	p
Pelvic artery index of tortuosity[a] (PAI)	Mean (SD)	1.61 (0.3)	1.48 (0.25)	NS
Common iliac artery index of tortuosity (CAI)	Mean (SD)	1.31 (0.2)	1.16 (0.13)	.009
Double iliac sign (DIS)	Yes	9 (53%)	4 (12%)	.003
Landing zone	EIA	5 (29%)	2 (6%)	.03
AAA diameter (mm)	Mean (SD)	65.1 (21.5)	63.7 (8.5)	NS
Diameter of iliac artery at landing zone (mm)	Mean (SD)	14.4 (3.2)	14.1 (2.9)	NS
Stent graft limb diameter (mm)	Mean (SD)	16.7 (3.3)	16.8 (3.9)	NS
Distal aortic diameter[b] (mm)		1		NS
SFA occlusion		1		NS

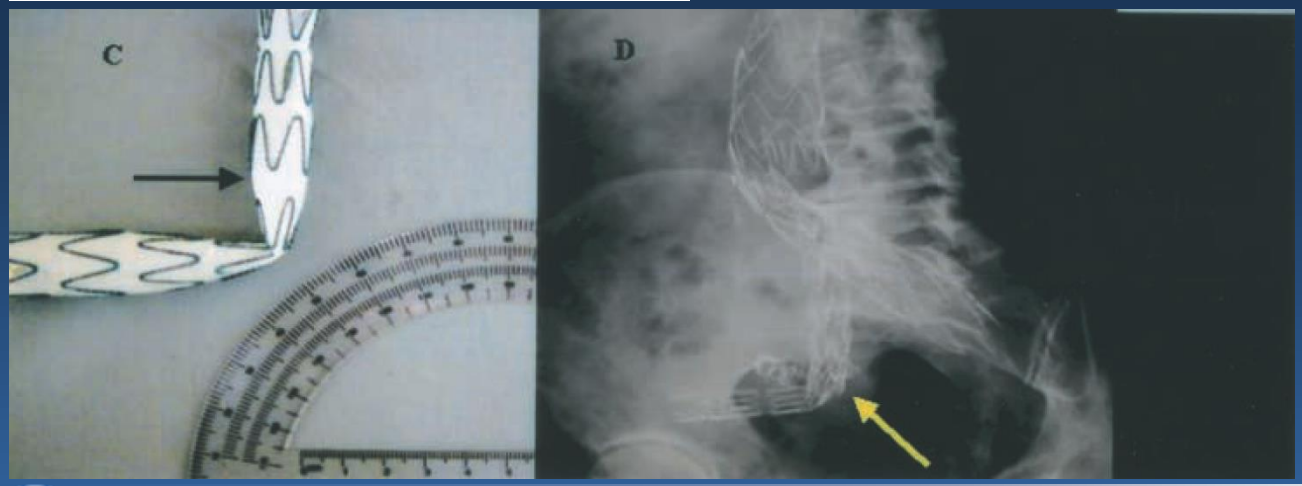


Eur J Vasc Endovasc Surg 2014;4:18

Complications in angulated iliac artery

- 351 patients
- Mean f/u duration: 20 months
- Limb occlusion: 26 / 702 limbs (3.7%)

