Directional Versus Orbital Atherectomy of Femoropopliteal Artery Lesions:
Angiographic and Intravascular Ultrasound Outcomes (The DIRECT Trial)

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Disclosure

Speaker name: Anvar Babaev, MD

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I have the following potential conflicts of interest to report:

[x] Consulting – Medtronic, Shockwave

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Background

- The widespread adoption of atherectomy tools speaks to the difficulty and inherent risk of approaching complex, heavily calcified lesions with PTA and stenting alone[1]
- Existing studies are usually single arm studies or compare atherectomy to PTA alone[2,3]
- Despite numerous atherectomy devices having FDA clearance, there is little comparative data to suggest superiority or even equivalence of any one device over another
- This paucity of adequate comparative evidence is reflected in current guidelines with atherectomy scoring a "low" in terms of level of evidence[4,5]
- The aim of this study was to compare the ability of two commonly used atherectomy modalities to modify plaque and augment luminal gain as evaluated by angiography and intravascular ultrasound (IVUS) in patients with symptomatic femoro-popliteal peripheral arterial disease (PAD)

1. Rocha-Singh KJ, et al. Catheter Cardiovasc Interv 2021 Jun 3. doi: 10.1002/ccd.29777
2. Dattilo R et al. J Invasive Cardiol. 2014;26(8):355-60.
3. McKinsey J et al. JACC Cardiovasc Interv. 2014;7(8):923-33.
4. Feldman D et al. Catheter Cardiovasc Interv. 2018:1-17
5. Conte M et a. J Vasc Surg. 2019; doi.org/10.1016/j.jvs.2019.02.016

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Study Design

Study Design:

- Prospective, open-label, single center, 1:1 randomized
- Investigator blinded to the randomization scheme

Study Population:

- 60 patients, (30 in each study arm)
- Symptomatic PAD, (Rutherford 1-4)
- Lesion located in the femoro-popliteal segment
- Refractory to medical therapy
- Angiographic stenosis ≥70%

Follow up:

- Planned follow-up period of 3 years following the index procedure

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Devices Used

Medtronic HawkOne™ directional atherectomy system (“DA”)

- 360° cutting
- Minimum 6 passes

CSI Diamondback 360™* peripheral orbital atherectomy system (“OA”)

- 2.0mm solid crown used
- Minimum 2 passes on each speed (60 rpm, 90 rpm, 120 rpm)

Medtronic IN.PACT™ Admiral™ drug-coated balloon (DCB)

- **DCB is adjunctive to atherectomy treatment**

Boston Scientific Opticross™* 18 intravascular ultrasound catheter

- Pre-treatment, post-atherectomy, and post-DCB images recorded and anonymized
- Analyzed by independent core laboratory (Cardiovascular Research Foundation)

