The VA Open Vs Endovascular Repair (OVER) Trial for AAA - VA CSP #498

Final Results (in press)

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Methods

- Multicenter randomized clinical trial
- Open repair vs. any FDA-approved EVR system
- AAA ≥ 5.0 cm, candidate for both procedures
- 1º outcome = mortality
- Study began Oct 2002, ended Oct 2011
- Vital status known for all patients
- Analyzed by intent-to-treat

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OVER Patient Characteristics

- 99.3% male 87% white
- Mean age: 70 years Mean wt: 90 kg
- Current smoker: 41% Cor. Art. disease: 41%
- AAA diameter < 5.5 cm: 43%
  ≥ 6.0 cm: 27%
- EVR system:
  Cook Zenith: 39%, Gore Excluder: 37%
  Medtronic Aneurx: 21%, Guidant/Endologix: 3%
- 95% had assigned repair + 2% attempted/aborted

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Recap of the 2-yr Report

ORIGINAL CONTRIBUTION

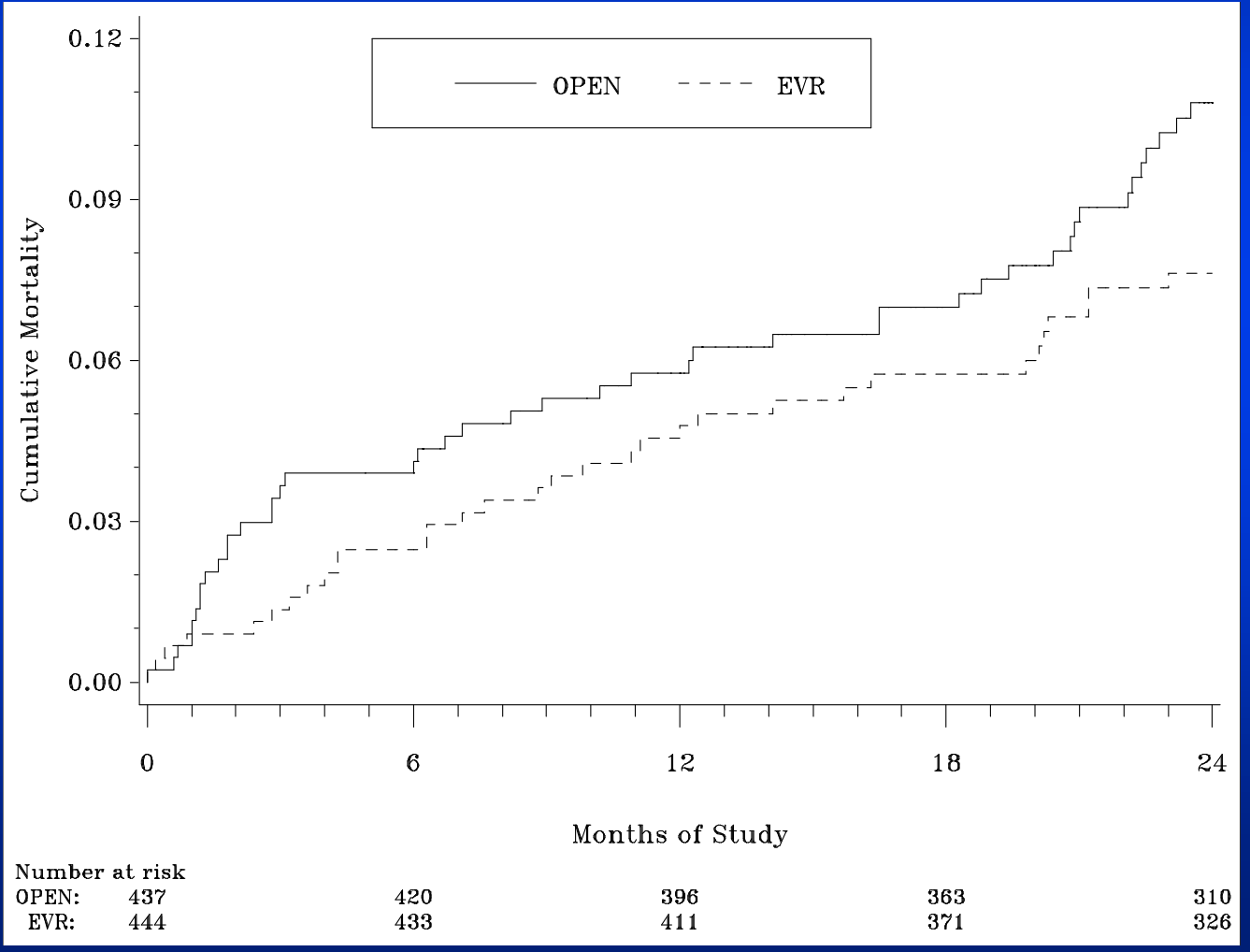
JAMA. 2009;302(14):1535-1542

Outcomes Following Endovascular vs Open Repair of Abdominal Aortic Aneurysm
A Randomized Trial

