

Surgical Options to treat Aortic Dissections

What We Know / What is murky?

Thomas Bilfinger, MD, ScD
Stony Brook University
Stony Brook, NY, USA

Evidence, Lack of Evidence, Controversy, and Debate in the Provision and Performance of the Surgery of Acute Type A Aortic Dissection

Robert S. Bonser, MD^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100}, Aaron M. Ranasinghe, MD^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100}, Mahmoud Loubani, MD^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100}, Jonathan D. Evans, BMedSci^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100}, Nassir M.A. Thalji, MB ChB^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100}, Jean E. Bachet, MD^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100}, Thierry P. Carrel, MD^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100}, Martin Czerny, MD^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100}, Roberto Di Bartolomeo, MD^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100}, Martin Grabenwöger, MD^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100}, Lars Lonn, MD, PhD^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100}, Carlos A. Mestres, MD, PhD^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100}, Marc A.A.M. Schepens, MD^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100}, Ernst Weigang, MD, PhD^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100}

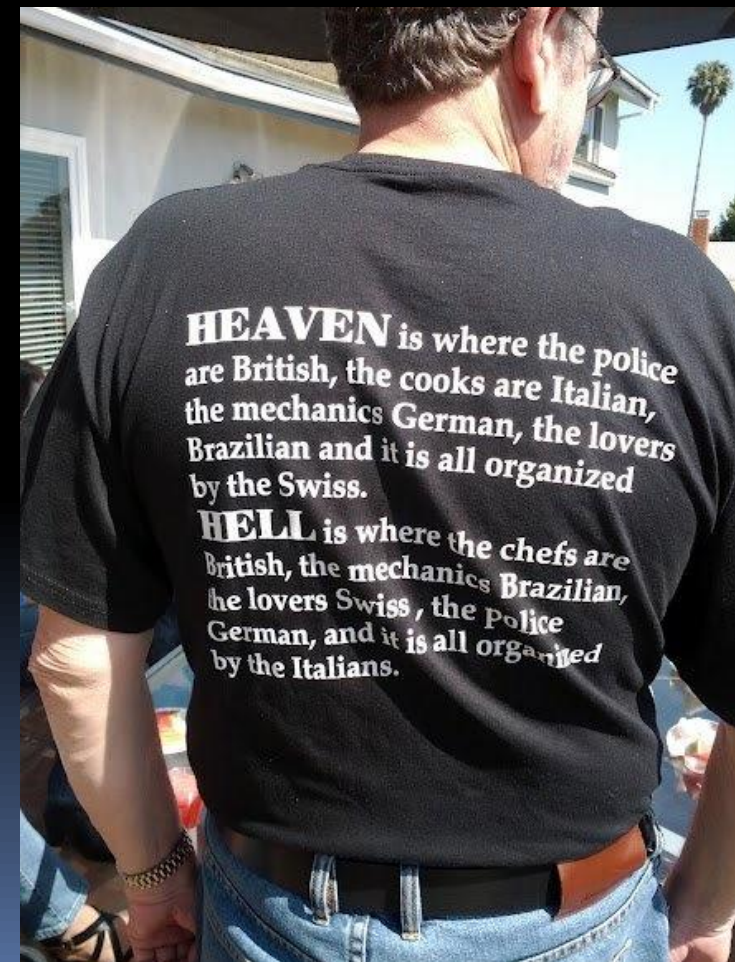
2/3 of pts after Type A repair have PFL (known for decades)

How **[true]** is it that **[false]** lumens are related to survival?






How **[false]** is it to pursue a **[true]** lumen as the ultimate way to **HEAVEN**?

Is there **HELL** to pay on the way?

(The answer is: it depends who is in charge!)