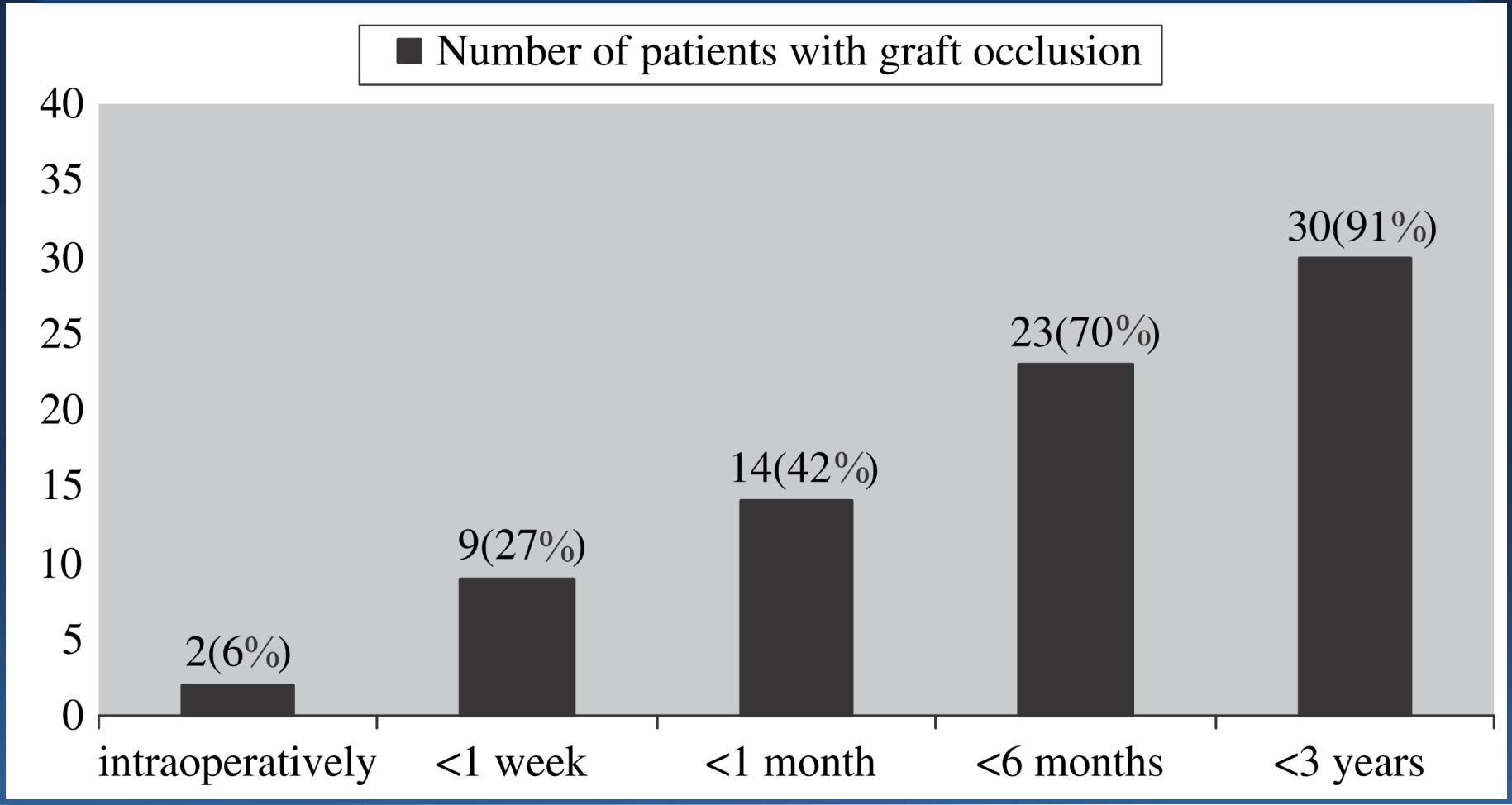
Occluded limbs	*Time interval to occlusion (mo)*
13 (50%)	≤1
11 (41.7%)	2-12
2 (8.3%)	13-24



J Vasc Surg 2002;35:584-8

Time interval to graft occlusion after EVAR

- Most occlusions occur in the first few months following EVAR.