Mortality

30-day + inpatient:
EVR 2 (.5%), OPR 13 (3%)
P = 0.004

2-year (data on 80%):
HR = 0.7 (95% CI 0.44, 1.1)
P = 0.13



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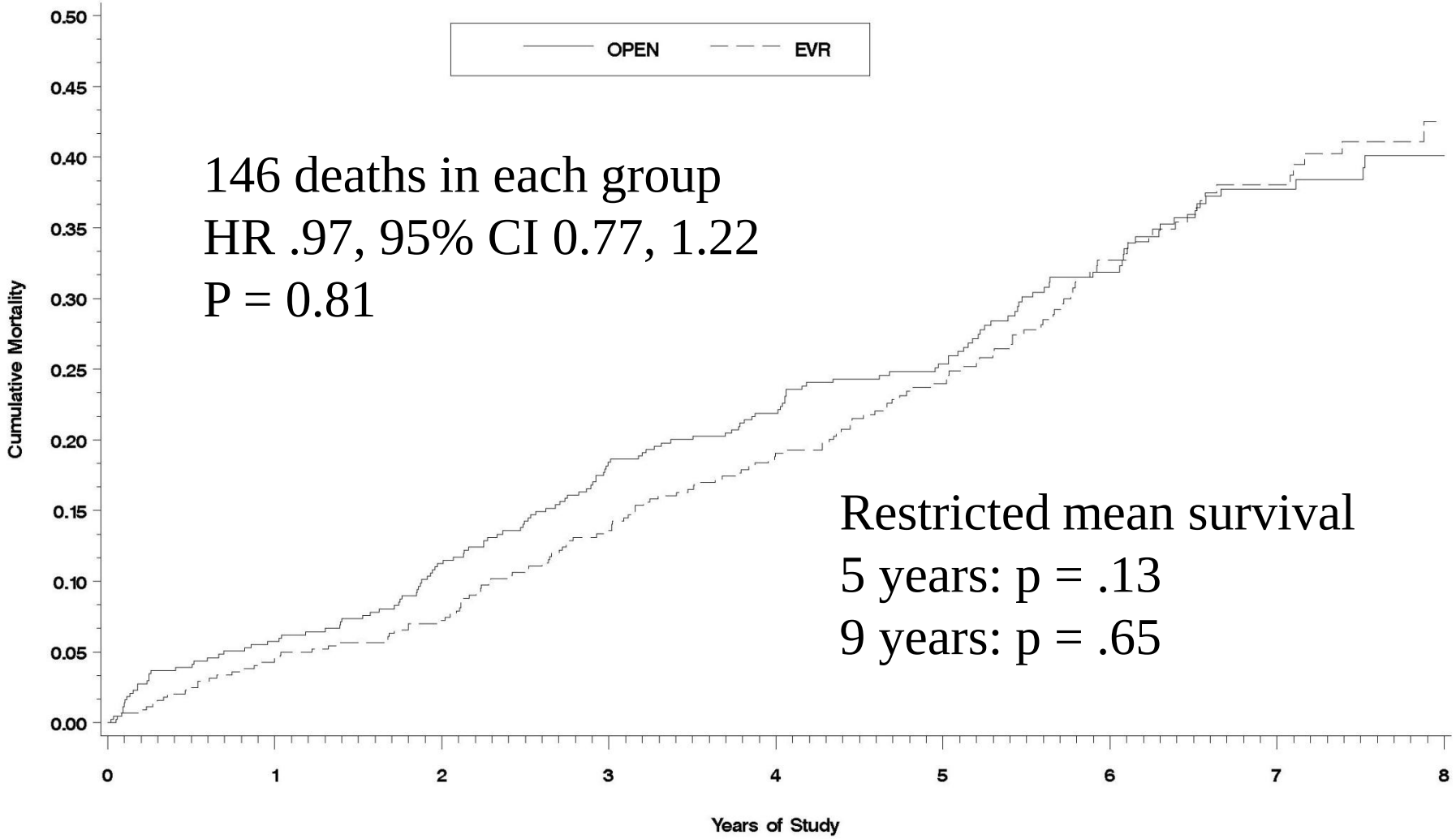
Now with all the data in…

- After 2 years:

  HR 0.63, 95% CI: 0.40-0.98, p=.04
- And after 3 years:

  HR 0.72, 95% CI: 0.51-1.00, p=.05
- But after that, no significant difference



Number at risk									
OPEN	437	410	386	354	329	266	169	102	35
EVR:	444	423	410	381	347	265	159	94	34

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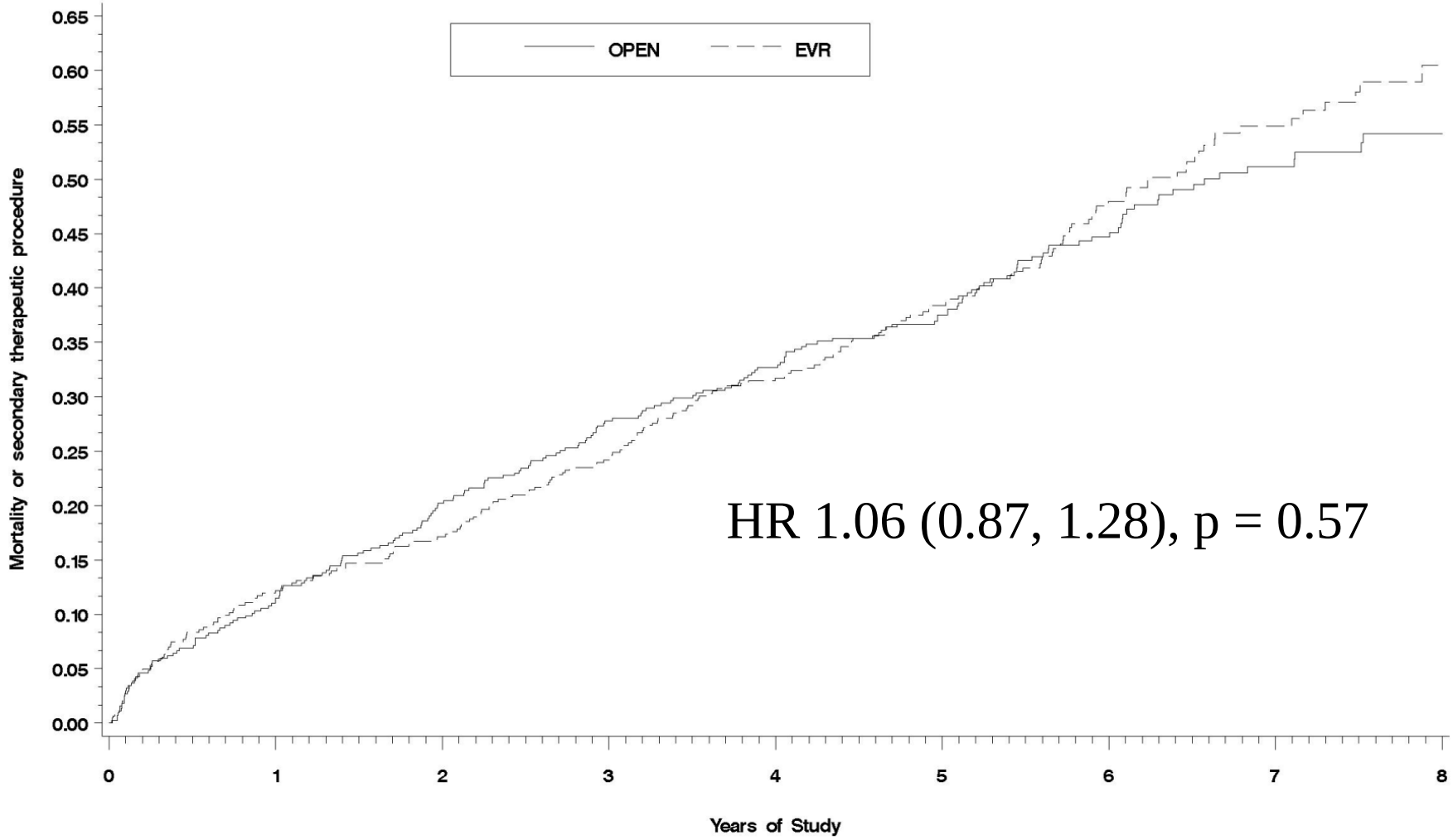
Outcome	EVR	Open	P value
	n = 444	*n = 437*	
	no. (%)		
All deaths	146 (32.9)	146 (33.4)	0.81
AAA-related death	10 (2.3)	16 (3.7)	0.22
Within 30 days or inpatient	2 (0.5)	13 (3.0)	0.004
AAA ruptures	6 (1.4)	0	0.03
Patients with new/worsened claudication	23	15	0.20
Patients w secondary therapeutic procedures	98	78	0.12
Number of secondary therapeutic procedures	148	105	0.26
Pts w post-repair AAA-related hospitalizations	95	78	0.19
All post-repair AAA-related hospitalizations	171	117	0.12
Patients having post-repair hospitalizations	325	314	0.66
All post-repair hospitalizations	954	1040	0.08