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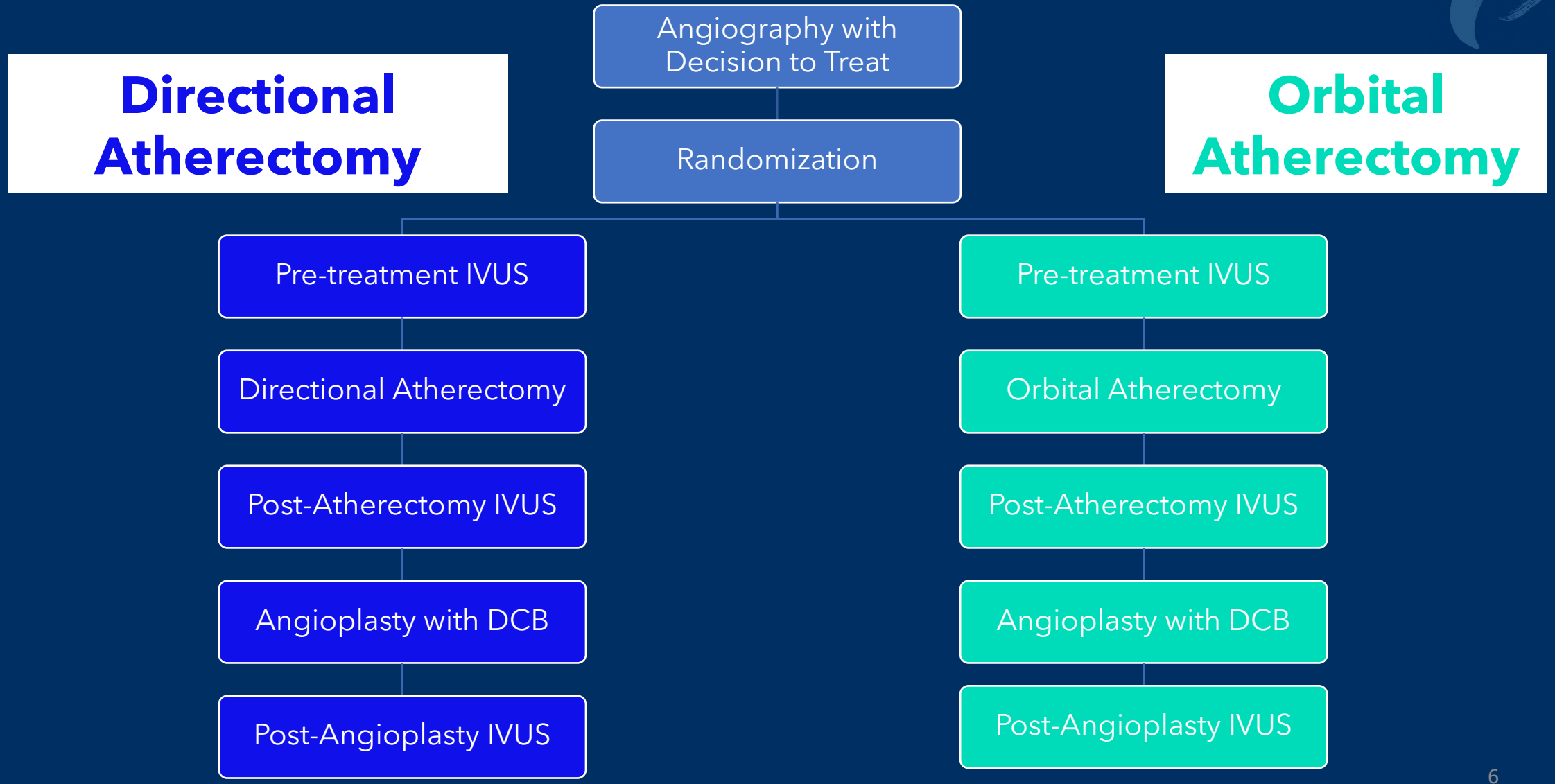
Index Procedure



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Trial Endpoints

Primary Endpoints

- Change in plaque volume via IVUS
- Change in luminal volume via IVUS
- Change in angiographic stenosis

Secondary Endpoints

- Device success rate
  - Reduction in angiographic stenosis to 30% or less
- Rate of bailout stenting
  - Criteria for stenting: flow-limiting dissection, significant residual stenosis or both

3-year follow-up data to be collected

Rutherford Class

ABI

Duplex ultrasonography

Target lesion revascularization rates

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Major Inclusion Criteria

- ≥ 18 years-old
- Symptomatic PAD
- SFA or popliteal disease
- Angiographic Stenosis ≥70%
- Total lesion length ≥ 80 mm and ≤ 250 mm
- Reference vessel ≥ 3.0 mm and ≤6.5 mm

- Patent infrapopliteal artery, (i.e., single vessel runoff or better)
- Atherectomy use with either OA or DA would be beneficial (as per operator discretion)

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Major Exclusion Criteria

- Previously stented target lesion
- Prior surgery of the target vessel
- Presence of aneurysm
- Target vessel with moderate or severe angulation (e.g. > 30°) or tortuosity
- Pre-planned interventional treatment other than OA or DA
- Thrombocytopenia, thrombocythemia, bleeding diathesis, or coagulation disorder
- Current dialysis
- Use of immunosuppressant therapy
- Intolerance to dual antiplatelet therapy

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Key Demographics and Clinical Characteristics

	DA (n = 30)	OA (n = 30)	p value
Age, years	70 (67, 73)	72 (65,77)	0.56
Female	10 (33)	14 (47)	0.43
Hypertension	29 (97)	30 (100)	1.00
Diabetes mellitus	14 (47)	17 (57)	0.61
eGFR < 60 mL/min/1.73 m^2	8 (27)	12 (40)	0.41
Coronary artery disease	22 (73)	25 (83)	0.53
Rutherford Class	3 ± 0	3 ± 0	1.00
Ankle-brachial index at rest	0.79 (0.75, 0.88)	0.86 (0.71, 0.91)	0.57

Baseline patient characteristics were similar between groups

Values are median (interquartile range), mean ± SD, or n (%)

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Baseline Lesion Characteristics

