ORIGINAL ARTICLE

# In-hospital outcomes of rotational versus orbital atherectomy during percutaneous coronary intervention: a meta-analysis

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**KEY WORDS**
atherectomy, calcified stenosis, rotablation

**EDITORIAL**
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**ABSTRACT**

**BACKGROUND** Data comparing rotational atherectomy (RA) with orbital atherectomy (OA) for calcified lesions is inconclusive and based on single observational studies in populations with limited numbers of patients.

**AIMS** The aim of the study was to perform a meta-analysis of observational studies comparing RA with OA for calcified lesions prior to percutaneous coronary intervention.

**METHODS** Electronic databases were searched for studies comparing short-term outcomes of RA with OA prior to percutaneous coronary intervention. Risk ratios (RRs) or mean differences (MD) and 95% confidence intervals (CIs) were calculated using a random-effects model.

**RESULTS** Meta-analysis included 6 retrospective studies with 1590 patients treated with RA and 721 with OA. The latter was associated with shorter fluoroscopy time (MD, –3.40 min; 95% CI, –4.76 to –2.04; $P<0.001$, $I^2 = 0\%$), but contrast use was similar (MD, –2.78 ml; 95% CI, –16.04 to 10.47; $P = 0.68$; $I^2 = 67\%$). Although coronary dissection occurred 4-fold more frequently with OA (RR, 3.87; 95% CI, 1.37–10.93; $P = 0.01$; $I^2 = 0\%$), perforations (RR, 2.73; 95% CI, 0.46–16.30, $P = 0.27$; $I^2 = 41$), tamponade (RR, 1.78; 95% CI, 0.37–8.58; $P = 0.47$; $I^2 = 0\%$), and slow or no-reflow phenomenon (RR, 0.81; 95% CI, 0.35–1.84; $P = 0.61$; $I^2 = 0\%$) occurred with similar frequency. The risk of 30-day or in-hospital myocardial infarction was lower in OA as compared with RA (RR, 0.67; 95% CI, 0.47–0.94; $P = 0.02$; $I^2 = 0\%$), yet the risk of in-hospital mortality (RR, 0.73; 95% CI, 0.11–4.64; $P = 0.74$; $I^2 = 43\%$) and length of stay (MD, –0.27 days; 95% CI, –0.76 to –0.23; $P = 0.29$; $I^2 = 0\%$) did not differ.

**CONCLUSIONS** Orbital atherectomy was associated with a lower risk of early myocardial infarction. However, a higher rate of coronary dissections produced by OA did not translate into increased risk of perforations, slow or no-reflow phenomenon, or in-hospital mortality.

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**Received:** June 13, 2019.
**Revision accepted:** August 2, 2019.
**Published online:** August 2, 2019.
Kardiol Pol. 2019; 77 (9): 846-852
doi:10.33963/KP.14919


**INTRODUCTION** Significant coronary artery calcifications are present in as many as 35% of all patients undergoing percutaneous coronary intervention (PCI).[1] It can significantly hamper the treatment of coronary artery disease with PCI and has been associated with reduced stent deliverability, higher rates of periprocedural complications, stent malapposition or underexpansion, and unfavorable long-term outcomes when compared with noncomplex lesions.[2,3] Treatment of coronary artery calcification prior to stent implantation using either rotational atherectomy

**WHAT'S NEW?**

The first meta-analysis to summarize comparative data from studies on rotational versus orbital atherectomy in calcified coronary lesions prior to percutaneous coronary intervention showed that orbital atherectomy had lower risk of early myocardial infarction as compared with rotational atherectomy. The rate of slow or no-reflow phenomenon was similar despite technical differences between methods. The 4-fold higher pooled rate of coronary dissections produced by orbital atherectomy did not translate into increased risk of serious complications like perforations, tamponade, or in-hospital mortality, which was low for both methods. The meta-analysis is the largest comparison of these methods and may guide future randomized controlled trials.

(RA) or more recently orbital atherectomy (OA) has been advocated as a way to improve stent implantation and patient outcomes.[4] However, the understanding of how the differences in RA and OA devices affect outcomes is based on limited evidence from small cohorts of patients. Since the 2 techniques have never been compared directly in a randomized controlled trial, the purpose of the present meta-analysis was to compare their short-term results using data from contemporary observational studies.

## METHODS

**Data sources and search strategy** This systematic review and meta-analysis was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement.[5] Relevant studies published until May 1, 2019 were searched through electronic databases including MEDLINE and Scopus. The search terms were: ("rotational" OR "rotablation") AND "orbital" AND ("atherectomy" OR "atheroablation"). No language restrictions were imposed. References of original articles were reviewed manually and cross-checked for other relevant reports. We excluded studies that reported duplicate outcomes.