Death or secondary procedure



OPEN:									
At Risk:	437	385	347	314	284	222	133	79	28
EVR:									
At Risk:	444	389	366	334	292	217	123	69	23

Details of Secondary Procedures

Endovascular repair group

(148 procedures)

- 100 EVR procedures
- 9 conversions to open repair (no deaths within one year)
- 19 arterial procedures with an open component
- 11 wound-related procedures
- 6 amputations
- 4 miscellaneous

Open Repair Group

(105 procedures)

- 48 incisional hernia repairs
- 15 EVR procedures
- 13 open arterial procedures
- 11 laparotomies for bowel ischemia/obstruction
- 4 wound-related procedures
- 7 amputations
- 7 misc. open procedures

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Uncorrected abnormalities from CT scans in the last year of study

- EVR group

  n = 298 alive

  3 sac increase

  1 Iliac > 3 cm

  1 graft kink

  1 graft migration

  54 – no CT scan

- Open repair group

  n = 291 alive

  1 iliac artery dissection

  2 Iliac > 3 cm

  1 prox AAA > 4 cm

  96 – no CT scan

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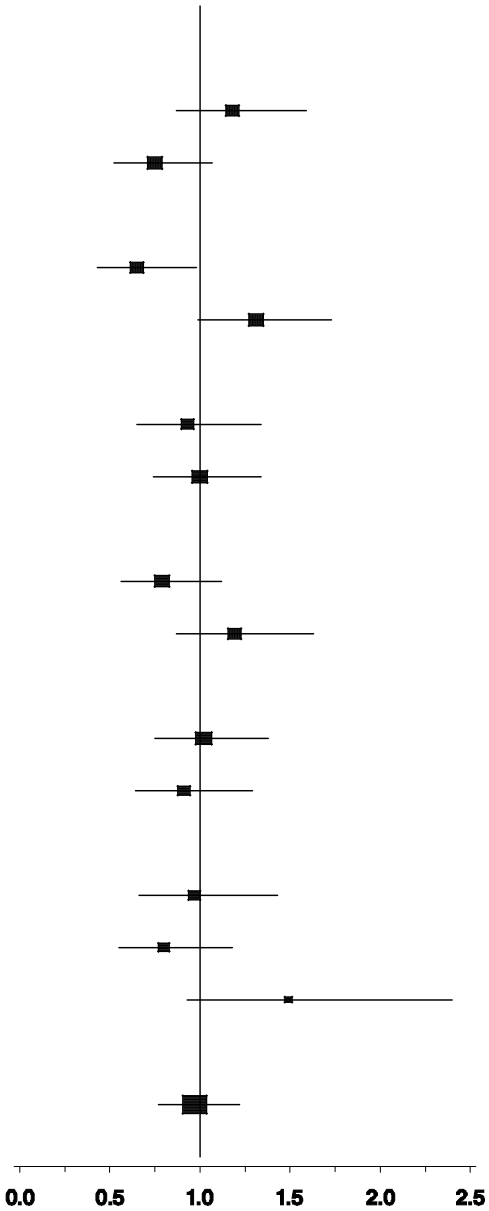
Death by Subgroups of Baseline Characteristics

Subgroup	Number of Patients	Number of Deaths	Hazard Ratio [95% CI]	P(interaction)
Randomization Period				0.05
Before April 15, 2005	413	170	1.18 [0.87, 1.59]	
After April 15, 2005	468	122	0.75 [0.52, 1.07]	
Age				0.01
Age <70 yrs	406	94	0.65 [0.43, 0.98]	
Age>=70 yrs	475	198	1.31 [0.99, 1.73]	
AAA Diameter				0.75
AAA <5.5cm	382	120	0.93 [0.65, 1.34]	
AAA>=5.5cm	499	172	1.00 [0.74, 1.34]	
Surgical Risk (RAND Score)				0.08
Low	468	129	0.79 [0.56, 1.12]	
Intermediate or High	404	157	1.19 [0.87, 1.63]	
Coronary Artery Disease				0.60
No	522	170	1.02 [0.75, 1.38]	
Yes	359	122	0.91 [0.64, 1.29]	
Intended EVR System				
Cook Zenith	341	104	0.97 [0.66, 1.43]	
Gore Excluder	327	107	0.80 [0.55, 1.18]	0.14*
Medtronic AneuRx	186	69	1.49 [0.93, 2.40]	0.06*
All Patients	881	292	0.97 [0.77, 1.22]	