Eur J Vasc Endovasc Surg 2007;34:59-65

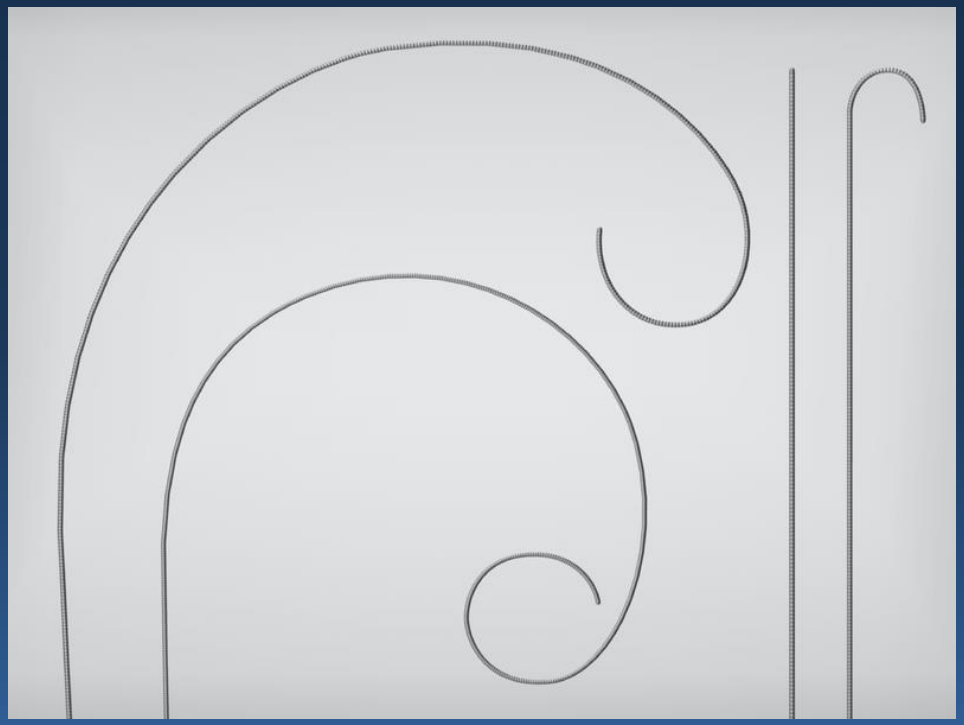
Overcoming highly angulated iliac anatomy

- **Wire**
  - ✓ Amplatz Super Stiff (Boston)
  - ✓ Lunderquist (Cook)
- **Aorto-uni-iliac (AUI) + Cross-over femoro-femoral bypass (CFFB)**
- **Gore® Excluder ® limb-graft**