	DA (n = 30)	OA (n = 30)	p value
Lesion Length, mm	151.0 ± 51.5	142.0 ± 54.3	0.34
Pre-Treatment Stenosis by Angiography, %	90.7 ± 11.5	87 ± 12.8	0.48
CTO, (%)	13 (43)	13 (43)	1.00
Calcification Severity, If Present	(n = 20)	(n = 19)	0.29
Mild, (%)	4 (20)	1 (5)	
Moderate, (%)	3 (15)	6 (32)	
Severe, (%)	13 (65)	12 (63)	
Vessel Reference Diameter (mm)	5.5 ± 1.1	5.7 ± 0.6	0.46

There was no difference in baseline lesion characteristics between the groups

Values are median (interquartile range), mean ± SD, or n (%)

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Procedural Characteristics

	DA (n = 30)	OA (n = 30)	p value
Device success*	11 (38)	0 (0)	0.0003
Post-Atherectomy Stenosis by Angiography, %	39.5 ± 14.2	69.8 ± 12.1	< 0.001
Post-DCB Stenosis by Angiography, %	16.7 ± 12.7	33.7 ± 16.1	< 0.001

*Device success was defined as a reduction of the treated stenosis to 30% or less on angiography

Device success was not achieved in any subject treated with Orbital Atherectomy
Reduction in stenosis was significantly greater in the Directional Atherectomy group

Values are median (interquartile range), mean ± SD, or n (%)

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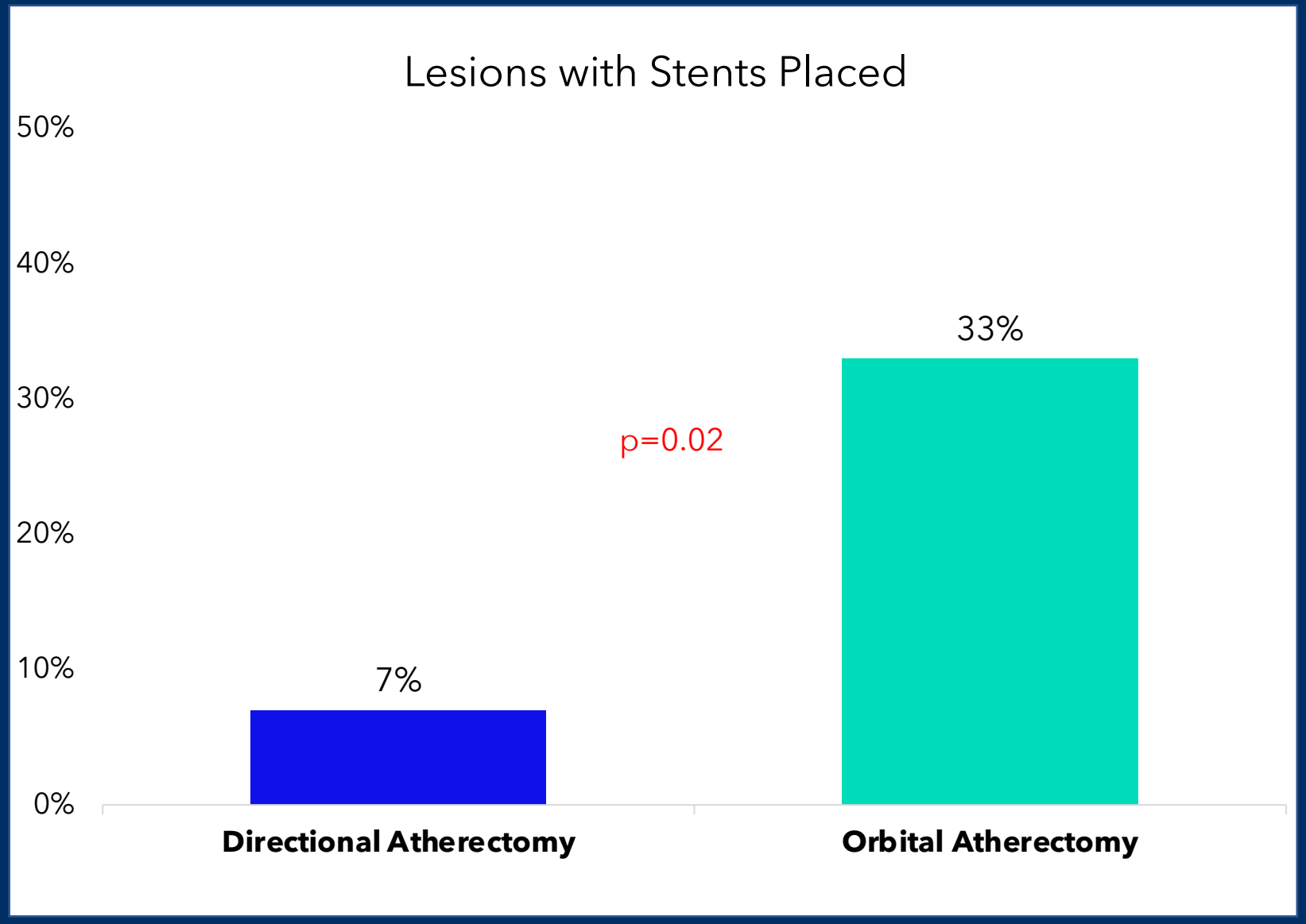
Provisional Stent Rate