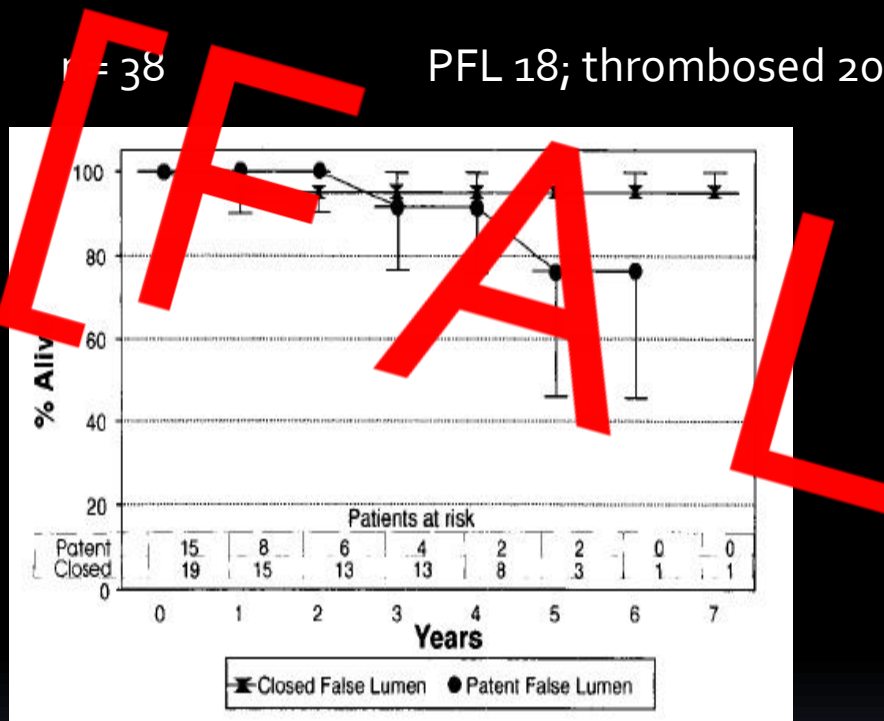


What We Know

| | | | | | |
|---|---|--|---|---|---|
| |  |  |  |  |  |
| number of patients | 72 | 15 | 11 | 13 | 11 |
| | ↓ | ↓ | ↓ | ↓ | ↓ |
| aneurysmal change | 43 | 6 | 8 | 1 | 0 |
| | (59.7%) | (40.0%) | (72.3%) | (7.7%) | |
| descending thoracic | 12 | 0 | 2 | | |
| TAAA type I/II | 28 | 3 | 5 | | |
| TAAA type III/IV or AAA | 3 | 3 | 1 | 1 | |
| regression of thoracic false lumen | 6 | 5 | 2 | 12 | 11 |
| | (8.3%) | (33.3%) | (18.2%) | (92.3%) | (100%) |

Park K-H et al Ann Thor Surg 2009; 87: 103-8

Patent False Lumen and Mortality



Actuarial survival



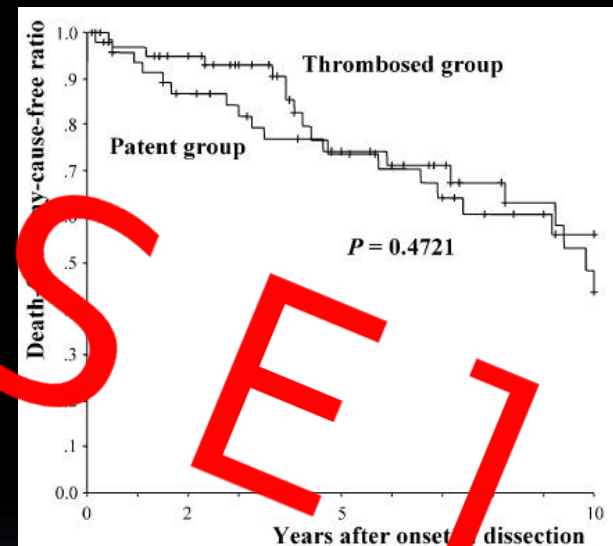
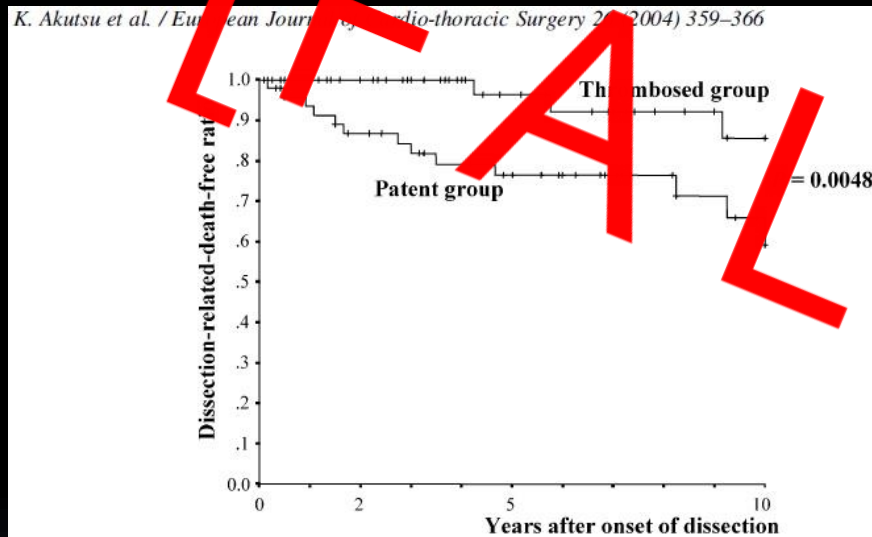
Event free survival