Eur J Vasc Endovasc Surg 2009;38:298-304

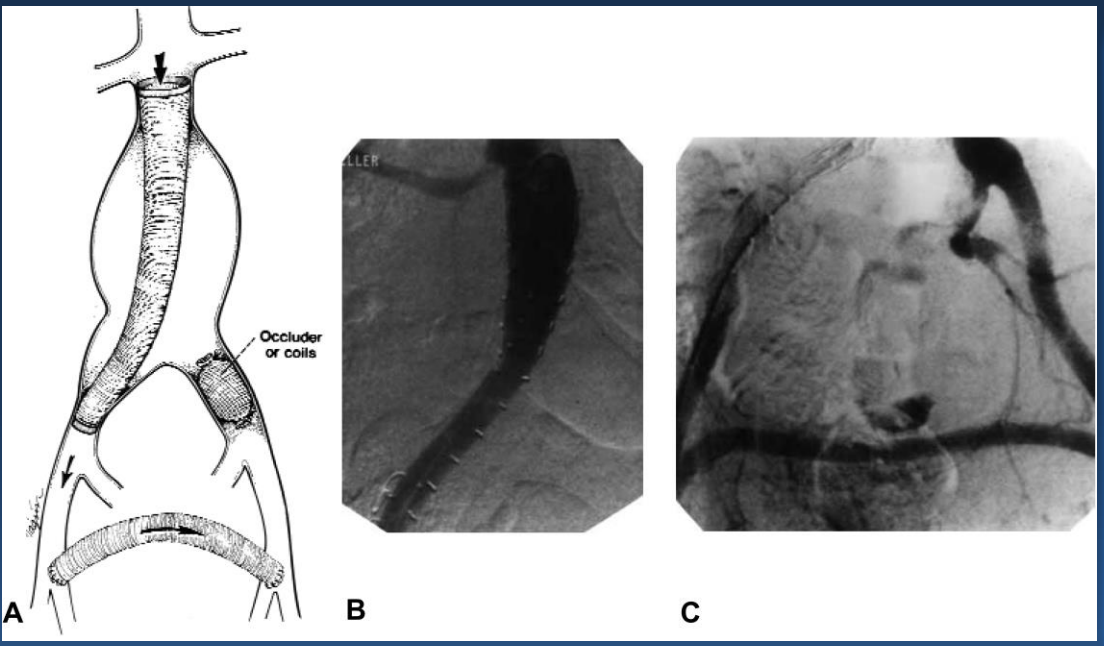
#1. Stiff wires

- ✓ Amplatz Super Stiff (Boston)
- ✓ Lunderquist (Cook)
- ➢ Double wire technique



#2. Aorto-uni-iliac with fem-femoral bypass

- 1997~1999
- 51 patients
- Mean f/u: 15.8 months

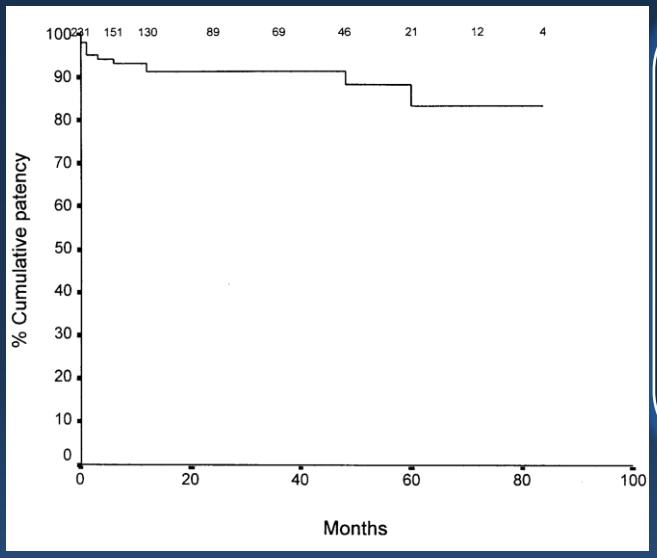


- ✓ Endoleak: 11 patients (22%)
- ✓ Fem-fem graft occlusion: 1 patient
- ✓ Clinical success: 88%
- ✓ 98% primary patency
- ✓ 100% secondary patency