There were significantly more stents placed in the Orbital Atherectomy group post DCB

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Safety Events and Complications

	DA (n = 30)	OA (n = 30)	p value
Perforations	1 (3)	0 (0)	1.00
Distal embolic protection device used	29 (97)	28 (93)	1.00
Distal embolization post-atherectomy	0 (0)	1 (3)	1.00
Distal embolization post-DCB	0 (0)	0 (0)	1.00

Overall, both devices were found to be very safe with minimal complications

Values n (%)

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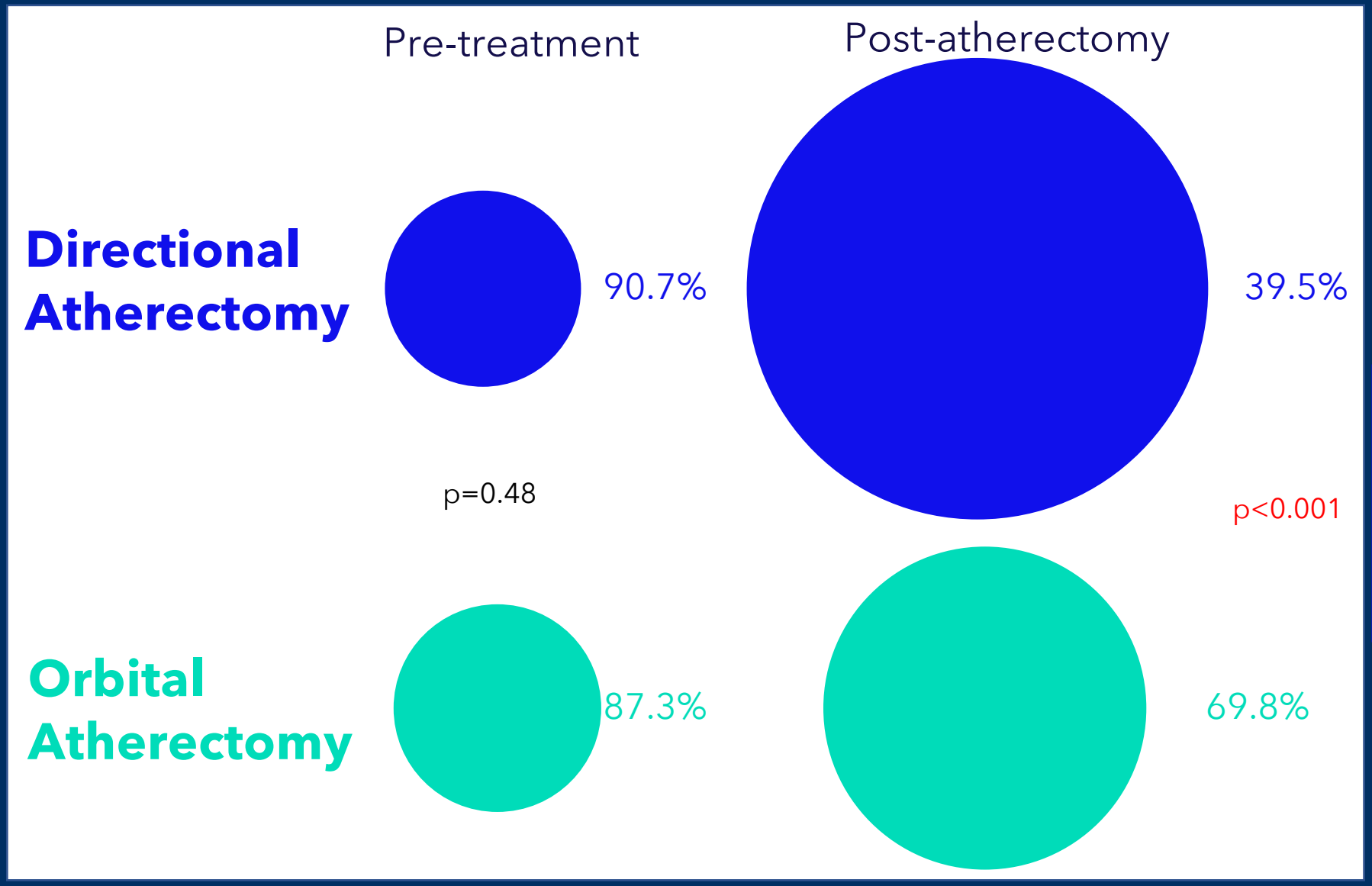
Percent Stenosis by Angiography