Two investigators independently screened all studies; a study was selected only if it satisfied the following inclusion criteria: a) it compared RA and OA for calcified native coronary artery lesions prior to stenting and b) it reported at least one of the following: 30-day or in-hospital mortality, 30-day or in-hospital myocardial infarction, length of stay, postprocedural complications (coronary dissection, perforation, tamponade, slow or no-reflow phenomenon), procedural data (procedural time, fluoroscopy time, and/or contrast use). Reviews, conference abstracts, or letters to the editor were excluded. Disparities and disagreements were resolved by consensus of authors.

**Quality assessment** As recommended by the Cochrane Non-Randomized Studies Methods Working Group, the Newcastle-Ottawa Scale[6] was used to assess the quality of the studies. The scale grades each study based on 3 criteria: study group selection (maximum of 4 stars), comparability of the groups (maximum of 2 stars), and outcome assessment (maximum of 3 stars). Two independent reviewers performed the Newcastle-Ottawa Scale grading. Discrepancies were resolved by consensus.

**Statistical analysis** Mean differences (MDs) or risk ratios (RRs) were estimated with 95% confidence intervals (CI) for continuous and categorical variables, respectively, using the DerSimonian-Laird random-effects method.[7] The statistical inconsistency test, $I^2 = [(Q\text{-}df)/Q] \times 100\%$, where Q is the $\chi^2$ statistic and df is a degree of freedom, was used to assess heterogeneity.[8] An $I^2$ value of less than 40% indicated no obvious heterogeneity; values between 40% and 70% were suggestive of moderate heterogeneity; and $I^2$ greater than 70% was considered high heterogeneity. Publication bias was assessed by visual inspection of the funnel plot. Statistical analyses were performed using the Review Manager, v. 5.3 (The Cochrane Collaboration, London, United Kingdom).

## RESULTS

Six observational studies[9-14] comparing OA with RA were included in the analysis reporting outcomes of 1590 patients treated with RA and 721 with OA. The PRISMA flow chart describing the study selection process and PRISMA checklist are available in Supplementary material, *Figure S1* and *Table S1*, respectively. One of the studies (Meraj et al)[12] included a propensity score analysis which was used to account for group differences.

Baseline demographic and clinical characteristics of the patients are presented in TABLE 1, and baseline lesion and procedural characteristics are presented in TABLE 2. Most of the patients were men at a mean (SD) age of 71.2 (10.6) years. All patients had calcified lesions with the majority identified as severe (81.6%). Clinically, 51.2% of patients presented with stable angina; only the study by Meraj et al[12] included a high percentage of patients with unstable angina (59.5%). Outcome definitions are outlined in Supplementary material, *Table S2*. All studies were of sufficient quality to be included in the analysis (TABLE 3). Funnel plots. demonstrating a reasonable degree of symmetry, are presented in Supplementary material, *Figures S2–S9*.

Orbital atherectomy was associated with shorter fluoroscopy time (MD, –3.40 min; 95% CI, –4.76 to –2.04; $P$ <0.001; $I^2$ = 0), but contrast use was similar (MD, –2.78 ml; 95% CI, –16.04 to 10.47; $P$ = 0.68; $I^2$ = 67%) (FIGURE 1). Although coronary dissection occurred more frequently with OA as compared with RA (RR, 3.87; 95% CI, 1.37–10.93; $P$ = 0.01; $I^2$ = 0%), perforations (RR, 2.73; 95% CI, 0.46–16.30; $P$ = 0.27;

**TABLE 1** Baseline patient characteristics and post-atherectomy management

| Study | No. of patients | | Age, y, mean (SD) | | Male, n (%) | | Stable angina, n (%) | | Diabetes, n (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | OA | RA | OA | RA | OA | RA | OA | RA | OA | RA |
| Chambers et al,[9] 2018 | 78 | 99 | 70 (9) | 72 (9) | 59 (76) | 61 (63) | NR | NR | 34 (44) | 41 (41) |
| Koifman et al,[10] 2018 | 67 | 117 | 73 (11) | 74 (10) | 48 (72) | 77 (66) | NR | NR | 30 (45) | 66 (56) |
| Lee et al,[11] 2017 | 50 | 67 | 62 (11) | 61 (12) | 34 (68) | 46 (69) | 34 (68) | 45 (67) | 18 (36) | 26 (39) |
| Meraj et al,[12] 2018 | 273 | 273 | 73 (11) | 73 (10) | 173 (63) | 171 (63) | 66 (24) | 51 (19) | 145 (53) | 145 (53) |
| Okamoto et al,[13] 2018[a] | 184 | 965 | 71 (11) | 71 (10) | 137 (75) | 689 (71) | 105 (57) | 559 (58) | 72 (39) | 472 (49) |
| Sareen et al,[14] 2017[a] | 157 | 841 | 71 (11) | 71 (10) | 115 (73) | 614 (72) | 90 (57) | 486 (58) | 60 (38) | 414 (49) |

**a** Sareen et al[14] included data on a subpopulation of patients from Okamoto et al[13] but reported data regarding 30-day / in-hospital mortality and 30-day / in-hospital myocardial infarction, which was analyzed.