J Vasc Surg 2000;31:1135-41

Aorto-uni-iliac with fem-femoral bypass

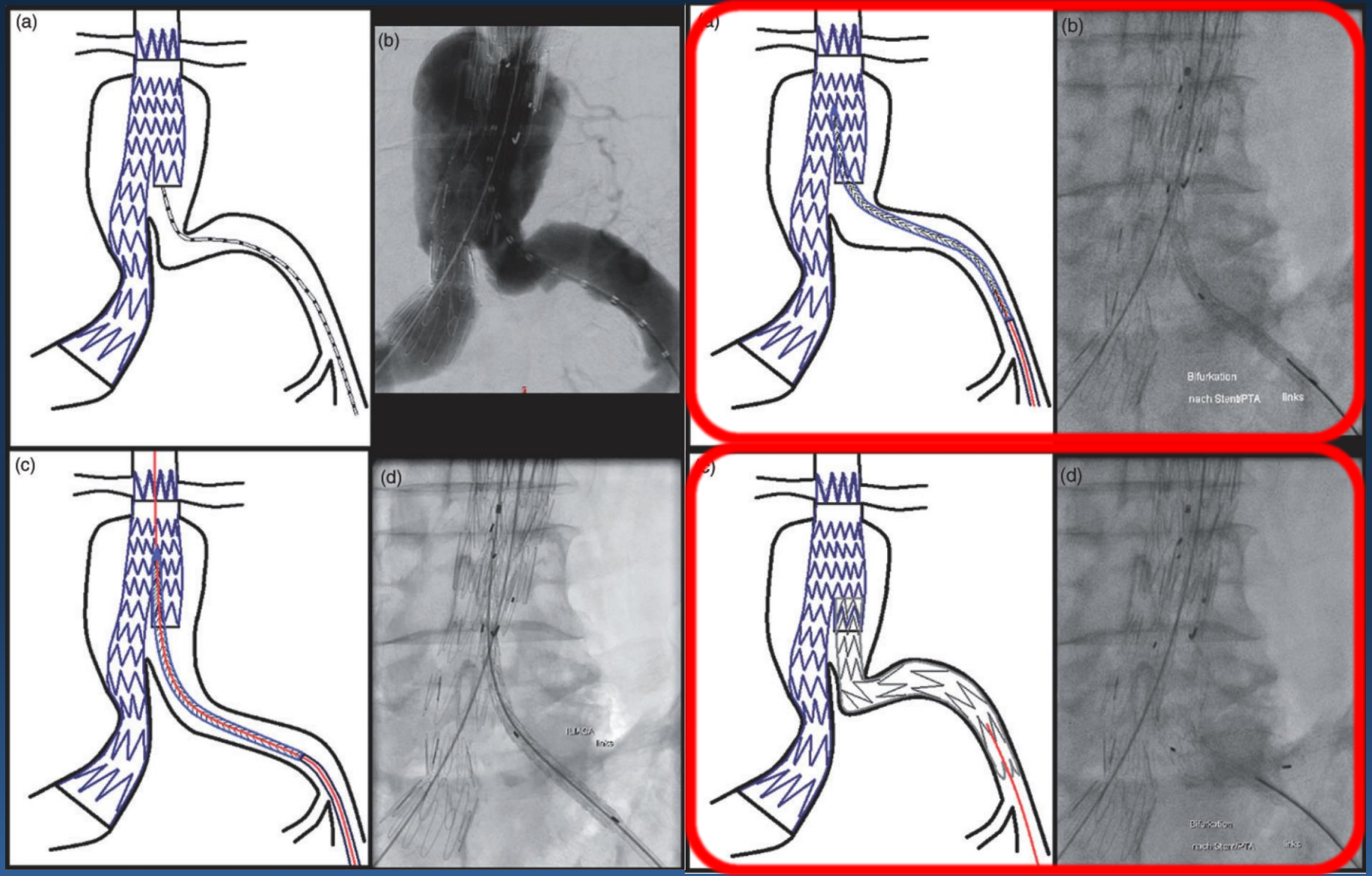
- 1994~2002, single institution, retrospecitve
- 231 patients
- Median f/u: 22 months



- ✓ Localized wound complications: 11%
- ✓ Cumulative 3-yr patency : 91%
- ✓ Cumulative 5-yr patency : 83%