Data torture required by reviewers

Table S2. Cause of death by age at time of randomization

	Endovascular repair	Open repair	P value
Patients < 70 years old	*n = 218*	*n = 188*	
All deaths	43 (19.7)	51 (27.1)	
AAA-related	2 (0.9)	5 (2.7)	0.257
Within 30 days after repair or during hospitalization	0	3 (1.6)	0.10
Cardiovascular	14 (6.4)	9 (4.8)	0.48
Cancer	9 (4.1)	20 (10.6)	0.01
Pneumonia & other infections	3 (1.4)	3 (1.6)	0.99
Chronic obstructive lung disease	2 (0.9)	4 (2.1)	0.42
Accident/homicide/suicide	0	2 (1.1)	0.21
Other	8 (3.7)	3 (1.6)	0.20
Unknown	5 (2.3)	5 (2.7)	0.99
Patients ≥ 70 years old	*n = 226*	*n = 249*	
All deaths	103 (45.6)	95 (38.2)	
AAA-related	8 (3.5)	11 (4.4)	0.67
Within 30 days after repair or during hospitalization	2 (0.9)	10 (4.0)	0.03
Cardiovascular	25 (11.1)	20 (8.0)	0.26
Cancer	30 (13.3)	28 (11.2)	0.50
Pneumonia & other infections	12 (5.3)	9 (3.6)	0.37
Chronic obstructive lung disease	3 (1.3)	9 (3.6)	0.11
Accident/homicide/suicide	10 (4.4)	2 (0.8)	0.01
Other	7 (3.1)	6 (2.4)	0.65
Unknown	8 (3.5)	10 (4.0)	0.79

Values expressed as no. (%). AAA is abdominal aortic aneurysm.

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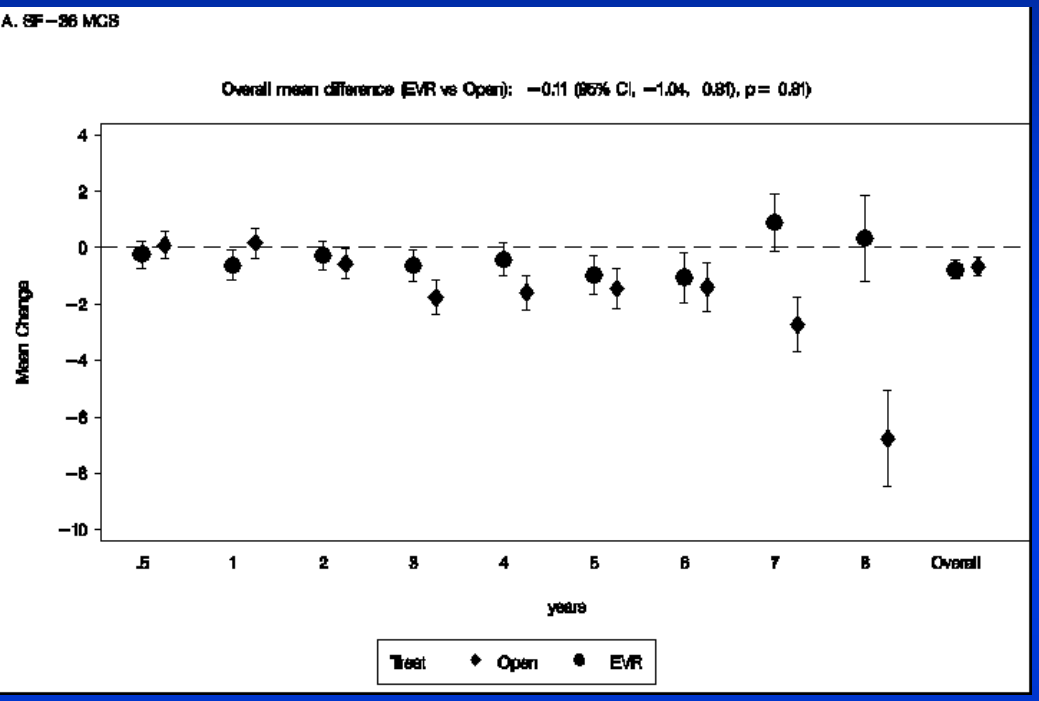
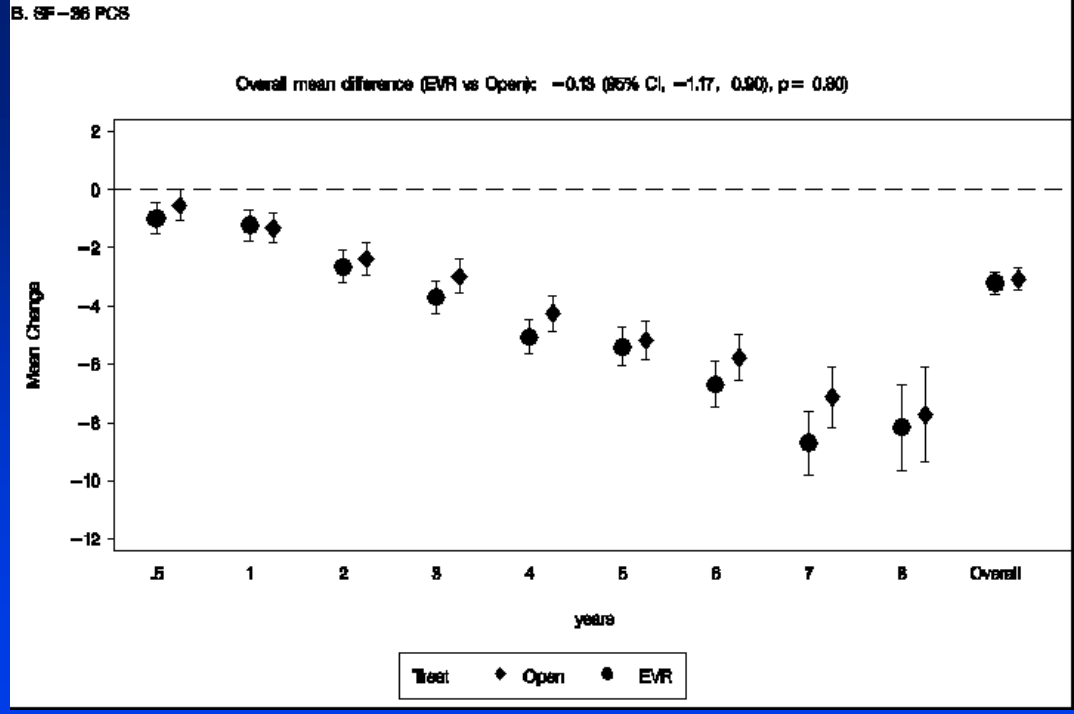
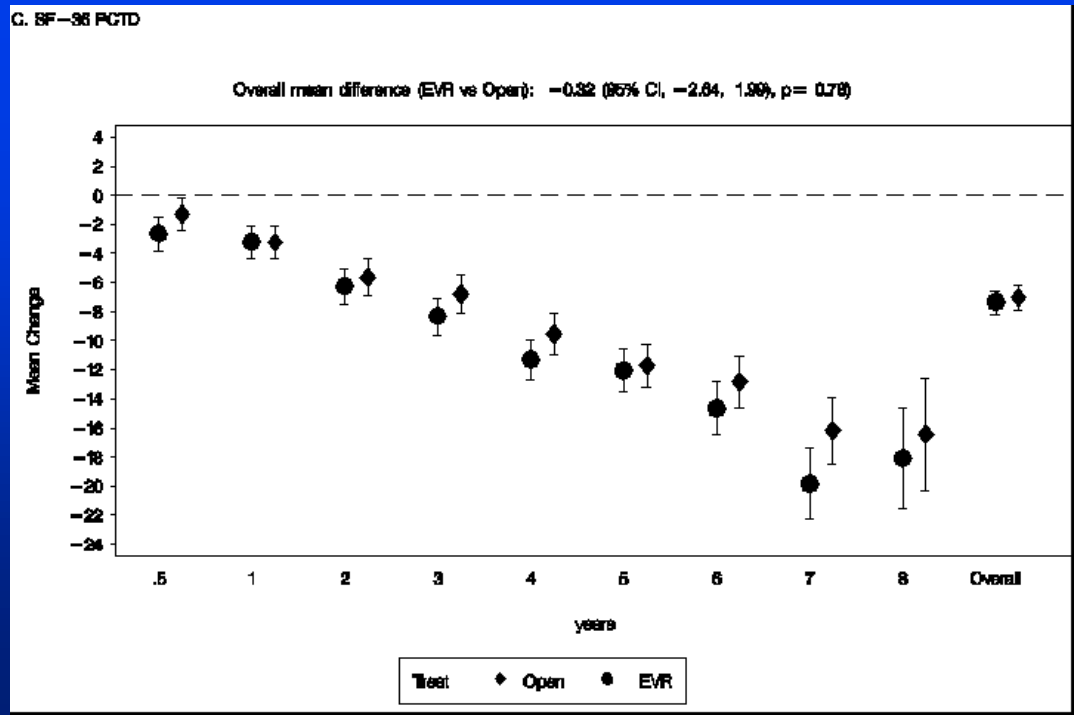
SF-36