Abbreviations: NR, not reported, OA, orbital atherectomy; RA, rotational atherectomy

**TABLE 2** Baseline lesion and procedural characteristics

| Study | LAD as a target lesion, n (%) | | Severe calcification, n (%) | | ACC / AHA lesion type C, n (%) | | OA max device speed 120 000 rpm, n (%) | RA maximal burr size, mm, mean (SD) | DES implantation, n (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | OA | RA | OA | RA | OA | RA | OA | RA | OA | RA |
| Chambers et al,[9] 2018 | 33 (42) | 30 (30) | 78 (100) | 99 (100) | NR | NR | NR | NR | NR | NR |
| Koifman et al,[10] 2018 | 26 (39) | 39 (27) | 49 (80) | 85 (71) | 38 (57) | 62 (43) | NR | 1.5 (0.2) | 64 (96) | 62 (92) |
| Lee et al,[11] 2017 | NR | NR | 50 (100) | 67 (100) | NR | NR | 36 (72) | 1.5 (0.1) | 46 (92) | 61 (91) |
| Meraj et al,[12] 2018 | NR | NR | NR | NR | 231 (85) | 219 (80) | NR | NR | NR | NR |
| Okamoto et al,[13] 2018[a] | 131 (71) | 547 (57) | 134 (73) | 785 (81) | NR | NR | 45 (24) | NR | NR | NR |
| Sareen et al,[14] 2017[a] | 113 (72) | 492 (59) | 114 (73) | 679 (81) | 145 (92)[b] | 770 (92)[b] | NR | NR | 153 (98) | 821 (98) |

**a** Sareen et al[14] included data on a subpopulation of patients from Okamoto et al[13] but reported data regarding 30-day / in-hospital mortality and 30-day / in-hospital myocardial infarction, which was analyzed.

**b** Data regarding the type B2 / C lesion according to ACC/AHA

Abbreviations: ACC / AHA, American College of Cardiology / American Heart Association; DES, drug-eluting stent; LAD, left anterior descending artery; others, see TABLE 1

**TABLE 3** Newcastle–Ottawa Scale Quality Assessment

| Study | Selection | Comparability | Outcome |
|---|---|---|---|
| Chambers et al,[9] 2018 | *** | * | *** |
| Koifman et al,[10] 2018 | *** | * | *** |
| Lee et al,[11] 2017 | *** | * | *** |
| Meraj et al,[12] 2018 | ** | ** | *** |
| Okamoto et al,[13] 2018 | *** | * | *** |
| Sareen et al,[14] 2017[a] | *** | * | *** |

* One point allocated in the quality assessment score in the respective criterium

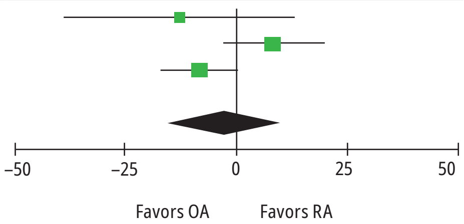
**a** Overlapping population with Okamoto 2018 et al[13]: 30-day/in-hospital mortality and 30-day/in-hospital myocardial infarction data were used.

**Contrast use, ml**

| Study or subgroup | OA Mean | OA SD | OA Total | RA Mean | RA SD | RA Total | Weight | Mean difference IV, random, 95% CI |
|---|---|---|---|---|---|---|---|---|
| Chambers et al, 2018 | 225 | 82.5 | 78 | 237.9 | 94.1 | 99 | 17.4% | –12.90 [–38.95, 13.15] |
| Meraj et al, 2018 | 158.2 | 66.4 | 273 | 150 | 66.5 | 273 | 38.8% | –8.20 [–2.95, 19.35] |
| Okamoto et al, 2018 | 147.9 | 53.4 | 184 | 156.4 | 59.2 | 965 | 43.7% | –8.50 [–17.07, 0.07] |
| **Total (95% CI)** | | | **535** | | | **1337** | **100%** | **–2.78 [–16.04, 10.47]** |

Heterogeneity: $\tau^2 = 85.44$; $\chi^2 = 6.01$, $df = 2$ ($P = 0.05$); $I^2 = 67\%$
Test for overall effect: $Z = 0.41$ ($P = 0.68$)