Conclusion: PFL increases Mortality; study underpowered ; $p < 0.05$ for both categories

Ergin MA et al ATS 1994; 57: 820-4

Where it gets Murky

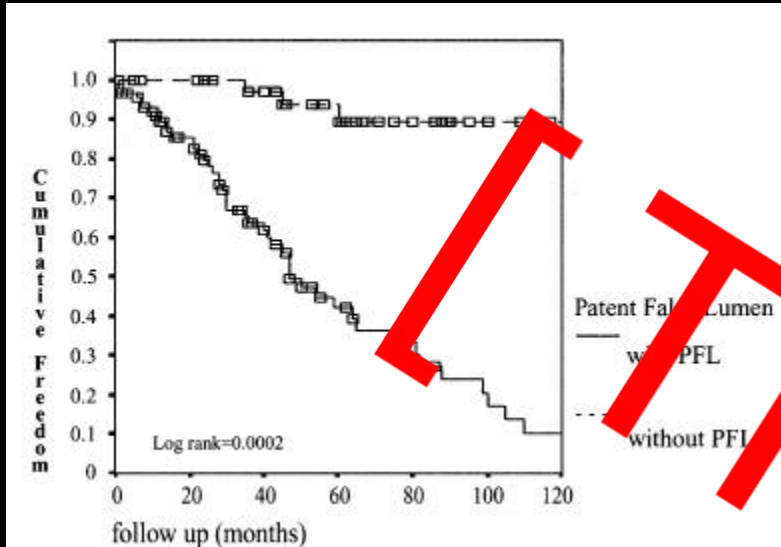
How does a patent false lumen affect mortality?



Type B Dissections

Patent False Lumen HR 1.9 $p=0.06$ $n=179$
Halstead JC et al JTCVS 2007; 133: 127-35

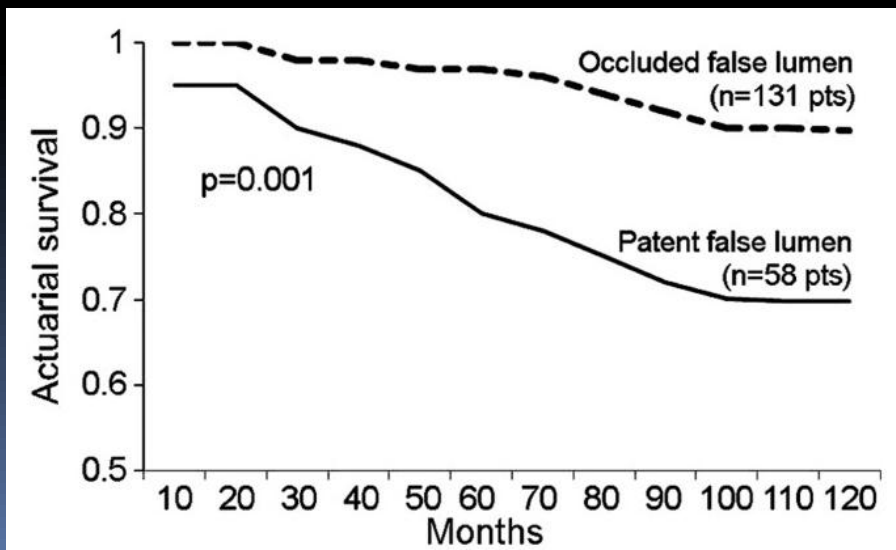
PFL & Aneurysm Formation & Effect



Yeh C-H et al Chest 2003; 124: 989-995

Freedom from Aneurysm formation or reoperation

| N=144 | OR | p |
|---------------------|-------|--------|
| Initial ao diameter | 1.11 | 0.002 |
| PFL | 13.28 | 0.0002 |
| Surgical technique | | NS |



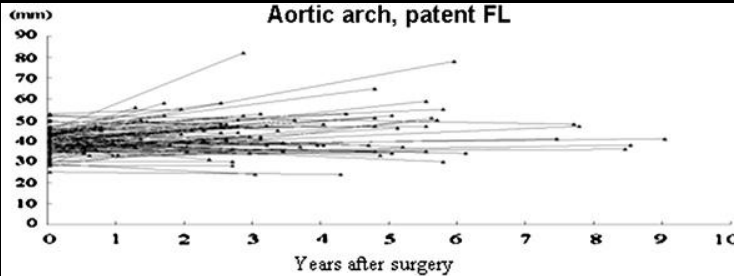
20% to 25% reduced actuarial and event free survival at 5 years with PFL