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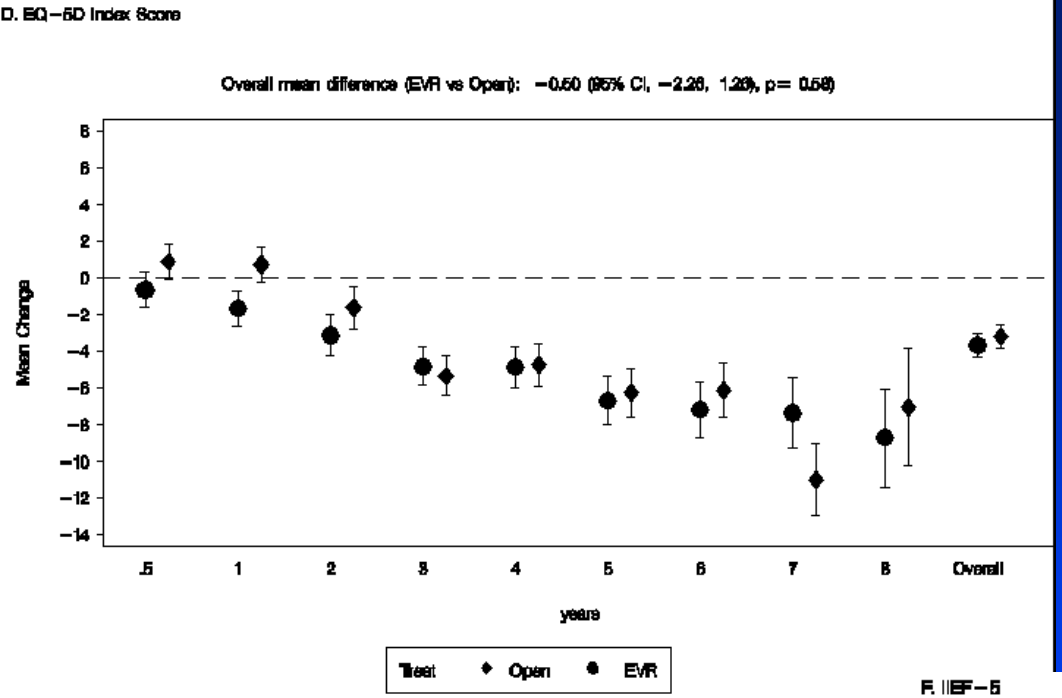

