

Safety and outcomes of upfront large-size rotational atherectomy burrs in left main coronary interventions

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Abstract

Background

Data on the safety and efficacy of PCI with adjunctive rotational atherectomy (RA) in left main (LM) disease are limited. Current guidelines recommend using a small-size RA burr initially with upsizing if required. Whether the upfront use of a large-size RA burr ($\geq 1.75\text{mm}$) is safe is unknown.

Aim

To assess the safety of upfront large rotablation burr in the treatment of LM calcification and the procedural and long term outcome of this approach in comparison to small size burr.

Methods

Retrospective analysis of all patients undergoing PCI with adjunctive RA to LM disease. The study outcomes were all-cause mortality and repeat target lesion revascularization (TLR) at medium-term follow-up in patients treated with large burr size ($\geq 1.75\text{mm}$) compared to small burr size ($< 1.75\text{mm}$).

Results

A total of 243 patients, mean age of 75 ± 9 years, and 80% males were included. Approximately half of the patients were treated with a large-size RA burr ($\geq 1.75\text{mm}$). Most treated lesions were bifurcation lesions involving the 3 branches (86%) with SYNTAX score of 35 ± 11 . Radial access was used in two-thirds of patients, with 7Fr sheath being the most used. There was no difference between the small compared to the large burr group in procedural complications (11% vs 8%, $p = 0.512$), all-cause mortality (34% vs 28%, $p = 0.267$), and repeat TLR up to 4 year after PCI (2.9% vs 2.1%, $p = 0.473$).

Conclusions

Upfront use of a large-size RA burr is feasible and safe for treating calcified LM disease, with no increase in procedural complications, repeat TLR, or medium-term all-cause mortality.

Introduction

Coronary artery calcification is present in up to 25% of treated lesions, with an increased risk of complications during percutaneous coronary intervention (PCI) ^{1,2}, particularly in PCI of calcified left main (LM) that increases the complexity and complications of such interventions ³.

Current guidelines recommend coronary artery bypass grafting (CABG) for heavily calcified LM lesions with a high Syntax score of ≥ 33 , however, in patients with increased surgical risk, PCI can be a reasonable alternative. Rotational atherectomy (RA), first introduced in 1978 remains one of the main calcium modification tools used in the treatment of heavily calcified lesions ⁴. Data on the use of RA for LM bifurcation intervention is scarce ⁵.

Current evidence from predominantly non-LM RA trials suggests that the use of a small burr/vessel ratio of <0.7 is associated with decreased risk of complications^{6,7} This is reflected in the current European and American guidelines, where starting with a small burr size and upsizing if required is recommended to minimize procedural risks ^{8,9}. The safety and efficacy of large versus small burr size in the context of LM RA is not known ^{5,10}.

In this study, we compare the use of a burr ≥ 1.75 mm versus <1.75 mm in the treatment of heavily calcified LM lesions and assess the immediate and medium term outcomes including procedural complications, target lesion revascularisation, and 4 year mortality.

Methods

Study design

A retrospective analysis of prospectively collected data on all LM PCI in a tertiary centre, Freeman Hospital, Newcastle upon Tyne, UK. The study was conducted in accordance with the Declaration of Helsinki and Good Clinical Practice guidelines. Anonymised data were obtained from the institutional electronic database normally utilized for patient care and

therefore the need for informed consent was waived by the institutional Medical Ethical Committee.

All baseline, procedural and outcome data are prospectively collected, validated and entered into the electronic database, which was used to obtain all information for analysis.

Study population

All consecutive patients undergoing PCI to LM with adjunctive RA (the new Rotapro system or the conventional Rotablator, Boston Scientific Corp., Maple Grove, Minn.) between June 2009 and June 2021, were included. Patients who had incomplete documentation of the procedure or outcome data were excluded.

PCI procedure

The PCI procedure was performed in line with approved standards practice in the UK. The vascular access site and LM bifurcation PCI strategy with adjunctive RA were left at the operator's discretion. RA was performed upfront due to heavy calcification of the target lesion or after failed PCI attempts due to non-dilatable lesions. Either Rota-Floppy or Rota Extra Support guide wires were used at the discretion of the operator. The selected burr size was <70% of the vessel diameter.

The burr size and ablation speed were also left to the operator's discretion. Procedures were performed by experienced operators in RA. Temporary pacing wires were not routinely used unless indicated by significant bradycardia not responding to conservative approach by short RA use and allowing time to recovery. Mechanical circulatory support devices were occasionally employed, as appropriate.