Fattouch et al ATS 2009; 88: 1244

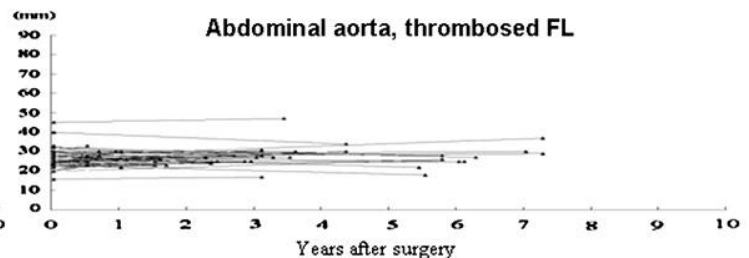
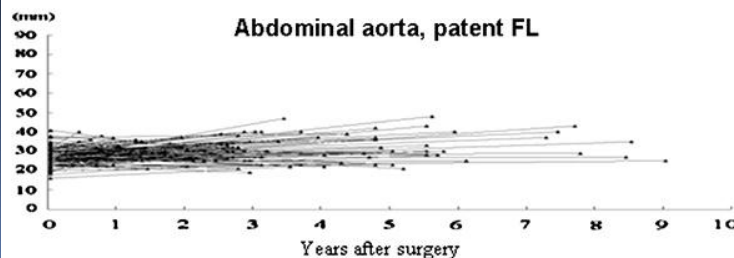
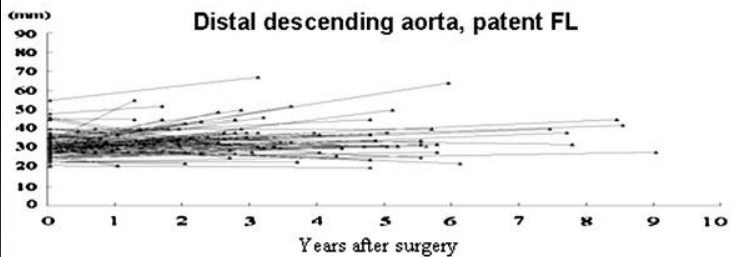
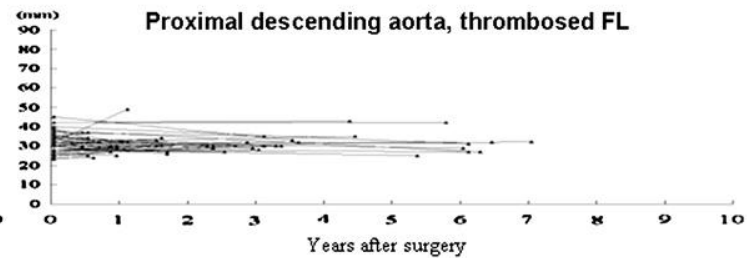
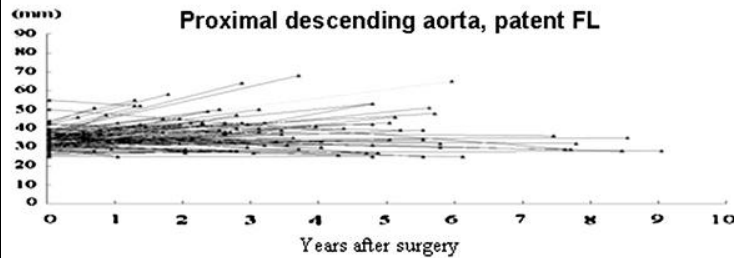
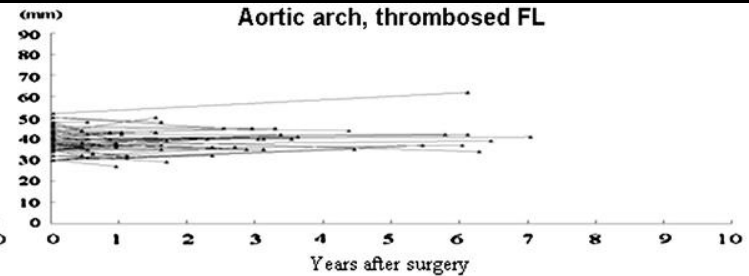
Region most at risk for aneurysm: dist Arch, prox desc Ao