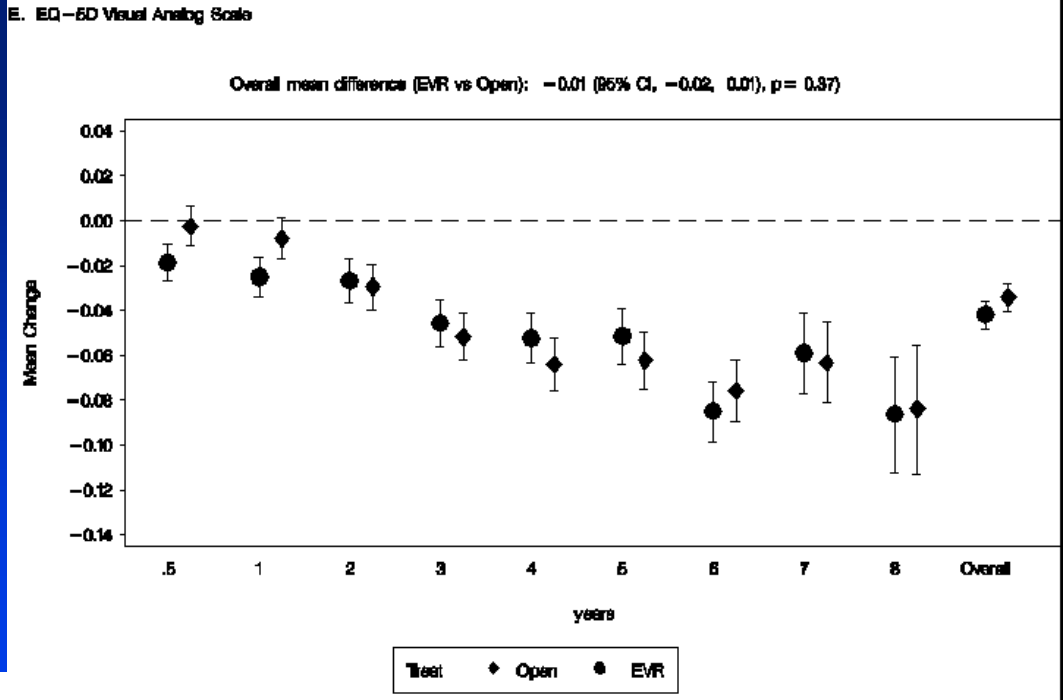

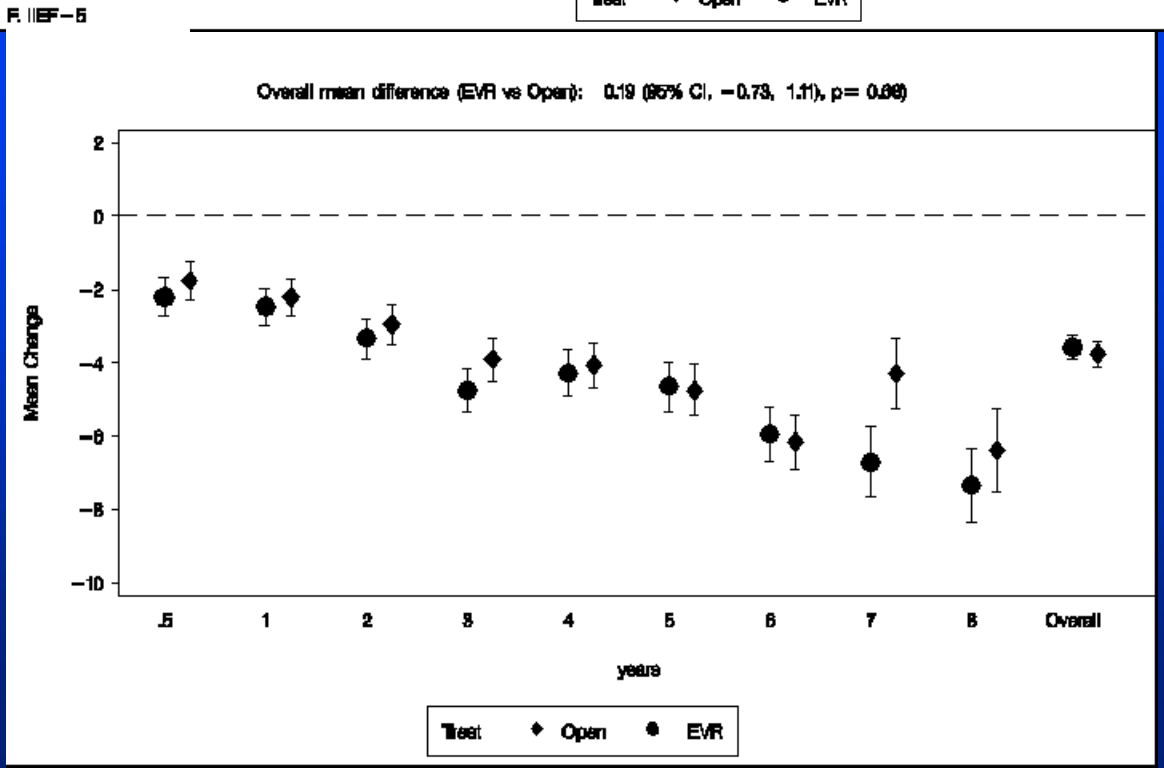

EQ-5D & IIEF-5

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Summary

- No difference in 1° outcome: long-term all-cause mortality
- Unlike other trials, the peri-operative survival advantage of EVR was sustained for several years.
- EVR improved long term survival in younger patients, but tended to worsen survival in older patients.
- Aneurysm rupture after repair was uncommon, but all in EVR group, differing significantly from open group.
- No difference between groups in secondary procedures, hospitalizations, quality of life, or erectile function.

Conclusions

- EVR continues to improve and is now an acceptable alternative to open repair even when judged by long-term results
- EVR does not yet offer a long-term advantage over open repair, and particularly not in the older and sicker patients for whom an advantage was hoped for and even expected

2-Year Cost-Effectiveness of Open vs Endovascular Repair of AAA: Results of a Multicenter Randomized Trial

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Open Versus Endovascular Repair

Methods for Cost Effectiveness Analysis

- QALYs from EQ-5D: baseline, 6 mo, annually
- Included costs for ALL health care to 2 years
- Non-VA costs from Medicare claims & billing data
- VA costs from VA databases using methods of the VA Health Economics Resource Center
  - Detailed 'DSS method' for costs of AAA repair (next slide)
  - Costs for other VA care from 'average cost datasets' (like Medicare costing used for non-VA care)
- All graft components recorded for each patient; prices from VA National Patient Prosthetics Database

Costs for AAA Repair Hospitalization

- From VA Decision Support System (DSS): combines VA accounting/payroll files & patient care/admin files
- Costs from ‘intermediate products’: i.e., an x-ray, a ward day, or a 15-minute block of time in the OR
- Hospital stay divided into segments based on Bed Section, i.e. medical, surgical, long-term care unit

Cost Categories

- Costs in each Bed Section allocated to 6 categories: surgery, nursing, lab, radiology, pharmacy, ‘other’
- ‘Surgery’ category (whether or not patient is on Surgery Bed Section) = pre-op, operating room, recovery room
- ‘Nursing’ = acute & long term care units, not MDs
- ‘Other’ = daily MDs, ward clerks, respiratory therapy, dietetics, social work, etc.