Mean difference IV, random, 95% CI

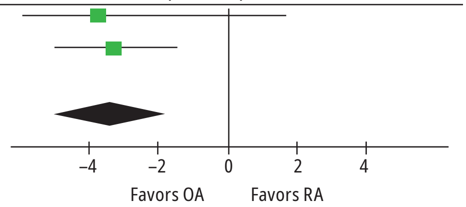



**Fluoroscopy time, min**

| Study or subgroup | OA Mean | OA SD | OA Total | RA Mean | RA SD | RA Total | Weight | Mean difference IV, random, 95% CI |
|---|---|---|---|---|---|---|---|---|
| Meraj et al, 2018 | 21.9 | 12.3 | 273 | 25.6 | 13.3 | 273 | 40.2% | –3.70 [–5.85, –1.55] |
| Okamoto et al, 2018 | 25.5 | 10.6 | 184 | 28.7 | 13.8 | 965 | 59.8% | –3.20 [–4.96, –1.44] |
| **Total (95% CI)** | | | **457** | | | **1238** | **100%** | **–3.40 [–4.76, –2.04]** |

Heterogeneity: $\tau^2 = 0.00$; $\chi^2 = 0.12$, $df = 1$ ($P = 0.72$); $I^2 = 0\%$
Test for overall effect: $Z = 4.89$ ($P < 0.00001$)

Mean difference IV, random, 95% CI

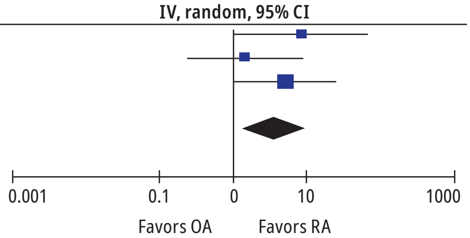



**Dissection**

| Study or subgroup | OA Events | OA Total | RA Events | RA Total | Weight | Risk ratio M-H, random, 95% CI |
|---|---|---|---|---|---|---|
| Koifman et al, 2018 | 5 | 67 | 1 | 117 | 23.8% | 8.73 [1.04, 73.17] |
| Meraj et al, 2018 | 3 | 273 | 2 | 273 | 33.9% | 1.50 [0.25, 8.91] |
| Okamoto et al, 2018 | 3 | 184 | 3 | 965 | 42.4% | 5.24 [1.07, 25.78] |
| **Total (95% CI)** | | **524** | | **1355** | **100%** | **3.87 [1.37, 10.93]** |
| Total events | 11 | | 6 | | | |

Heterogeneity: $\tau^2 = 0.00$; $\chi^2 = 1.79$, $df = 2$ ($P = 0.41$); $I^2 = 0\%$
Test for overall effect: $Z = 2.56$ ($P = 0.01$)

Risk ratio IV, random, 95% CI

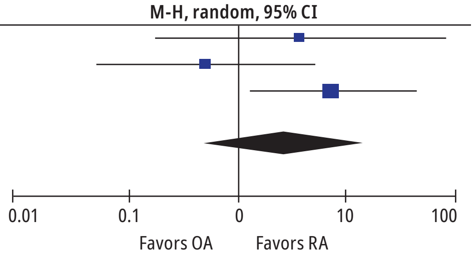



**Perforation**

| Study or subgroup | OA Events | OA Total | RA Events | RA Total | Weight | Risk ratio M-H, random, 95% CI |
|---|---|---|---|---|---|---|
| Lee et al, 2017 | 1 | 50 | 0 | 67 | 22.6% | 4.00 [0.17, 96.18] |
| Meraj et al, 2018 | 1 | 273 | 2 | 273 | 32.8% | 0.50 [0.05, 5.48] |
| Okamoto et al, 2018 | 3 | 184 | 2 | 965 | 44.6% | 7.87 [1.32, 46.75] |
| **Total (95% CI)** | | **507** | | **1305** | **100%** | **2.73 [0.46, 16.30]** |
| Total events | 5 | | 4 | | | |

Heterogeneity: $\tau^2 = 1.04$; $\chi^2 = 3.40$, $df = 2$ ($P = 0.18$); $I^2 = 41\%$
Test for overall effect: $Z = 1.10$ ($P = 0.27$)

Risk ratio M-H, random, 95% CI




**Slow-/no-reflow**

| Study or subgroup | OA Events | OA Total | RA Events | RA Total | Weight | Risk ratio M-H, random, 95% CI |
|---|---|---|---|---|---|---|
| Chambers et al, 2018 | 1 | 45 | 2 | 60 | 12.2% | 0.67 [0.06, 7.13] |
| Lee et al, 2017 | 2 | 50 | 5 | 67 | 26.7% | 0.54 [0.11, 2.65] |
| Okamoto et al, 2018 | 4 | 184 | 21 | 965 | 61.1% | 1.00 [0.35, 2.88] |
| **Total (95% CI)** | | **279** | | **1092** | **100%** | **0.81 [0.35, 1.84]** |
| Total events | 7 | | 28 | | | |