Kimura N et al JTCVS 2008; 136: 1160-6

n=124



n=69



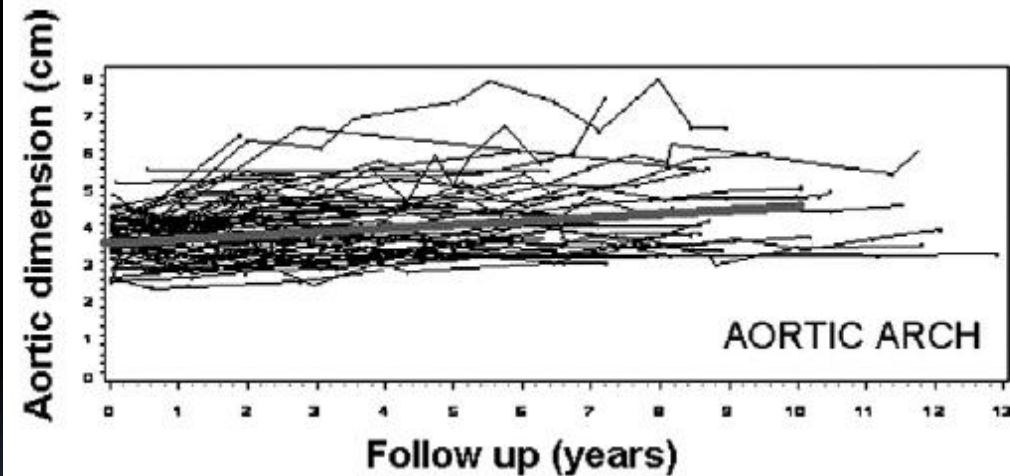
1.9mm/yr

0.71mm/yr

How Fast is the Aorta Expanding?

The fate of the distal aorta after repair of acute type A aortic dissection

James C. Halstead, MA (Cantab), MB, BChir, MRCS (Eng),^a Matthias Meier, MD,^a Christian Etz, MD,^a
David Spielvogel, MD,^a Carol Bodian, DrPH,^b Michael Wurm, MD,^a Rohit Shahani, MD,^a and Randall B. Griepp, MD^a



n= 179

Diameter >4 cm p=0.005

Diameter < 4cm and PFL p=0.004

Expansion may be slow, linear & limited

50% of aortas and PFL will experience growth rates < 1 mm/year

The number of late reoperations in most series is between 2% and 13% ,
Equally divided between operations for aneurysms and pseudo-aneurysms

Factors that seem to predispose to Aneurysm Formation:

Aortic Enlargement and Late Reoperation After Repair of Acute Type A Aortic Dissection

Andreas Zierer, MD, Rochus K. Voeller, MD, Karen E. Hill, BS,
Nicholas T. Kouchoukos, MD, Ralph J. Damiano, Jr, MD, and Marc R. Moon, MD

Division of Cardiothoracic Surgery, The Center for Diseases of the Thoracic Aorta, Washington University School of Medicine, Barnes Jewish Hospital and Department of Cardiothoracic Surgery, Missouri Baptist Medical Center, St. Louis, Missouri

n = 201 freedom from reoperation at 10 years $74 \pm 5\%$

ATS 2007; 84: 479 - 87

Uncontrolled hypertension $p=0.008$,
absence of beta blocker therapy $p=0.02$

Non-resection of entry tear $p=0.05$

49% showed growth during F/U ($5.3 \pm 4.5\text{mm/yr}$)

Preexisting Aortic dilatation; in this study incremental increase in risk ($>4.9\text{ cm}$) $p<0.001$

