

Supplemental Material

Table S1. Baseline clinical and procedural characteristics stratified by closure device in a propensity matched cohort.

	Overall (n=26,336)	ACD (n=13,168)	No ACD (n=13,168)	Standardized Difference (%)
Closure Device Type				---
Manual	13,168 (50.0)	----	13,168 (100.0)	
Collagen Plug	163 (0.6)	163 (1.2)		
Extra Vascular Plug	1 (0.0)	1 (0.0)	----	
Seal	8,750 (33.2)	8,750 (66.4)	----	
Starclose/Clip	535 (2.0)	535 (4.1)	----	
Suture	3,719 (14.1)	3,719 (28.2)	----	
Demographics				
Age, yrs (mean (sd))	66.7 (9.4)	66.7 (9.4)	66.7 (9.3)	0.6
Male	25,808 (98.0)	12,903 (98.0)	12,905 (98.0)	0.1
White	22,032 (83.7)	10,921 (82.9)	11,111 (84.4)	3.9
BMI (kg/m ²) (mean (sd))	29.9 (5.6)	29.9 (5.5)	29.9 (5.8)	0.1
Tobacco use	16,730 (63.5)	8,195 (62.2)	8,535 (64.8)	5.4
Hypertension	24,250 (92.1)	12,136 (92.2)	12,114 (92.0)	0.6
Hyperlipidemia	23,753 (90.2)	11,861 (90.1)	11,892 (90.3)	0.8
Renal Failure (GFR<30)	1,536 (5.8)	753 (5.7)	783 (5.9)	1.0
Chronic Kidney Disease	6,747 (25.6)	3,348 (25.4)	3,399 (25.8)	0.9
Cerebrovascular Disease	5,516 (20.9)	2,767 (21.0)	2,749 (20.9)	0.3
Peripheral Arterial Disease	7,332 (27.8)	3,650 (27.7)	3,682 (28.0)	0.5
COPD	6,885 (26.1)	3,471 (26.4)	3,414 (25.9)	1.0

Diabetes	13,401 (50.9)	6,637 (50.4)	6,764 (51.4)	1.9
Congestive Heart Failure	8,044 (30.5)	3,909 (29.7)	4,135 (31.4)	3.7
Chronic Depression	8,083 (30.7)	4,046 (30.7)	4,037 (30.7)	0.1
PTSD	4,217 (16.0)	2,093 (15.9)	2,124 (16.1)	0.6
Prior MI	11,530 (43.8)	5,644 (42.9)	5,886 (44.7)	3.7
Prior PCI	12,040 (45.7)	6,037 (45.8)	6,003 (45.6)	0.5
Prior CABG	8,542 (32.4)	4,017 (30.5)	4,525 (34.4)	8.2
Presentation Characteristics				
Med IIbIIIa	4,457 (16.9)	2,195 (16.7)	2,262 (17.2)	1.4
Presentation Type				1.9
STEMI	1,889 (7.2)	949 (7.2)	940 (7.1)	
NSTEMI	6,192 (23.5)	3,067 (23.3)	3,125 (23.7)	
Unstable Angina	6,439 (24.4)	3,229 (24.5)	3,210 (24.4)	
Stable Angina	7,518 (28.5)	3,769 (28.6)	3,749 (28.5)	
Chest Pain	1,156 (4.4)	589 (4.5)	567 (4.3)	
Other*	471 (1.8)	224 (1.7)	247 (1.9)	
Unknown	2,378 (9.0)	1,191 (9.0)	1,187 (9.0)	

- Data are presented as counts (percentages) unless otherwise noted.
- *Other includes presentations for valve diseases, arrhythmia, asymptomatic, cardiomyopathy, heart failure, positive functional study, non-cardiac pre-op, pulmonary hypertension, syncope, and transplant evaluation

Table S2. Facility characteristics by closure device use in the propensity matched cohort.

	Overall (n=26,336)	ACD (n=13,168)	No ACD (n=13,168)	Standardized Difference (%)
Region				8.3
Continental	6,427 (24.4)	3,161 (24.0)	3,266 (24.8)	
Midwest	7,131 (27.1)	3,576 (27.2)	3,555 (27.0)	
North Atlantic	3,130 (11.9)	1,707 (13.0)	1,432 (10.8)	
Pacific	3,736 (14.2)	1,918 (14.6)	1,818 (13.8)	
Southeast	5,912 (22.4)	2,806 (21.3)	3,106 (23.6)	
Academic Affiliation	26,008 (98.8)	13,000 (98.7)	13,008 (98.8)	0.5
Fellows Listed at Site	25,515 (96.9)	12,754 (96.9)	12,761 (96.9)	0.3
Operating Beds in FY2018 (mean (sd))	180.3 (69.2)	182.9 (72.6)	177.6 (65.5)	7.8

Table S3. Baseline clinical and procedural characteristics by high and low use of closure devices.