Fixed Costs

Each of the 6 cost categories also includes:

- Fixed direct costs = attributable to that category but incurred regardless of volume of services provided (i.e., surgical supplies, C-arm)
- Fixed indirect costs = overhead departments (i.e., housekeeping, engineering, administration)

allocated by formulae based on intermediate product use

Table I. Costs of hospitalization for abdominal aortic aneurysm repair

Item[a]	*Endovascular repair (n = 444)*	*Open repair (n = 437)*	*Cost difference (95% CI)*	P
Surgery bed section	35,695 (24,762)	40,169 (48,519)	−4474 (−10,265 to −67)	.04
Nursing cost category	6193 (11,328)	16,007 (24,025)	−9815 (−12,857 to −7833)	<.001
Intensive care units	2349 (5639)	6466 (11,803)	−4118 (−5757 to −3089)	<.001
Wards	830 (1646)	1317 (2411)	−486 (−766 to −233)	.0005
Other[b]	412 (1069)	1274 (3717)	−862 (−1372 to −575)	<.001
Fixed indirect total	2482 (4489)	6579 (11,219)	−4097 (−5615 to −3206)	<.001
Fixed direct total	119 (271)	371 (1358)	−252 (−444 to −156)	.0002
Surgery cost category	23,618 (8453)	11,594 (8813)	12,024 (10,852−13,187)	<.001
Operating room	3219 (2857)	3902 (3295)	−683 (−1070 to −280)	.001
Surgical implants	14,052 (3626)	1363 (2935)	12,689 (12,227−13,099)	<.001
Anesthesia	1184 (1180)	1528 (1586)	−344 (−526 to −158)	.0003
Other	447 (1974)	415 (1545)	32 (−181 to 286)	.79
Fixed indirect total	4389 (4108)	3982 (3354)	407 (−105 to 907)	.11
Fixed direct total	327 (351)	405 (459)	−77 (−129 to −22)	.005
Radiology cost category	1597 (3071)	1253 (2382)	343 (0 to 717)	.06
Laboratory cost category	796 (1473)	2034 (3169)	−1238 (−1612 to −958)	<.001
Pharmacy cost category	895 (1914)	2733 (8946)	−1838 (−3446 to −1291)	<.001
Other cost category	2597 (4911)	6548 (11,098)	−3951 (−5254 to −3003)	<.001
Other bed sections	1373 (8752)	2802 (11,599)	−1429 (−2804 to −50)	.04
Total cost	37,068 (28,551)	42,970 (51,952)	−5901 (−12,135 to −821)	.04
Total cost, median (IQR)	32,094 (26,306, 40,038)	30,506 (21,785, 42,768)		
Mean LOS (d)	5.0	10.5		p<.001

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- Cost from hospital discharge to 2 years were nearly identical
- Total costs after 2 years reflected difference from repair hospitalization

Table III. Continued.

Variable[a]	*Endovascular repair (n = 444)*	*Open repair (n = 437)*	*Cost difference (95% CI)*	P
Median (IQR)	6511 (2772, 16,322)	5810 (2356, 16,002)		
Total at 2 years	75,325 (58,879)	80,344 (96,436)	−5019 (−16,720 to 4928)	.35
Median (IQR)	59,782 (43,666, 82,568)	55,153 (38,262, 85,369)		

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EQ-5D scores converted to utility weights based on survey of US population: 0.0 = death, 1.0 = perfect health

Table IV. Quality of life from randomization to 2 years as measured by EuroQol-5D (*EQ-5D*) scores

EQ-5D scores[a]	*Endovascular repair (n = 444)*	*Open repair (n = 437)*	P
Baseline	0.785 (0.176)	0.789 (0.173)	.76
6 months	0.756 (0.217)	0.757 (0.231)	.93
1 year	0.735 (0.242)	0.742 (0.252)	.68
2 years	0.715 (0.262)	0.700 (0.286)	.42

[a]Values are mean (standard deviation).

QALY's = area under the curve

= 1.462 for EVAR, 1.461 for open (NS)