There was a greater reduction in stenosis following Directional Atherectomy compared to Orbital Atherectomy

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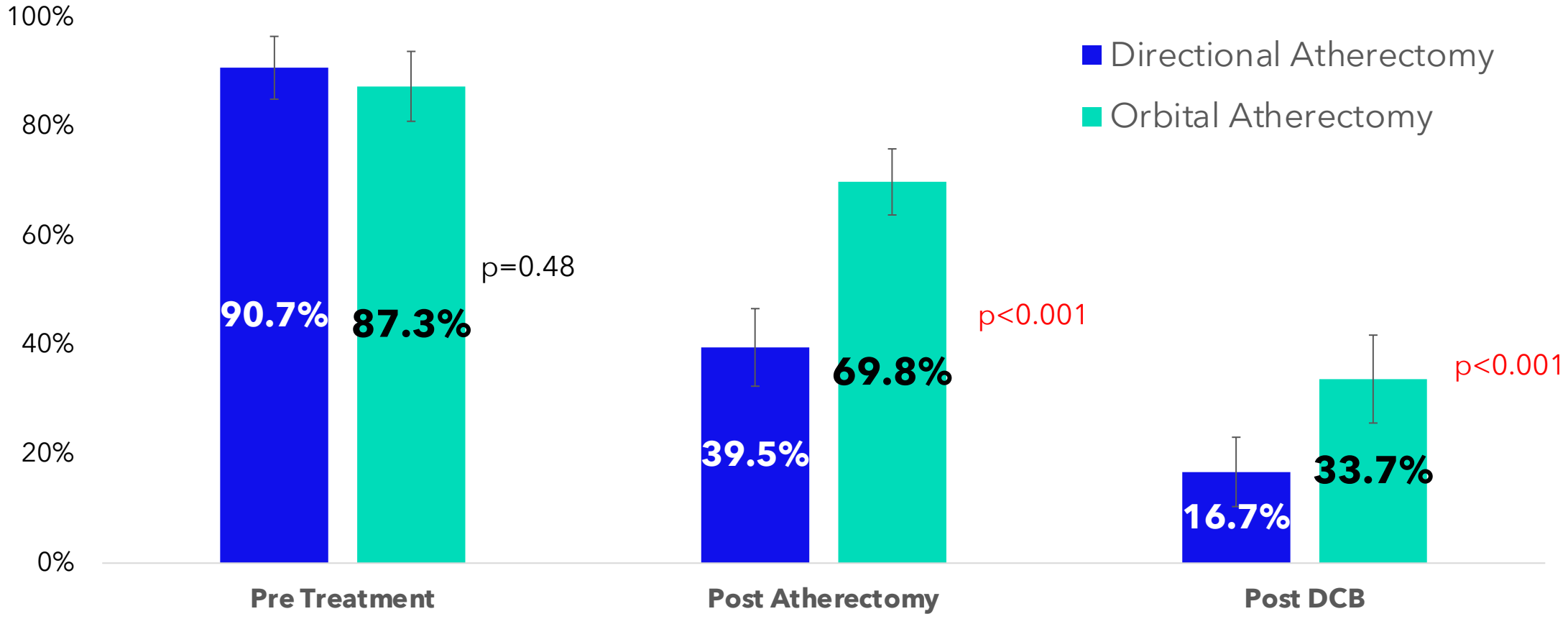
Percent Stenosis by Angiography



There was a greater reduction in stenosis following Directional Atherectomy compared to Orbital Atherectomy. This difference persisted after DCB.