	Overall (n=20,883)	PCI by high- use operator (n=10,737)	PCI by low- use operator (n=10,146)	Standardized Difference (%)
Arterial Closure Device	12,502 (59.9)	10,065 (93.7)	2,437 (24.0)	200.8
Closure Device Type				202.0
Manual	8,381 (40.1)	672 (6.3)	7,709 (76.0)	
Collagen Plug	286 (1.4)	266 (2.5)	20 (0.2)	
Seal	8,310 (39.8)	6,793 (63.3)	1,517 (15.0)	
Starclose/Clip	549 (2.6)	469 (4.4)	80 (0.8)	
Suture	3,357 (16.1)	2,537 (23.6)	820 (8.1)	
Demographics				
Age, yrs (mean (sd))	66.5 (9.4)	67.0 (9.5)	65.9 (9.2)	11.6
Male	20,498 (98.2)	10,542 (98.2)	9,956 (98.1)	0.4
White	17,781 (85.1)	9,168 (85.4)	8,613 (84.9)	1.4
BMI (kg/m ²) (mean (sd))	30.3 (5.7)	30.3 (5.7)	30.3 (5.7)	0.6
Tobacco use	13,447 (64.4)	6,956 (64.8)	6,491 (64.0)	1.7
Hypertension	18,963 (90.8)	9,717 (90.5)	9,246 (91.1)	2.2
Hyperlipidemia	18,963 (90.8)	9,796 (91.2)	9,167 (90.4)	3.1
Renal Failure (GFR<30)	1,064 (5.1)	570 (5.3)	494 (4.9)	2.0
Chronic Kidney Disease	5,031 (24.1)	2,704 (25.2)	2,327 (22.9)	5.3
Cerebrovascular Disease	4,034 (19.3)	2,150 (20.0)	1,884 (18.6)	3.7
Peripheral Arterial Disease	4,746 (22.7)	2,574 (24.0)	2,172 (21.4)	6.1
COPD	5,080 (24.3)	2,678 (24.9)	2,402 (23.7)	3.0

Diabetes	10,485 (50.2)	5,427 (50.5)	5,058 (49.9)	1.4
Congestive Heart Failure	5,995 (28.7)	3,164 (29.5)	2,831 (27.9)	3.5
Chronic Depression	6,520 (31.2)	3,322 (30.9)	3,198 (31.5)	1.3
PTSD	3,515 (16.8)	1,814 (16.9)	1,701 (16.8)	0.3
Prior MI	8,996 (43.1)	4,716 (43.9)	4,280 (42.2)	3.5
Prior PCI	9,285 (44.5)	4,831 (45.0)	4,454 (43.9)	2.2
Prior CABG	6,499 (31.1)	3,243 (30.2)	3,256 (32.1)	4.1
Presentation Characteristics				
Med IIbIIIa	3,271 (15.7)	1,380 (12.9)	1,891 (18.6)	15.9
Outpatient PCI	126 (0.6)	63 (0.6)	63 (0.6)	0.4
Presentation Type				13.7
STEMI	1,424 (6.8)	745 (6.9)	679 (6.7)	
NSTEMI	5,194 (24.9)	2,902 (27.0)	2,292 (22.6)	
Unstable Angina	5,204 (24.9)	2,579 (24.0)	2,625 (25.9)	
Stable Angina	5,857 (28.0)	2,863 (26.7)	2,994 (29.5)	
Chest Pain	860 (4.1)	403 (3.8)	457 (4.5)	
Other*	416 (2.0)	261 (2.4)	155 (1.5)	
Unknown	1,713 (8.2)	889 (8.3)	824 (8.1)	

Table S4. Facility characteristics by high and low closure device utilization.

	Overall (n=20,883)	PCI by high- use operator (n=10,737)	PCI by low- use operator (n=10,146)	Standardized Difference (%)
Region				41.8
Continental	3,931 (18.8)	1,443 (13.4)	2,488 (24.5)	
Midwest	6,723 (32.2)	3,918 (36.5)	2,805 (27.6)	
North Atlantic	3,015 (14.4)	1,962 (18.3)	1,053 (10.4)	
Pacific	3,007 (14.4)	1,664 (15.5)	1,343 (13.2)	
Southeast	4,207 (20.1)	1,750 (16.3)	2,457 (24.2)	
Academic Affiliation	39,096 (96.0)	9,977 (92.9)	10,146 (100.0)	39.0
Fellows Listed at Site	37,319 (91.7)	8,841 (82.3)	9,950 (98.1)	54.9
Operating Beds in FY2012 (mean (sd))	186.6 (73.1)	167.9 (74.1)	175.2 (58.5)	10.9
Operating Beds in FY2018 (mean (sd))	178.1 (72.2)	159.5 (73.2)	167.8 (58.3)	12.6

Table S5. Crude bleeding events stratified by instrumental variable.

IV Status	ACD Status	Number of Patients	Number of Bleeding Events	Bleeding Event Rate (per 100)
High-ACD use operator	Overall	10,737	380	3.54
	No ACD	672	43	6.40
	ACD used	10,065	337	3.35
Low-ACD use operator	Overall	10,146	363	3.58
	No ACD	7,709	293	3.80
	ACD used	2,437	70	2.87

Figure S1. Histogram of unmatched (A) and matched (B) propensity scores.

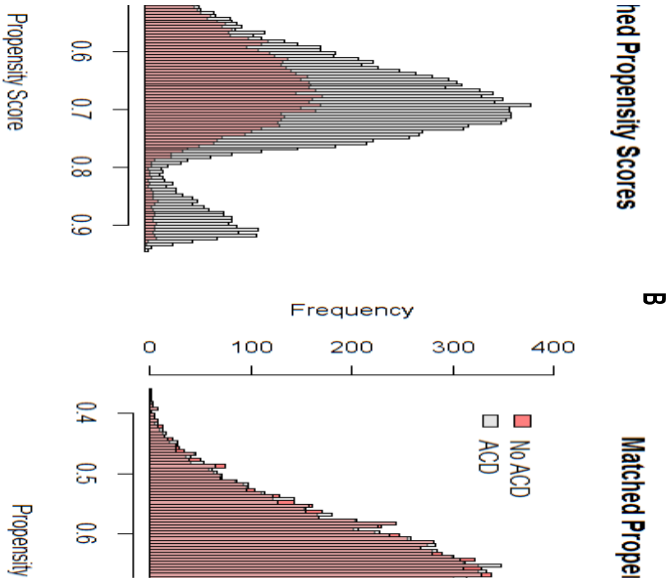


Figure S2. Histogram of proportion of providers previous twenty cases that utilized a closure device.