Study outcomes

The study outcomes were procedural complications, all-cause mortality, and repeat target lesion revascularization (TLR) up to a median follow-up of 4 years. Technical success was defined as successful revascularization of coronary lesions with achievement of <30%

residual diameter stenosis within the treated segment and restoration or maintenance of Thrombolysis in Myocardial Infarction (TIMI) grade 3 antegrade flow.

Statistical analysis

Paired and unpaired t-tests were used for comparison of normally distributed and Wilcoxon rank sum test was used for non-normally distributed variables. Data are presented as mean (standard deviation) or median and Q1–Q3. Dichotomous variables were compared using χ^2 test or Fisher's exact test, as appropriate. The Kaplan-Meier survival methods with log-rank tests were used. Cox regression analysis was performed on all key risk factors in the baseline and procedural characteristics.

Results

A total of 243 patients who underwent RA to LM bifurcation disease were included. Overall, technical success was achieved in 96% of patients. The mean age was 74.7 ± 9 years and males represented almost 80% of cases. Approximately half of the patients were treated with a burr size $>1.75\text{mm}$ (51.4%), and the majority of lesions were bifurcation lesions involving the three branches (85.6%). Baseline and procedural characteristics are shown in **Tables 1** and **2**, respectively.

The mean Syntax score was 35.3 ± 10.6 , reflecting the complex anatomy of patients undergoing RA. Male patients were more likely to be treated with a larger burr size. Hypercholesterolemia was more prevalent in the large burr size group, while there were fewer patients with previous CABG. (**Table 1**).

The majority of patients were treated via the radial approach (73.7%). A 7 Fr compatible sheath (The Slender 6/7 sheath, Terumo) was the most frequently used in 73.7% of cases. Adjunctive devices such as cutting balloons and intracoronary imaging, were used more with burr size $\geq 1.75\text{mm}$, $p = 0.004$, and $p = 0.017$, respectively. Upsizing RA burr was only used in 9 patients of the small burr size group.

Provisional stenting technique was used more in the small size group, the 2-stent technique was employed much more in the large burr size group, with the Culotte technique used more frequently compared to other techniques. The use of T-stent or T-TAP technique was similar between groups.

LM stent size and post-dilatation balloon were significantly larger in the large burr size group (**Table 2**).

There was no increase in complications rate when large burr $\geq 1.75\text{mm}$ was used upfront. The overall complications rate was not significantly different between the two groups so was repeat revascularization at 4 years (2.9% vs 2.1%, $p = 0.487$). While the in-hospital mortality was significantly higher in the small compared to the large burr group (1.6% vs 0%, $p = 0.038$) (**Table 3**). There was no significant difference in 4-year mortality between the small and the large burr group (34% vs 28%, $p = 0.267$) (**Figure 1**).

Similarly, when we assessed a burr size threshold of $< 2.0\text{mm}$ and $\geq 2.0\text{mm}$ use, there was no significant difference on 4-year mortality ($p = 0.544$) (**Figure 2**).

A cox proportional hazard model showed no effect of large burr size on mortality (HR 0.975, 0.496 to 1.917). The primary factors which influenced mortality according to the Cox-proportional hazard model were the traditional risk factors for mortality in coronary artery disease; female gender, peripheral vascular disease, diabetes mellitus, chronic kidney disease and previous myocardial infarction (**Table 4**).

Discussion

This study shows that the use of large burr size in LM as an initial strategy is safe and effective with a low complication rate which was not different between groups using a threshold of burr size $\geq 1.75\text{mm}$. Furthermore, procedure related complications, repeat revascularization, and mortality were not different between the two groups.

To our knowledge, this is the largest cohort of such approach. The use of larger burr sizes is perceived to be associated with increased risk of complications, hence the current recommendation by expert consensus documents is the use of small burr size to treat calcified LM disease^{8,9}.

Femoral route was used less often in this study compared to previous ones. While femoral access use was high ranging from 57% to 80.3%^{11,12} and 100 % in older studies and registries, more recently, the use of radial access has increased to 51%, and 63.2%^{13,14}. In this study, the use of 8F sheath was low at about 7.8%, demonstrating the use of large burr size ≥ 1.75 is feasible from radial access in most cases.