Heterogeneity: $\tau^2 = 0.00$; $\chi^2 = 0.43$, $df = 2$ ($P = 0.81$); $I^2 = 0\%$
Test for overall effect: $Z = 0.51$ ($P = 0.61$)

Risk ratio M-H, random, 95% CI

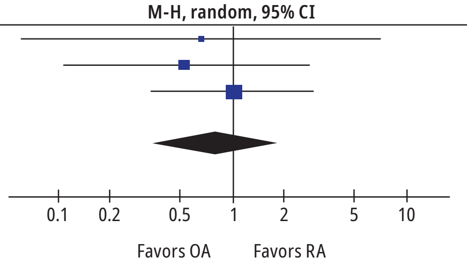



**FIGURE 1** Analysis of procedural data and complications

Abbreviations: CI, confidence interval; IV, inverse-variance weighting; M-H, the Mantel–Haenszel method; others, see TABLE 1

$I^2$ = 41), tamponade (RR, 1.78; 95% CI, 0.37–8.58; $P$ = 0.47; $I^2$ = 0%), and the slow or no-reflow phenomenon (RR, 0.81; 95% CI, 0.35–1.84; $P$ = 0.61; $I^2$ = 0%) occurred with similar frequency (FIGURE 1). The risk of 30-day or in-hospital myocardial infarction was lower in OA as compared with RA (RR, 0.67; 95% CI, 0.47–0.94; $P$ = 0.02; $I^2$ = 0%), but with similar in-hospital mortality (RR, 0.73; 95% CI, 0.11–4.64; $P$ = 0.74; $I^2$ = 43%) and length of stay (MD, −0.27 days; 95% CI, −0.76 to 0.23; $P$ = 0.29; $I^2$ = 0%) (FIGURE 2).

**DISCUSSION** According to current recommendations, the use of atherectomy could be indicated in severely calcified or fibrotic lesions, when crossing and balloon dilatation cannot be performed and adequate stent expansion cannot be assured.[15,16] The current meta-analysis is the first to summarize comparative data of 2 atherectomy methods, RA as compared with OA, which became available only recently (2017–2018), and it represents the largest comparison of these methods. Both RA and OA are based on differential