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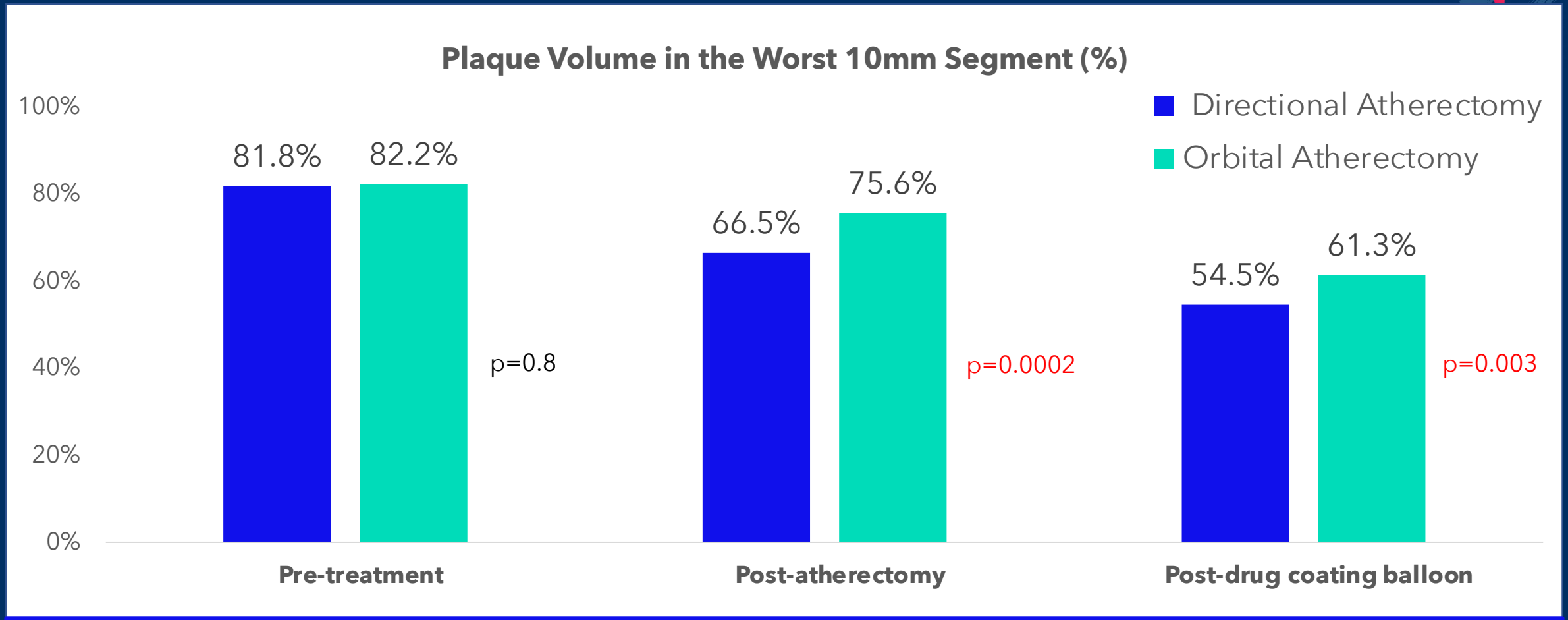
Plaque Volume – Volumetric Analysis by IVUS*



Greater plaque volume reduction was achieved in the Directional Atherectomy group. This difference in plaque volume reduction persisted following DCB

*Percent plaque volume was defined as total plaque volume / vessel volume ×100

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Volumetric Analysis by IVUS

Plaque volume at the worst 10mm segment, %	DA (n = 29)	OA (n = 30)	p value
Pre-treatment	81.8 (73.3, 89.3)	82.2 (71.5, 91.6)	0.80
Post-atherectomy	66.5 (61.8, 73.2)	75.6 (69.9, 81.8)	0.0002
Post-drug coating balloon	54.5 (46.9, 61.2)	61.3 (56.2, 66.4)	0.003
Plaque volume in the entire lesion segment, %			
Pre-treatment	68.3 (63.0, 76.7)	69.0 (58.1, 78.5)	0.43
Post-atherectomy	61.4 (55.4, 67.0)	67.0 (60.0, 71.5)	0.06
Post-drug coating balloon	53.2 (47.4, 58.4)	56.7 (54.7, 59.9)	0.01
Change from pre- to post- atherectomy	-5.9 (-15.9, -1.3)	-1.1 (-5.4, 0.9)	0.003

Directional Atherectomy reduced plaque volume significantly more in the entire lesion and in the worst 10mm segment of the lesion compared to Orbital Atherectomy