The IFU recommendations from Boston Scientific is to use a 7Fr guide catheter for 1.75mm burr and 8Fr guide catheter for 2.0mm burr. However, the current launcher guide catheters (Medtronic, USA) 6 Fr can accommodate up to 1.75mm burr, the 7Fr can accommodate up to 2.0mm burr which allows for the use of larger size burrs through a smaller arterial access. This is enhanced by the use of the Slender 6/7 sheaths (Terumo) from the radial approach and from the femoral approach which is adopted by the senior author ~~operator~~.

The 8F sheath was used via the radial route in about 50% of our cases (3.7% of the total) suggesting feasibility of using larger sheath sizes via the radial access route in suitable patients. The use of 8 Fr from the radial artery was done in a sheathless manner where the initial approach would be 5/6 Fr then exchange to a sheathless 8Fr. The use of radial access is encouraged as it has been associated with a lower incidence of complications in the context of rotablation^{15,16}.

Intracoronary imaging (mostly IVUS) was used in 29.7% of our patients which is higher than reported in previous studies. The European Society of Cardiology gives a class IIa recommendation for the use of IVUS in PCI of unprotected LM lesions¹⁵, and it has been shown

that there is a mortality benefit with use of IVUS in LM intervention¹⁶. The use of IVUS can guide selection of appropriate burr size as suggested by a previous study¹⁵.

Prior to the era of coronary stents, the use of RA was associated with increased risk of complications^{17,18}, which has reduced with the use of bare metal stents and even more so with the use of second-generation drug eluting stents¹⁸.

The repeat revascularisation rate was low at 4.9% in the present study compared to higher rates reported historically¹⁹. With more use of second-generation DES, this trend is clearly seen when the recently published Euro4C registry²⁰ outcomes are compared to the older ROTATE registry¹⁹ with reported rates of TLR of 2.4% and 11.3% respectively.

In comparison to previous UK experience, we report similar complication rates of 9.5% compared to a large study from 2014 including patients with both LM and non-LM disease treated with RA reporting a complication rate of 9.7%²¹.

There was a low-overall in-hospital mortality of 1.6%. Previous studies of RA reported in-hospital mortality rates of 7.7%^{22,23}. Our data compare favourably to a recently published contemporary large European registry (Euro4C) where a mortality of 5.3% is reported.

The 4-yr-mortality was 31%. Although this rate appears high, previous evidence suggested a significant survival benefit in high-risk patients undergoing LM RA in comparison to no RA with an in-hospital mortality of 8.3% and 29%, respectively²².

Mortality risk related to the use of RA in the context of calcific LM disease is difficult to determine, as mortality can also be influenced by other patient related factors such as complex anatomy, advanced age and significant comorbidities²¹.

The cox proportional hazard model revealed that mortality was driven by traditional risk factors for mortality in coronary artery disease such as female gender, diabetes, peripheral vascular disease and previous myocardial infarction. There was no impact of burr size on mortality in our study.

The upfront use of larger burr size as an initial strategy is not associated with worse outcomes in this study. The CARAT²⁴ and STRATS⁶ trials from early 2000s showed that a burr to vessel size ≤ 0.7 is associated with lower rates of angiographic complications. It should be noted however that LM was not the target for intervention in these trials.

Almost half of the patients in this study were treated with an initial large burr $\geq 1.75\text{mm}$ with low overall complication rate. This can be explained by the low burr to vessel size ratio in our group which was 0.4 and 0.5 in small and large groups respectively. This is indeed consistent with the current recommendation of expert guidelines from Europe and USA of using a burr size of 0.4 to 0.6 for LM intervention^{8,9}. However, these guidelines recommend starting with a small burr size of 1.25 or 1.5mm, our study suggests that starting with a large burr, in suitable anatomy, is safe and is not associated with worse outcomes in LM interventions. The larger average size of the LM in general allows for use of larger burr sizes while still maintaining a low burr to vessel size ratio. This suggests that in the context of LM disease, debulking with upfront larger burr sizes is safe which is unlike to what previously was held.

It is suggested that 1.25, and 1.5 burrs are safer initial burr size options to reduce complications, and this is reflected in the current guidelines²⁴. It was also suggested that the usage of 1.75mm burrs could have resulted in more complications, which is contrary to our findings. It is known on the other hand that use of small burr sizes can be associated with a higher risk of burr entrapment²⁵, and it might be safer to start with larger burr sizes especially in LM to avoid this complication as well as better lesion modification potentially enabling greater final stent expansion and lower rates of repeat revascularisation.