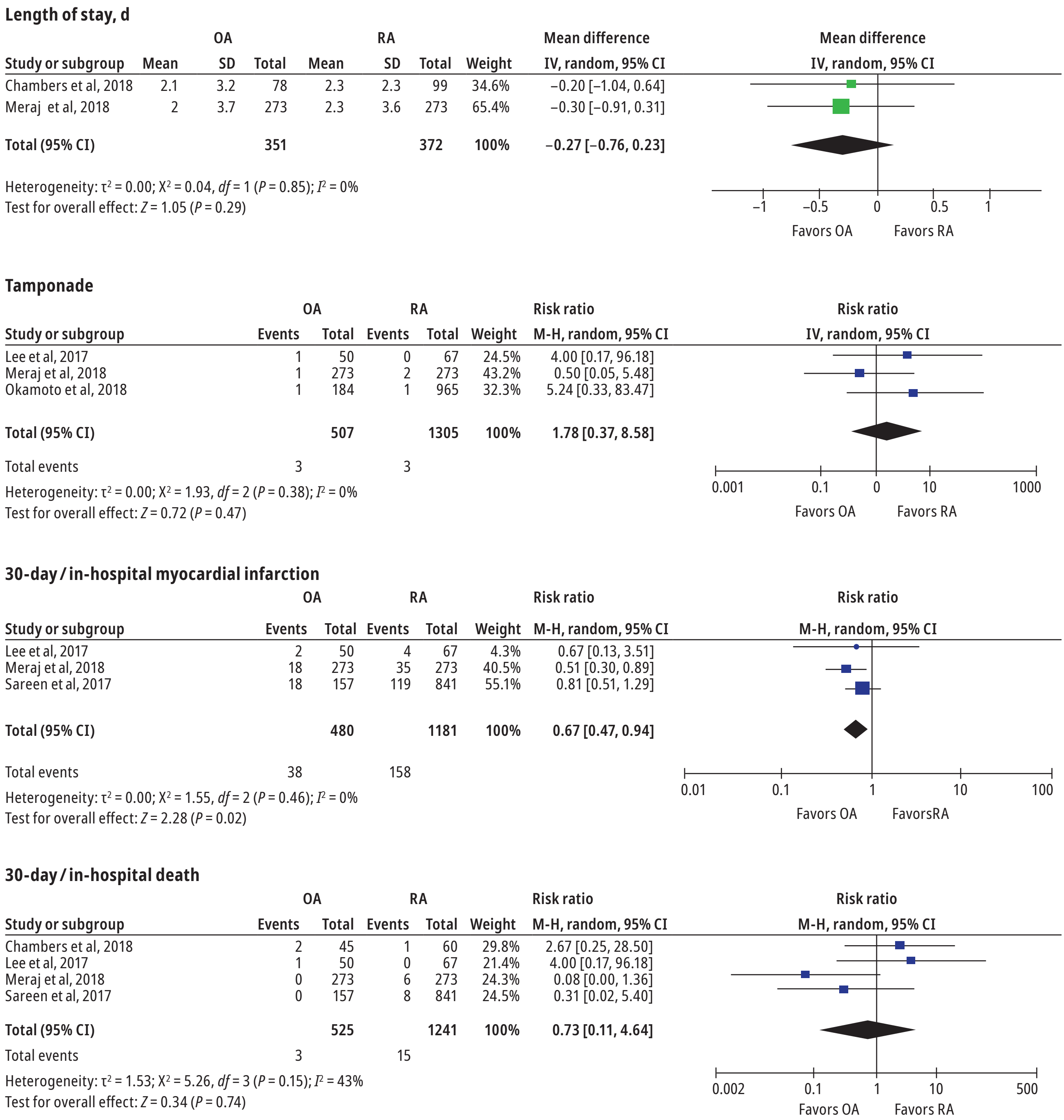



**FIGURE 2** Analysis of the length of stay, number of tamponade and myocardial infarction events, and mortality rates

Abbreviations: see TABLE 1 and FIGURE 1

ablation of calcified tissue, but the devices differ distinctly. Orbital atherectomy involves 1 burr that rotates bidirectionally along the vessel in a centrifugal fashion, and desired sanding size is achieved by modulation of the rotational speed within the range of 80 000 to 120 000 rpm. Each RA burr drills a vessel lumen of a particular diameter only during forward movement.[17]

One of the most important findings of our study is that patients who underwent RA had more early myocardial infarctions. The average size of the particles released with RA was larger (5 µm)[18] than with OA (2 µm),[19] and these are released intermittently. Although distal embolization was described as leading to slow or no-flow phenomenon,[20] we did not find significant differences in terms of rates of the phenomenon in studies directly comparing RA with OA. No significant changes of coronary flow or wedge pressure after the procedure with both devices were described.[21] The elevation of cardiac biomarkers, both creatine kinase MB and troponin, was also comparable in both methods.[10,14] On the other hand, the index of microcirculatory resistance was significantly lower after OA as compared with RA,[21] and the loss of microcirculatory function has been described as an independent predictor of adverse cardiac events.[22,23]

We identified a higher frequency of coronary dissections after OA as compared with RA, which is consistent with studies using optical coherence tomography that reported deeper lesion modification with longer cuts in OA.[24] Deeper lesion ablation and dissections do not necessarily lead to an increased number of serious complications such as perforation or tamponade, which are generally low in both methods. Nevertheless, the increased occurrence of coronary dissections warrants caution and further research. On the other hand, excessive plaque modification with OA may be associated with final stent implantation results. This was demonstrated by Okamoto et al,[13] who used optical coherence tomography and showed lower percentage of stent strut malapposition and a trend toward better stent expansion when using OA. Conversely, this was not supported by Yamamoto et al,[25] who found no significant difference in the final stent expansion. However, patients undergoing OA in this study had larger vessel diameters, and lack of randomization might have been partly responsible for bias in device selection.

Data collected in our study show a homogenous tendency for shorter fluoroscopy time with OA, which potentially is mainly due to bidirectional nature of OA atherectomy. In OA, lesion preparation is performed both when moving the device distally or proximally. Changes in the rotational speed in OA can increase the degree of ablation and the resulting lumen diameter; and the procedure can be completed in less time with fewer passes. Conversely, upsizing an RA burr may require exchanging for a larger guiding catheter when the burr size exceeds 1.75 mm. Similarly, the dedicated RA guidewire is often exchanged for a different guidewire for the next step of the procedure, that is, stent implantation.[17,26] These characteristics, however, did not translate into less contrast medium when using OA as compared with RA.