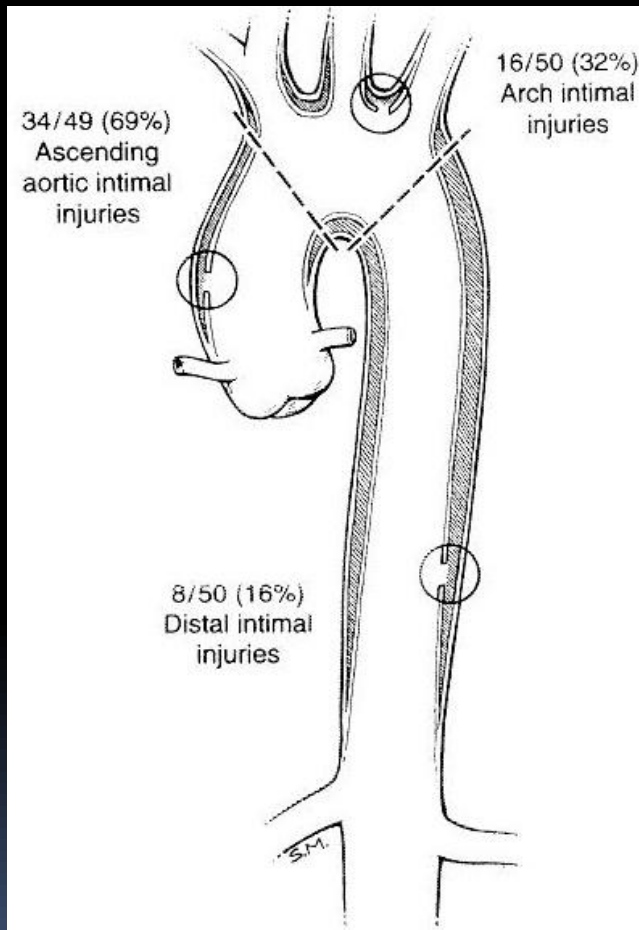
Presence of a false lumen $p=0.05$

Surgical technique was not a risk factor $p>0.17$

All efforts are geared towards avoiding a PFL... (is that reasonable?)

Lai DT et al Circulation 2002; 106 Suppl 1: 218

Van Arsdel GS et al Circulation 1998;98 suppl II 299



Open vs Closed

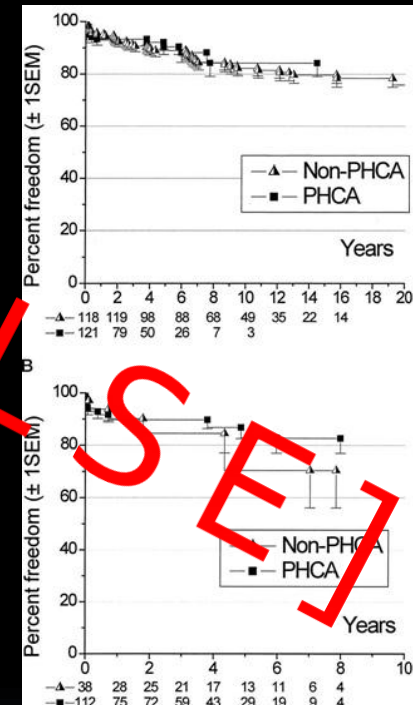
n=307

Propensity matched

113 circ a rest vs 39 no

Despite its many
theoretical disadvantages
closed repair has about
equal outcome to open

To glue or not to glue



Different techniques of distal aortic repair in acute type A dissection:
impact on late aortic morphology and reoperation¹

B. Nguyen^a, M. Müller^b, B. Kipfer^a, P. Berdat^a, B. Walpoth^a, U. Althaus^a, T. Carrel^{a,*}

No solid data demonstrating that glue avoids PFL

Embolisation, inflammatory reaction and persistent patent false lumen: is biological glue really effective in repair of type A aortic dissection?

Pasquale Mastroroberto^{a,*}, Massimo Chello^b,
Francesco Onorati^a, Attilio Renzulli^a

Extending the Amount of Replaced Arch

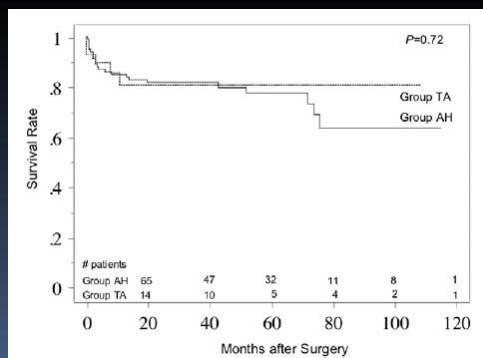
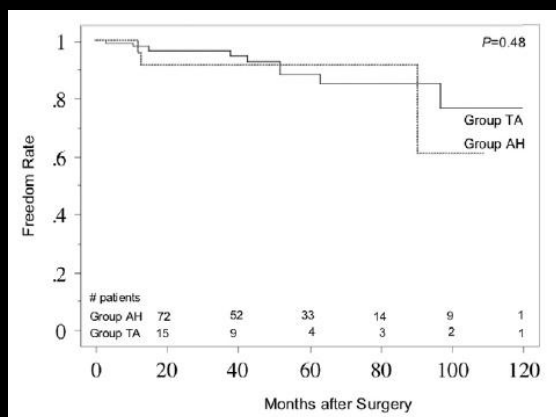
- Hemiarch replacement: safe , no worse than ascending Ao replacement; no significant improvement in obliterating PFL (mortality as low as 8.5% [German Registry])
- Extending Hemiarch Replacement: here is the debate
 - IRAD (18 Aortic Centers World Wide)
 - Trimarchi S et al JTCVS 2005; 129: 112-22

| | | |
|---------------|-----|-------|
| Asc Ao Repl | 463 | 91.9% |
| Ao Root Repl | 135 | 31.5% |
| Hemiarch Repl | 110 | 23.2% |
| Total Arch | 59 | 12.2% |

Does it Help?