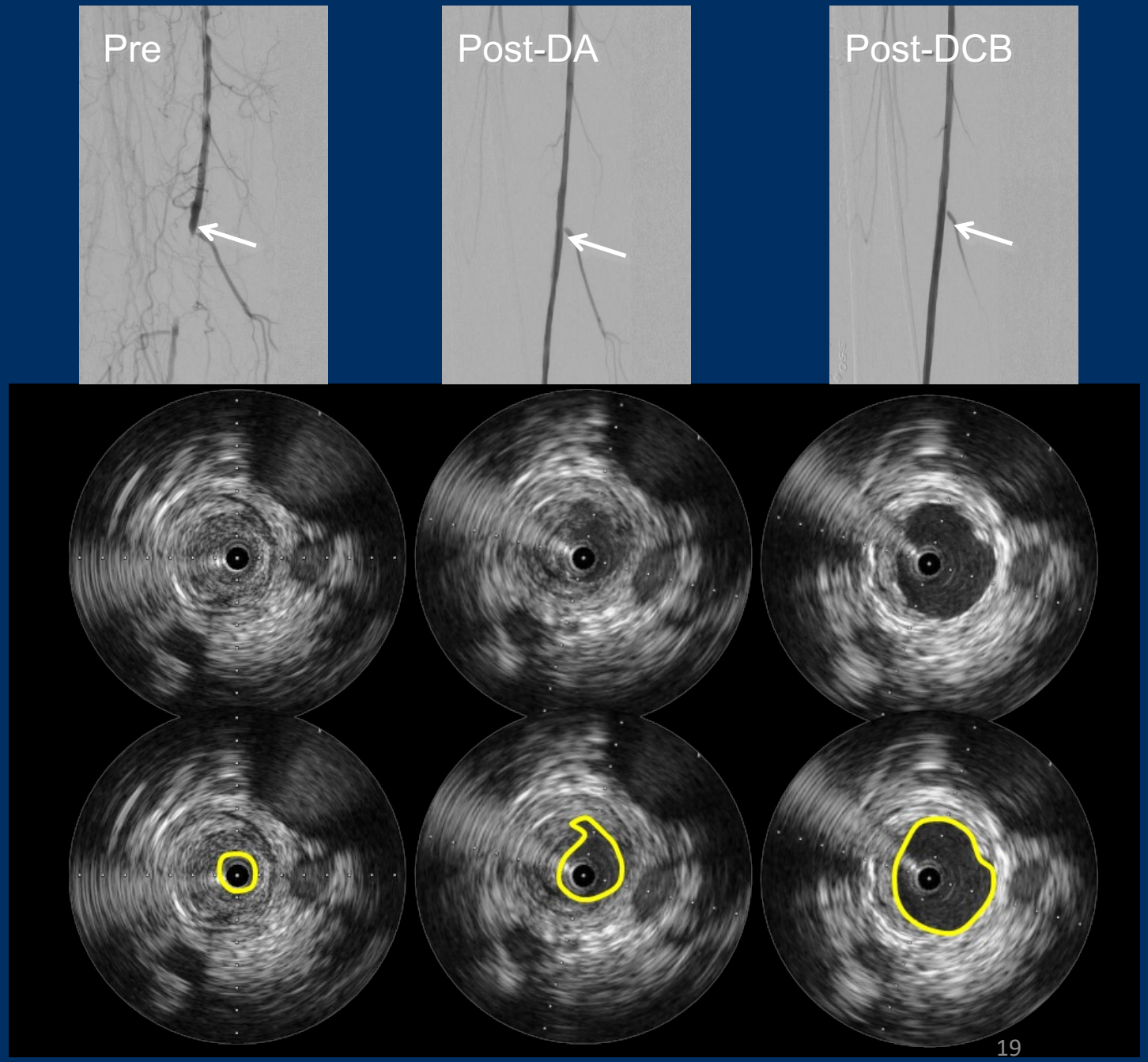
This improved reduction in plaque volume persisted after DCB

Values are median (interquartile range), mean ± SD, or n (%)