It has been shown that one-third of the patients who underwent PCI facilitated with atherectomy are assessed as high risk (with higher EuroSCORE II [European System for Cardiac Operative Risk Evaluation II] and SYNTAX [Synergy Between PCI with Taxus and Cardiac Surgery] scores, more prevalent heart failure, and a history of coronary artery bypass grafting), which disqualifies them from coronary artery bypass grafting. Atherectomy is a treatment of last resort for successful revascularization in those patients.[27] Although complication rates may be dependent on the use of some preventive measures proposed by experts including appropriate burr size and rotational speed for RA,[15] here we aimed to show that differences in technology of atherectomy devices (OA vs RA) could have an impact on short-term outcomes, thus being of particular importance in the high-risk patient population. The current evidence showed lower risk of early myocardial infarction with OA at the expense of higher risk of dissection. It has been suggested that the continuous blood flow that occurs during OA due to eccentric attachment of the crown and orbital motion may reduce the negative hemodynamic effects and necessity for mechanical circulatory support for heart failure.[26] As the anatomic complexity of coronary artery disease in high-risk populations increases (signified with increasing SYNTAX score), other device-specific differences may gain importance when selecting RA as compared with OA. The OA burr is characterized by unsatisfactory anchoring in ostial lesions and lacks ablative surface on the tip, although an OA device with a tip cutter was recently approved. An additional floppy guidewire that might be useful in tortuous vessels is offered in RA, and OA may be the device of choice in eccentric and angulated lesions because centrifugal movement allows elastic, noncalcified tissue to flex away from the crown.[14,26]

The main findings of this analysis can be summarized as follows: a) compared with RA, OA was associated with a lower risk of early myocardial infarction; b) compared with RA, OA was associated with a higher frequency of coronary dissections; c) the frequency of other procedural complications – such as slow or no-reflow phenomenon, perforations, and tamponade – was similar.

**Limitations** All studies included in our meta-analysis were retrospective. Caution must be exercised in the interpretation of the results due to a probable inherent confounding and selection bias in selecting RA or OA based on better perceived suitability of certain lesions for a particular device. There were baseline differences between the 2 groups. We only identified a small number of studies with short-term outcomes. The studies were mostly describing single-center experiences.

**Conclusions** Orbital atherectomy in calcified lesions prior to stenting was associated with a lower risk of early myocardial infarction compared with RA. However, a higher rate of coronary dissections produced by orbital atherectomy did not translate into an increased risk of perforations, slow or no-reflow phenomenon, or in-hospital mortality, which was low for both methods. Randomized controlled studies are needed to produce more consistent evidence.

## SUPPLEMENTARY MATERIAL

Supplementary material is available at www.mp.pl/kardiologiapolska.

## ARTICLE INFORMATION

**ACKNOWLEDGMENTS** This study was not supported by any funding or sponsorship.

**CONFLICT OF INTEREST** None declared.



**HOW TO CITE** Zieliński K, Kołtowski Ł, Kalińczuk Ł, et al. In-hospital outcomes of rotational versus orbital atherectomy during percutaneous coronary intervention: a meta-analysis. Kardiol Pol. 2019; 77: 846-852. doi:10.33963/KP.14919

## REFERENCES

**1** Kawaguchi R, Tsurugaya H, Hoshizaki H, et al. Impact of lesion calcification on clinical and angiographic outcome after sirolimus-eluting stent implantation in real-world patients. Cardiovasc Revasc Med. 2008; 9: 2-8.

**2** Lee MS, Yang T, Lasala J, Cox D. Impact of coronary artery calcification in percutaneous coronary intervention with paclitaxel-eluting stents: two-year clinical outcomes of paclitaxel-eluting stents in patients from the ARRIVE program. Catheter Cardiovasc Interv. 2016; 88: 891-897.

**3** von Birgelen C, Mintz GS, Böse D, et al. Impact of moderate lesion calcium on mechanisms of coronary stenting as assessed with three-dimensional intravascular ultrasound in vivo. Am J Cardiol. 2003; 92: 5-10.

**4** Barbato E, Shlofmitz E, Milkas A, et al. State of the art: evolving concepts in the treatment of heavily calcified and undilatable coronary stenoses - from debulking to plaque modification, a 40-year-long journey. EuroIntervention. 2017; 13: 696-705.

**5** Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. BMJ. 2009; 339: b2700.

**6** Wells GA, Shea B, O'Connell D, et al. The Newcastle-Ottawa Scale (NOS) for assessing the quality if nonrandomized studies in meta-analyses. http://www.ohri.ca/programs/clinical_epidemiology/oxford.htm. Accessed October 19, 2009.

**7** DerSimonian R, Laird N. Meta-analysis in clinical trials. Control Clin Trials. 1986; 7: 177-188.

**8** Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. BMJ. 2003; 327: 557-560.

**9** Chambers JW, Warner C, Cortez J, et al. Outcomes after atherectomy treatment of severely calcified coronary bifurcation lesions: a single center experience. Cardiovasc Revasc Med. 2019; 20: 569-572.