Hemiarch Total Arch

| | | | |
|--------------------------|-------------|-------------|------|
| Hospital death | 7 (6.7%) | 2 (6.9%) | 0.69 |
| False lumen: open | 12 (11.4%) | 7 (24.1%) | 0.08 |
| Closing interval (month) | 30.1 ± 24.3 | 31.7 ± 21.6 | 0.43 |
| Repeat surgery | 8 (7.6%) | 4 (13.8%) | 0.88 |



Hirotsu T et al ATS 2003; 76: 1957-61

| n=45 | | |
|------|------|---------------|
| 27 | 63% | No PFL |
| 12 | 28% | Abdominal PFL |
| 14 | 9.3% | Thoracic PFL |

Urbanski PP et al ATS 2003; 75: 525-61

| n=43 | |
|------|-----------|
| 14 | 32.5% PFL |

Shino M et al ATS 2006; 82: 1665

Type A aortic dissection: New surgical strategy using intra-operative stenting
 Bertrand Léobon, Daniel Roux, Stefano Saccani, Antoine Mugniot, Fabrice Muscari,
 Yves Glock and Gérard Fournial
J Thorac Cardiovasc Surg 2006;131:482-483

8/12 PFL's thrombosed (66.7%)

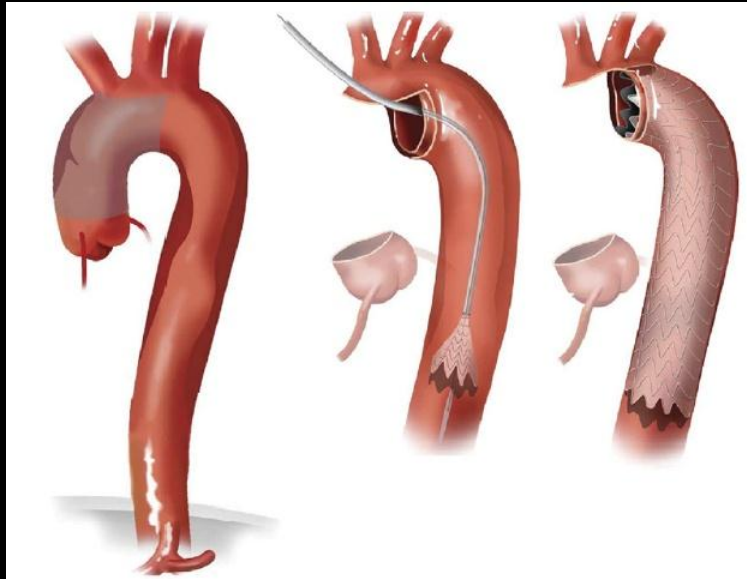
Transluminal Stenting in Type A Acute Aortic Dissection: Does the Djumbodis System Have Any Impact on False Lumen Evolution?
 Fabio Ius, Igor Vendramin, Enzo Mazzaro, Gianluca Piccoli, Flavio Bassi, Daniele Gasparini and Ugolino Livi
Ann Thorac Surg 2010;90:1450-1456

| | Group A | Group B | <i>p</i> Value |
|------------------|--------------------------|---------------------------|----------------|
| First control | | | |
| Aortic arch | 10/22 ^a (45%) | 9/18 ^a (50%) | 0.77 |
| Isthmus | 10/15 ^a (66%) | 10/15 ^a (66%) | 1.00 |
| Descending aorta | 12/14 ^a (86%) | 14/14 ^a (100%) | 0.14 |
| Last control | | | |
| Aortic arch | 8/19 ^a (42%) | 3/14 ^a (21%) | 0.21 |
| Isthmus | 7/12 ^a (58%) | 4/11 ^a (36%) | 0.30 |
| Descending aorta | 9/12 ^a (75%) | 7/10 ^a (70%) | 0.80 |

^a Patients presenting with a patent false lumen preoperatively and undergoing postoperative controls.

Antegrade Thoracic Stent Grafting During Repair of Acute DeBakey I Dissection Prevents Development of Thoracoabdominal Aortic Aneurysms

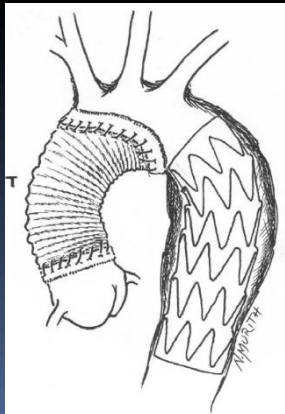
Alberto Pochettino, William T. Brinkman, Patrick Moeller, Wilson Y. Szeto, William Moser, Katherine Cornelius, Frank W. Bowen, Y. Joseph Woo and Joseph E. Bavaria
Ann Thorac Surg 2009;88:482-490