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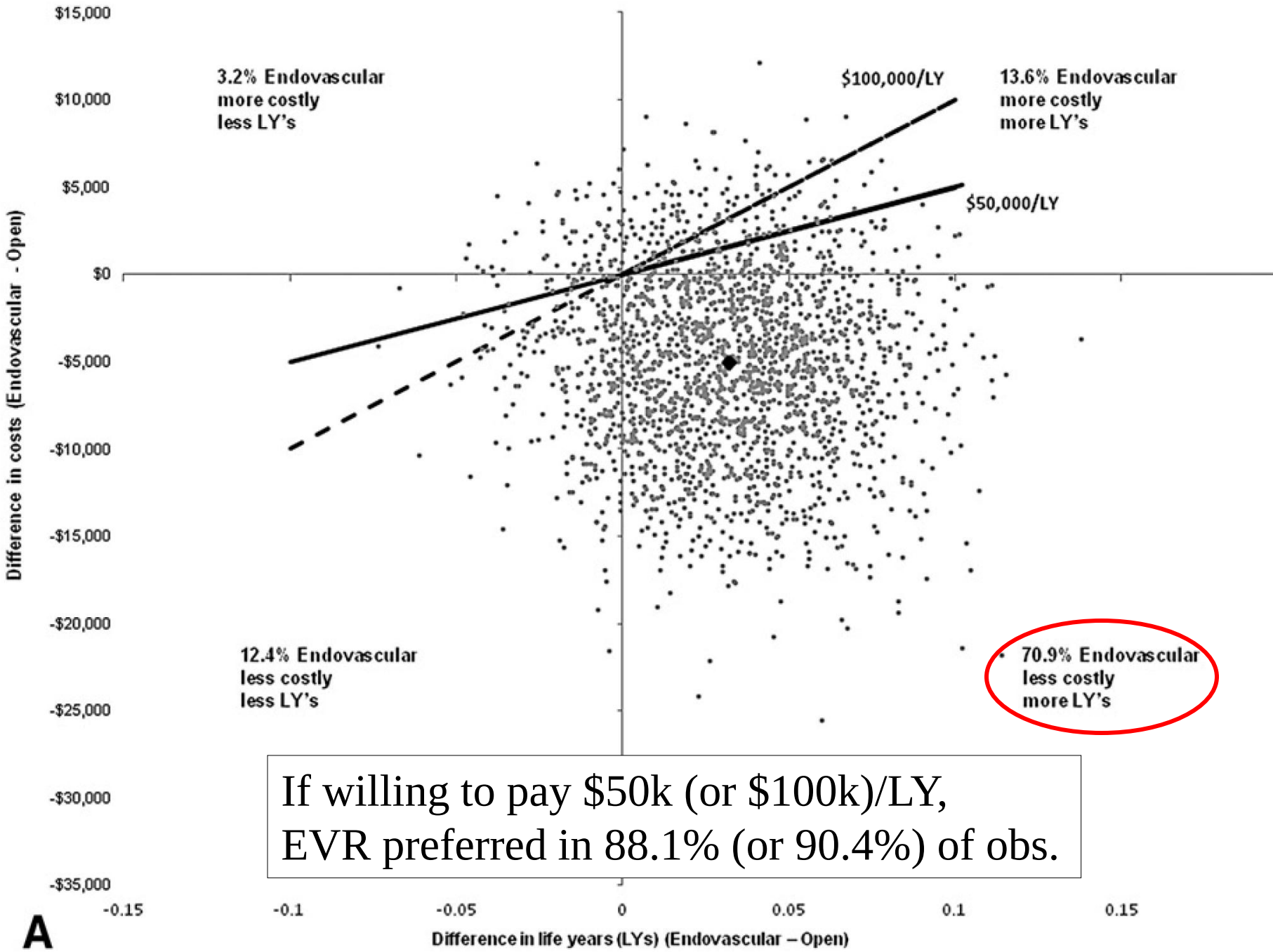
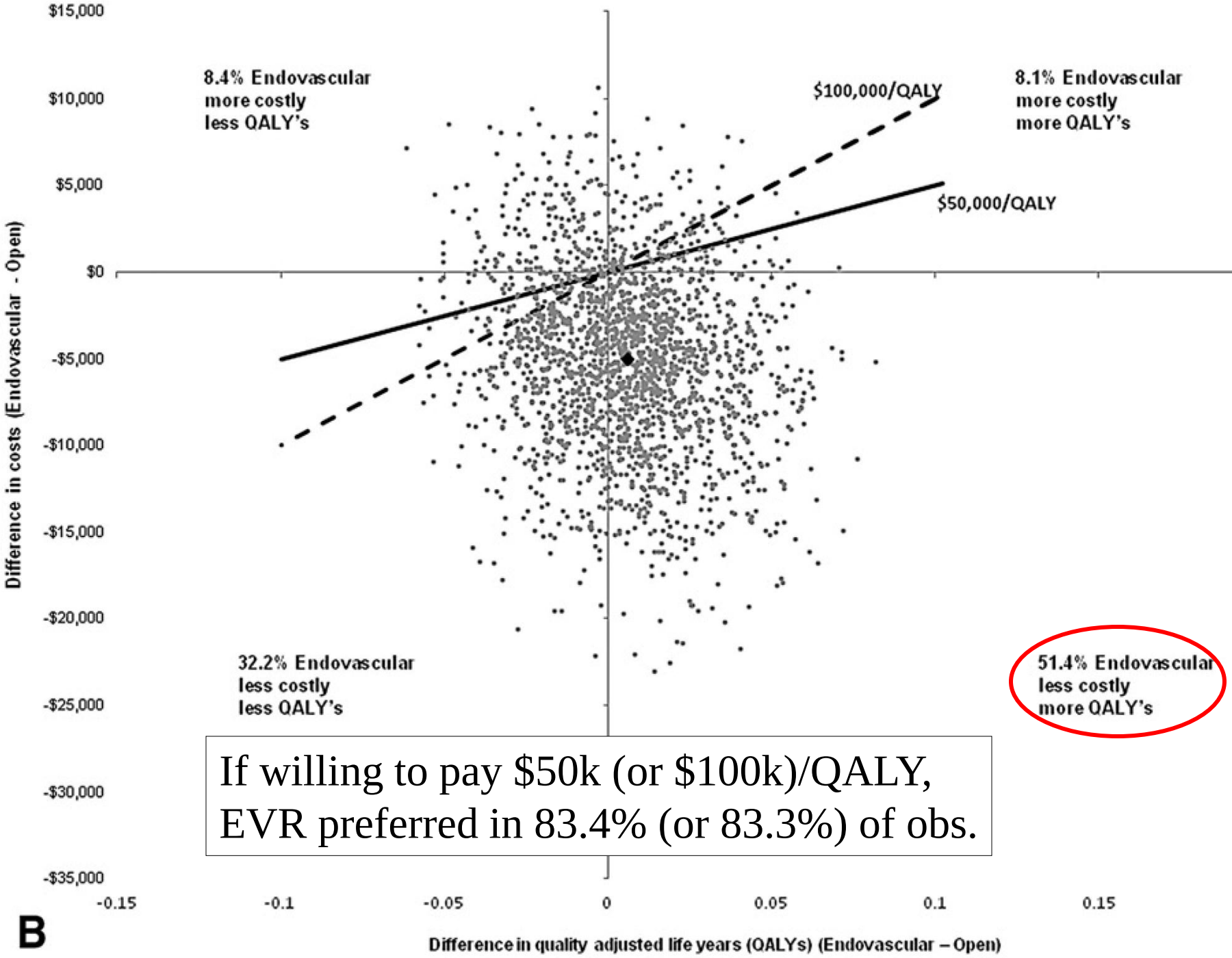
Bootstrap Analysis: Life years



If willing to pay $50k (or $100k)/LY, EVR preferred in 88.1% (or 90.4%) of obs.

Bootstrap Analysis: QALY's



If willing to pay $50k (or $100k)/QALY, EVR preferred in 83.4% (or 83.3%) of obs.

Conclusions

- No significant difference after 2 years between EVAR and open repair in survival, quality of life, or costs.
- AAA repair hospitalization → $5901 less w EVAR (p=.04), 2° ↓LOS & despite hi cost of EVAR grafts
- Costs from discharge to 2 years were nearly identical
- Probable that EVAR saves $ & LY but not QALY at 2y
- EVAR is a cost-effective alternative to open repair in the US VA system, at least in the first two years.