We would still recommend starting with a burr size that is 0.5 ratio to the vessel size followed by intravascular imaging then a decision can be made whether to upgrade the burr size or whether the starting burr has achieved enough calcium modification. However, if the

decision is made to start with a large burr size $\geq 1.75\text{mm}$, this appears to be a safe approach in such cases.

Limitations of the study

This is a single centre, retrospective study with all inherent limitations of such studies. The number of operators performing these interventions is low, particularly for the large burr size group. Procedures in this cohort are performed in a high-volume centre as well, which may not apply to other centres. High volume centres and operators have been shown to be associated with better outcomes compared to lower volume centres.

Conclusion

An upfront large burr $\geq 1.75\text{mm}$ or $\geq 2.0\text{mm}$ in calcified LM interventions is effective and safe and was not associated with increased risk of in-hospital complications, need for revascularization or mortality at 4-years compared to small burr sizes.

References

1. Copeland-Halperin RS, Baber U, Aquino M, Rajamanickam A, Roy S, Hasan C, Barman N, Kovacic JC, Moreno P, Krishnan P, et al. Prevalence, correlates, and impact of coronary calcification on adverse events following PCI with newer-generation DES: Findings from a large multiethnic registry. *Catheterization and Cardiovascular Interventions*. 2018;91.
2. Fitzgerald PJ, Ports TA, Yock PG. Contribution of localized calcium deposits to dissection after angioplasty: An observational study using intravascular ultrasound. *Circulation* [Internet]. 1992 [cited 2025 Nov 10];86:64–70. Available from: [/doi/pdf/10.1161/01.CIR.86.1.64?download=true](https://doi.org/10.1161/01.CIR.86.1.64)
3. D'Ascenzo F, Elia E, Marengo G, Waríha W, Ferreiro RG, Truffa A, Trabattoni D, Figini F, Verardi R, Palma G Di, et al. Long-term (≥ 15 years) Follow-up of Percutaneous Coronary Intervention of Unprotected Left Main (From the GRAVITY Registry). *American Journal of Cardiology*. 2021;156.
4. Angsubhakorn N, Kang N, Fearon C, Techorueangwiwat C, Swamy P, Brilakis ES, Bharadwaj AS. Contemporary Management of Severely Calcified Coronary Lesions. *J Pers Med*. 2022;12.
5. Fajadet J, Chieffo A. Current management of left main coronary artery disease. *Eur Heart J*. 2012;33.
6. Whitlow PL, Bass TA, Kipperman RM, Sharaf BL, Ho KKL, Cutlip DE, Zhang Y, Kuntz RE, Williams DO, Lasorda DM, et al. Results of the study to determine rotablator and transluminal angioplasty strategy (STRATAS). *American Journal of Cardiology* [Internet]. 2001 [cited 2025 Nov 10];87:699–705. Available from: <https://www.ajconline.org/action/showFullText?pii=S0002914900014867>
7. Safian RD, Feldman T, Muller DWM, Mason D, Schreiber T, Haik B, Mooney M, O'Neill WW. Coronary angioplasty and Rotablator atherectomy trial (CARAT): Immediate and late results of a prospective multicenter randomized trial. *Catheterization and Cardiovascular Interventions* [Internet]. 2001 [cited 2025 Nov 10];53:213–220. Available from: [/doi/pdf/10.1002/ccd.1151](https://doi.org/10.1002/ccd.1151)