Representative Directional Atherectomy Sample

IVUS Data
Stenosis
Pre-DA 69.2%
Post-DA 54.1%
Post-DCB 5.6%

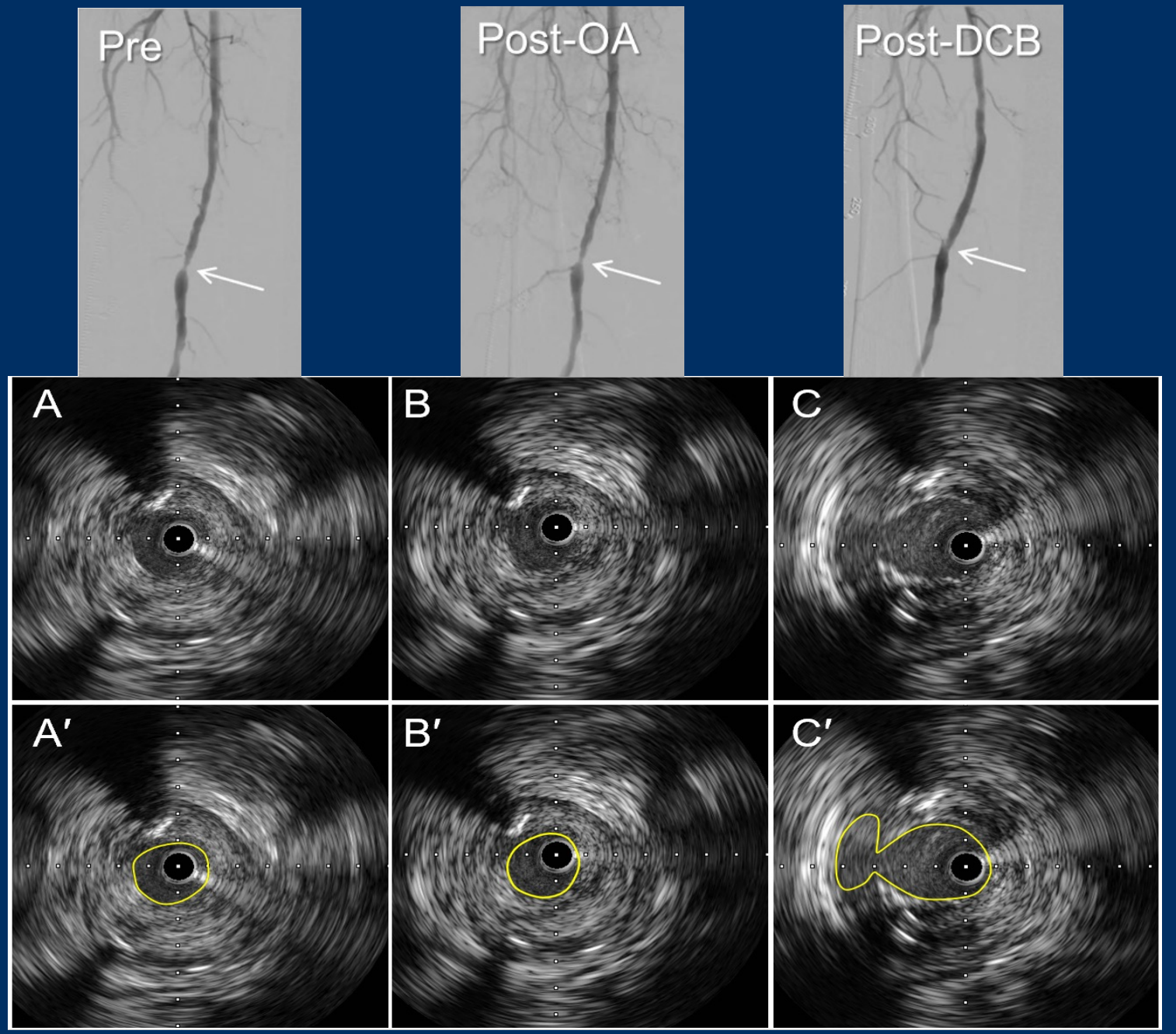
Mechanism of Lumen Enlargement:
Plaque reduction and vessel stretch



Representative Orbital Atherectomy Sample

IVUS Data
Stenosis
Pre-OA 84.0%
Post-OA 74.8%
Post-DCB 59.8%

Mechanism of Lumen Enlargement:
Medial dissection and vessel stretch



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Summary

- This study is the first to evaluate the impact of Orbital vs Directional Atherectomy on atherosclerotic plaque in patients with PAD conducted in prospective, head-to-head, randomized fashion

- Lesions treated with Directional Atherectomy demonstrated a greater plaque volume reduction and luminal gain than those treated with Orbital Atherectomy

- There were significantly fewer stents placed in the Directional Atherectomy followed by DCB group than Orbital Atherectomy followed by DCB group (7% vs 33% p=0.02)

- Patients will be followed for 3 years to determine whether the observed larger “debulking” effect of Directional compared to Orbital Atherectomy leads to better clinical outcomes