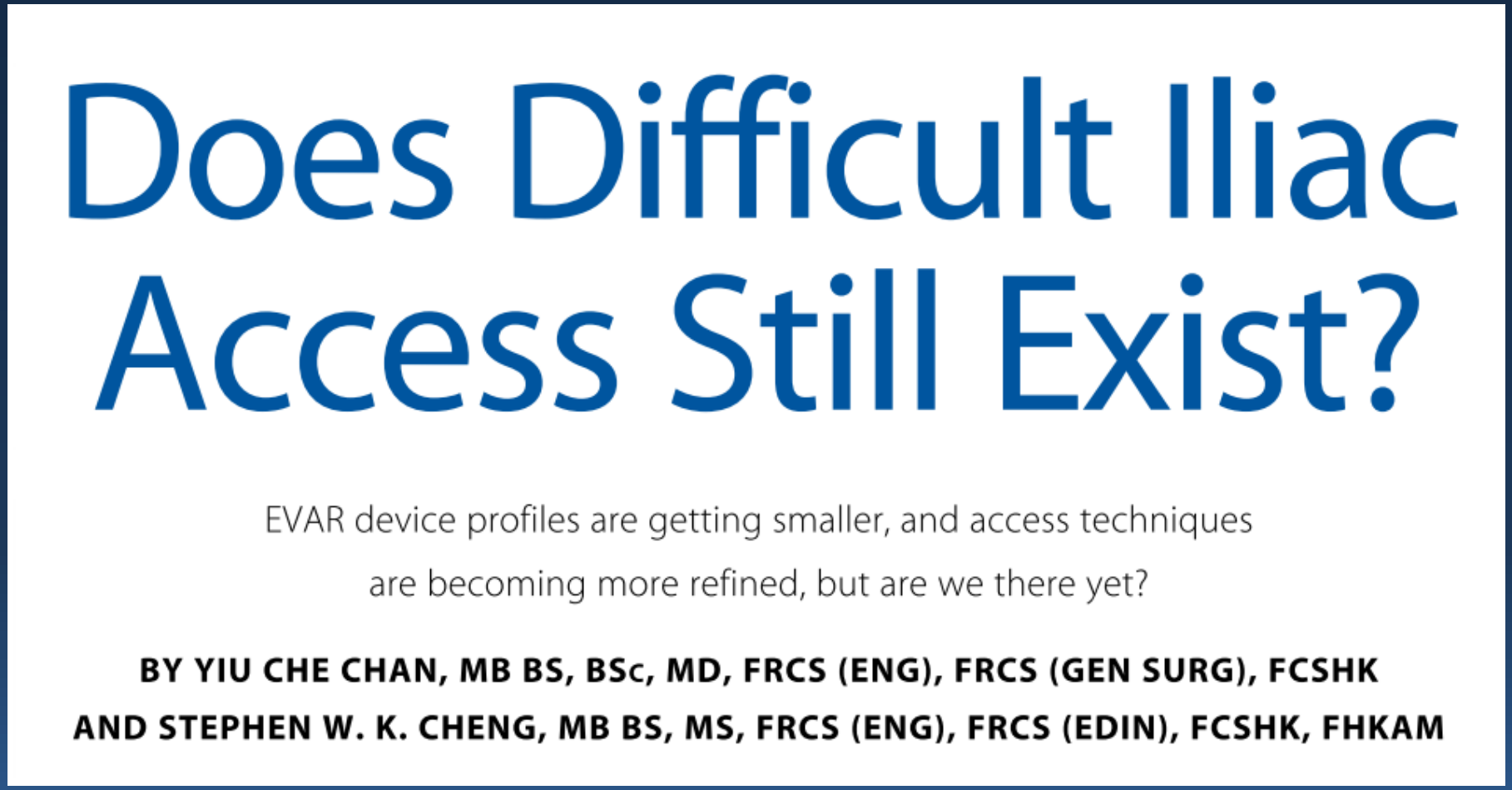
J Vasc Surg 2003;:38:498-503

#3. Gore Excluder limb depolyment



Vascular 2015;23:78-82

Overcoming highly angulated iliac limb



Does Difficult Iliac Access Still Exist?

EVAR device profiles are getting smaller, and access techniques are becoming more refined, but are we there yet?

BY YIU CHE CHAN, MB BS, BSc, MD, FRCS (ENG), FRCS (GEN SURG), FCSHK AND STEPHEN W. K. CHENG, MB BS, MS, FRCS (ENG), FRCS (EDIN), FCSHK, FHKAM

Courtesy of Endovascular today

Conclusions

Highly angulated iliac limb anatomy

- Complications
  - ✓ Access complications
  - ✓ Graft shortening
  - ✓ Kinging → graft occlusion
- reintervention ↑
- high mortality ↑

Conclusions

- Stiff wires
  Double wire technique
- Aorto-uni-iliac graft + fem-fem bypass
- Gore® limb graft
  : not available in Korea


Thank you for your attention