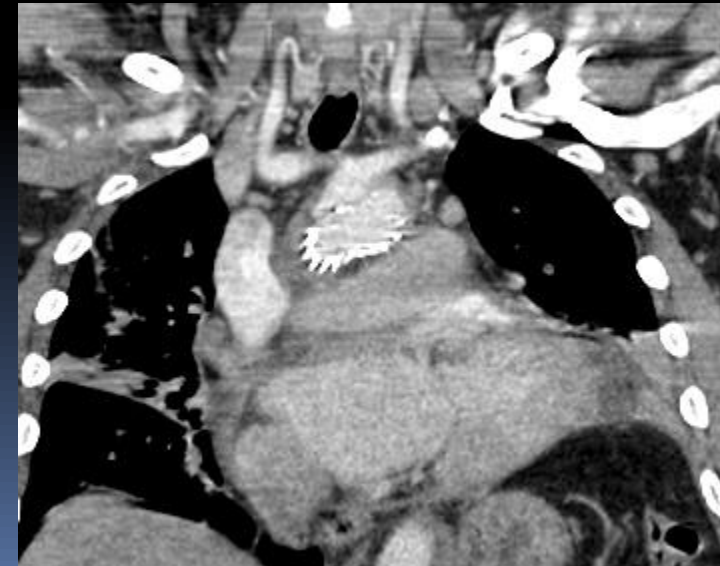
| | Full Obliteration of the False Lumen | Partial Obliteration of the False Lumen | Fully Patent False Lumen |
|-------------------|---|--|--------------------------------|
| Stented (n = 30) | 5 (17%) | 18 (60%) | 7 (23%) |
| No stent (n = 24) | 4 (17%) | 2 (8%) | 18 (75%) |

Roselli EE Celveland Clinic

Panos A et al ATS 2005; 80: 1087



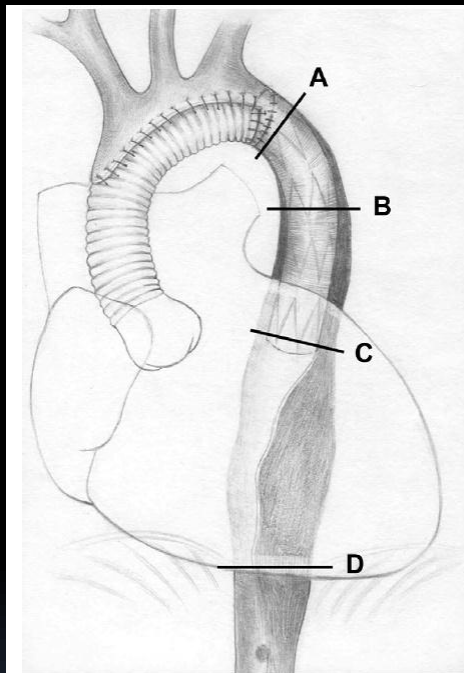
n=17
 LCA covered 46%
 88% thrombosed FL



Fate of the False Lumen After Combined Surgical and Endovascular Repair Treating Stanford Type A Aortic Dissections

Michael Gorlitzer, Gabriel Weiss, Johann Meinhart, Ferdinand Waldenberger, Markus Thalmann, Sandra Folkmann, Reinhard Moidl and Martin Grabenwoeger

Ann Thorac Surg 2010;89:794-799



| n = 14 | thrombosed |
|--------|------------|
| 86% | 2 weeks |
| 100% | 3 months |

E-vita open registry Tsagakis K et al *Interact Cardio Vasc Thor Surg* 2009; 9: 121

N=56

PFL thrombosed > 90%

In-hosp Mortality 11%

Distal Endoleak requiring intervention 5

Extensive deployment of the stented elephant trunk is associated with an increased risk of spinal cord injury

Jorge Flores, Takashi Kuniyara, Norihiko Shiiya, Kimihiro Yoshimoto, Kenji Matsuzaki and Keishu Yasuda

J Thorac Cardiovasc Surg 2006;131:336-342

Device discordancy: Lost cords, quick-fix seekers, quality, and ethics

Lars G. Svensson

J Thorac Cardiovasc Surg 2006;131:261-263

What do we know and what not?

- PFL occurs in 2/3 of type A Dissections after standard repair
- There is an association between PFL and long-term survival; the degree is controversial
- There is an association between PFL and late aneurysm formation; speed, degree and significance are controversial
- There is data to suggest that extending a repair beyond the standard hemiarch replacement may decrease PFL

How to do this safely is controversial/unknown

The way the data is reported is woefully inadequate to answer those questions