**10** Koifman E, Garcia-Garcia HM, Kuku KO, et al. Comparison of the efficacy and safety of orbital and rotational atherectomy in calcified narrowings in patients who underwent percutaneous coronary intervention. Am J Cardiol. 2018; 121: 934-939.

**11** Lee MS, Park KW, Shlofmitz E, Shlofmitz RA. Comparison of rotational atherectomy versus orbital atherectomy for the treatment of heavily calcified coronary plaques. Am J Cardiol. 2017; 119: 1320-1323.

**12** Meraj PM, Shlofmitz E, Kaplan B, at al. Clinical outcomes of atherectomy prior to percutaneous coronary intervention: a comparison of outcomes following rotational versus orbital atherectomy (COAP-PCI study). J Interv Cardiol. 2018; 31: 478-485.

**13** Okamoto N, Ueda H, Bhatheja S, et al. Procedural and one-year outcomes of patients treated with orbital and rotational atherectomy with mechanistic insights from optical coherence tomography. EuroIntervention. 2019; 14: 1760-1767.

**14** Sareen N, Baber U, Aquino M, et al. Mid-term outcomes of consecutive 998 cases of coronary atherectomy in contemporary clinical practice. J Interv Cardiol. 2017; 30: 331-337.

**15** Dobrzycki S, Reczuch K, Legutko J, et al. Rotational atherectomy in everyday clinical practice. Association of Cardiovascular Interventions of the Polish Society of Cardiology (Asocjacja Interwencji Sercowo-Naczyniowych Polskiego Towarzystwa Kardiologicznego – AISN PTK): expert opinion. Kardiol Pol. 2018; 76: 1576-1584.

**16** Barbato E, Carrié D, Dardas P, et al. European expert consensus on rotational atherectomy. EuroIntervention. 2015; 11: 30-36.

**17** Sotomi Y, Shlofmitz RA, Colombo A, et al. Patient selection and procedural considerations for coronary orbital atherectomy system. Interv Cardiol. 2016; 11: 33-38.

**18** Kini A, Marmur JD, Duvvuri S, et al. Rotational atherectomy: improved procedural outcome with evolution of technique and equipment. Single-center results of first 1,000 patients. Catheter Cardiovasc Interv. 1999; 46: 305-311.

**19** Adams GL, Khanna PK, Staniloae CS, et al. Optimal techniques with the Diamondback 360 degrees System achieve effective results for the treatment of peripheral arterial disease. J Cardiovasc Transl Res. 2011; 4: 220-229.

**20** Wong DT, Puri R, Richardson JD, et al. Myocardial 'no-reflow' – diagnosis, pathophysiology and treatment. Int J Cardiol. 2013; 167: 1798-1806.

**21** Galougahi KK, Bhatti N, Shlofmitz R, et al. TCT-236 effects of orbital versus rotational atherectomy facilitated pci on the coronary microcirculation. J Am Coll Cardiol. 2016; 68 (suppl): B96.

**22** Murai T, Yonetsu T, Kanaji Y, et al. Prognostic value of the index of microcirculatory resistance after percutaneous coronary intervention in patients with non-ST-segment elevation acute coronary syndrome. Catheter Cardiovasc Interv. 2018; 92: 1063-1074.

**23** Park SD, Baek YS, Lee MJ, et al. Comprehensive assessment of microcirculation after primary percutaneous intervention in ST-segment elevation myocardial infarction: insight from thermodilution-derived index of microcirculatory resistance and coronary flow reserve. Coron Artery Dis. 2016; 27: 34-39.

**24** Kini AS, Vengrenyuk Y, Pena J, et al. Optical coherence tomography assessment of the mechanistic effects of rotational and orbital atherectomy in severely calcified coronary lesions. Catheter Cardiovasc Interv. 2015; 86: 1024-1032.

**25** Yamamoto MH, Maehara A, Karimi Galougahi K, et al. Mechanisms of Orbital Versus Rotational Atherectomy Plaque Modification in Severely Calcified Lesions Assessed by Optical Coherence Tomography. JACC Cardiovasc Interv. 2017; 10: 2584-2586.

**26** Shlofmitz E, Martinsen BJ, Lee M, et al. Orbital atherectomy for the treatment of severely calcified coronary lesions: evidence, technique, and best practices. Expert Rev Med Devices. 2017; 14: 867-879.

**27** Kübler P, Zimoch W, Kosowski M, et al. The use of rotational atherectomy in high-risk patients: results from a high-volume centre. Kardiol Pol. 2018; 76: 1360-1368.