8. Barbato E, Carrié D, Dardas P, Fajadet J, Gaul G, Haude M, Khashaba A, Koch K, Meyer-Gessner M, Palazuelos J, et al. European expert consensus on rotational atherectomy. *EuroIntervention*. 2015;11:30–36.
9. Sharma SK, Tomey MI, Teirstein PS, Kini AS, Reitman AB, Lee AC, Généreux P, Chambers JW, Grines CL, Himmelstein SI, et al. North American Expert Review of Rotational Atherectomy. *Circ Cardiovasc Interv* [Internet]. 2019 [cited 2025 Nov 10];12:e007448. Available from: [/doi/pdf/10.1161/CIRCINTERVENTIONS.118.007448?download=true](https://doi/pdf/10.1161/CIRCINTERVENTIONS.118.007448?download=true)
10. Bouisset F, Barbato E, Reczuch K, Dobrzycki S, Meyer-Gessner M, Bressollette E, Cayla G, Lhermusier T, Zajdel W, Molinero JP, et al. Clinical outcomes of PCI with rotational atherectomy: The European multicentre Euro4C registry. *EuroIntervention*. 2021;16:E305–E312.
11. Iannaccone M, Barbero U, D’ascenzo F, Latib A, Pennacchi M, Rossi ML, Ugo F, Meliga E, Kawamoto H, Moretti C, et al. Rotational atherectomy in very long lesions: Results for the ROTATE registry. *Catheterization and Cardiovascular Interventions* [Internet]. 2016 [cited 2025 Nov 10];88:E164–E172. Available from: [/doi/pdf/10.1002/ccd.26548](https://doi/pdf/10.1002/ccd.26548)
12. Rola P, Kulczycki JJ, Włodarczak A, Barycki M, Włodarczak S, Szudrowicz M, Furtan Ł, Jastrzębski A, Pęcherzewski M, Lesiak M, et al. Intravascular Lithotripsy as a Novel Treatment Method for Calcified Unprotected Left Main Diseases—Comparison to Rotational Atherectomy—Short-Term Outcomes. *Int J Environ Res Public Health* [Internet]. 2022 [cited 2025 Nov 10];19. Available from: <https://www.mdpi.com/1660-4601/19/15/9011>
13. Kübler P, Zimoch W, Kosowski M, Tomasiewicz B, Telichowski A, Reczuch K. In patients undergoing percutaneous coronary intervention with rotational atherectomy radial access is safer and as efficient as femoral access. *J Interv Cardiol*. 2018;31:471–477.
14. Kotowycz MA, Khan SQ, Freixa X, Ivanov J, Seidelin PH, Overgaard CB, Džavík V. Rotational atherectomy through the radial artery is associated with similar procedural success when compared with the transfemoral route. *Coron Artery Dis* [Internet]. 2015 [cited 2025 Nov 10];26:254–258. Available from: https://journals.lww.com/coronary-artery/fulltext/2015/05000/rotational_atherectomy_through_the_radial_artery.11.aspx
15. Sakakura K, Yamamoto K, Taniguchi Y, Tsurumaki Y, Momomura S ichi, Fujita H. Intravascular ultrasound enhances the safety of rotational atherectomy. *Cardiovascular*

- Revascularization Medicine* [Internet]. 2018 [cited 2025 Nov 10];19:286–291. Available from:
<https://www.sciencedirect.com/science/article/pii/S1553838917303792?via%3Dihub>
16. Park SJ, Kim YH, Park DW, Lee SW, Kim WJ, Suh J, Yun SC, Lee CW, Hong MK, Lee JH, et al. Impact of intravascular ultrasound guidance on long-term mortality in stenting for unprotected left main coronary artery stenosis. *Circ Cardiovasc Interv* [Internet]. 2009 [cited 2025 Nov 10];2:167–177. Available from: </doi/pdf/10.1161/CIRCINTERVENTIONS.108.799494?download=true>
 17. Ellis SG, Popma JJ, Buchbinder M, Franco I, Leon MB, Kent KM, Pichard AD, Satler LF, Topol EJ, Whitlow PL. Relation of clinical presentation, stenosis morphology, and operator technique to the procedural results of rotational atherectomy and rotational atherectomy-facilitated angioplasty. *Circulation* [Internet]. 1994 [cited 2025 Nov 10];89:882–892. Available from: </doi/pdf/10.1161/01.CIR.89.2.882?download=true>
 18. Warth DC, Leon MB, O'Neill W, Zacca N, Polissar NL, Buchbinder M. Rotational atherectomy multicenter registry: Acute results, complications and 6-month angiographic follow-up in 709 patients. *J Am Coll Cardiol* [Internet]. 1994 [cited 2025 Nov 10];24:641–648. Available from: </doi/pdf/10.1016/0735-1097%2894%2990009-4?download=true>
 19. Kawamoto H, Latib A, Ruparel N, Ielasi A, D'Ascenzo F, Pennacchi M, Sardella G, Garbo R, Meliga E, Moretti C, et al. In-hospital and midterm clinical outcomes of rotational atherectomy followed by stent implantation: The ROTATE multicentre registry. *EuroIntervention*. 2016;12:1448–1456.
 20. Bouisset F, Ribichini F, Bataille V, Reczuch K, Lhermusier T, Dobrzycki S, Meyer-Gessner M, Bressollette E, Zajdel W, Faurie B, et al. Clinical Outcomes of Left Main Coronary Artery PCI With Rotational Atherectomy. *American Journal of Cardiology* [Internet]. 2023 [cited 2025 Nov 10];186:36–42. Available from: <https://www.ajconline.org/action/showFullText?pii=S000291492201061X>
 21. Cockburn J, Hildick-Smith D, Cotton J, Doshi S, Hanratty C, Ludman P, Robinson D, Redwood S, De Belder M, De Belder A. Contemporary clinical outcomes of patients treated with or without rotational coronary atherectomy - An analysis of the UK central cardiac audit database. *Int J Cardiol* [Internet]. 2014 [cited 2025 Nov 10];170:381–387. Available from:

<https://www.internationaljournalofcardiology.com/action/showFullText?pii=S0167527313019906>

22. Dahdouh Z, Roule V, Dugué AE, Sabatier R, Lognoné T, Grollier G. Rotational atherectomy for left main coronary artery disease in octogenarians: Transradial approach in a tertiary center and literature review. *J Interv Cardiol* [Internet]. 2013 [cited 2025 Nov 15];26:173–182. Available from: [/doi/pdf/10.1111/joic.12026](#)
23. Cuenza LR, Jayme AC, Sui JHK. Clinical Outcomes of Patients Undergoing Rotational Atherectomy Followed by Drug-eluting Stent Implantation: A Single-center Real-world Experience. *Heart Views* [Internet]. 2017 [cited 2025 Nov 15];18:115. Available from: <https://pmc.ncbi.nlm.nih.gov/articles/PMC5755191/>
24. Sakakura K, Taniguchi Y, Yamamoto K, Tsukui T, Seguchi M, Wada H, Momomura S ichi, Fujita H. Comparison of complications with a 1.25-mm versus a 1.5-mm burr for severely calcified lesions that could not be crossed by an intravascular ultrasound catheter. *Cardiovascular Intervention and Therapeutics* 2019 35:3 [Internet]. 2019 [cited 2025 Nov 10];35:227–233. Available from: <https://link.springer.com/article/10.1007/s12928-019-00606-9>
25. Sakakura K, Ako J, Momomura SI. Successful removal of an entrapped rotablation burr by extracting drive shaft sheath followed by balloon dilatation. *Catheterization and Cardiovascular Interventions* [Internet]. 2011 [cited 2025 Nov 10];78:567–570. Available from: [/doi/pdf/10.1002/ccd.22957](#)

Table 1. Baseline patient characteristics

	Whole group (n=243)	Burr size <1.75 (n=118)	Burr size ≥1.75 (n=125)	P value
Age (year)	74.7±9	74.9±9	74.4±9	0.642
Male	194 (79.8)	88 (74.6)	106 (84.8)	0.055
Body mass index (kg/m²)	28.1±5.0	27.6±4.9	28.4±5.2	0.276
Diabetes Mellitus	87 (35.8)	45 (38.1)	42 (33.6)	0.504
Hypertension	198 (81.5)	97 (82.2)	101 (80.8)	0.869
Dyslipidaemia	127 (52.3)	54 (45.8)	73 (58.4)	0.055
Cerebrovascular accident	28 (11.5)	14 (11.9)	14 (11.2)	1.000
Chronic kidney disease stage >3	35 (14.4)	16 (13.6)	19 (15.2)	0.855
Peripheral vascular disease	33 (13.6)	13 (11.0)	20 (16.0)	0.269
Previous MI	102 (41.9)	56 (47.5)	46 (36.8)	0.119
Previous PCI	75 (30.9)	43 (36.4)	32 (25.6)	0.073
Prior CABG	43 (17.7)	27 (22.9)	16 (12.8)	0.045
Current Smoker	24 (9.9)	15 (12.7)	9 (7.2)	0.197
Acute coronary syndromes	129 (53.1)	63 (53.4)	66 (52.8)	1.000
Severe LV systolic dysfunction *	27 (11.1)	15 (12.7)	12 (9.6)	0.541
SYNTAX score	35.3±10.6	35.22±11	35.3±10.3	0.054
Low (≤22)	24 (9.9)	13 (11.0)	11 (8.8)	0.668
Intermediate (23-32)	81 (33.3)	43 (36.4)	38 (30.4)	0.343
High (>33)	138 (56.8)	62 (52.5)	76 (60.8)	0.199

Values are mean ± standard deviation or n (%).

CABG: coronary artery bypass graft surgery, LV: left ventricle, MI, myocardial infarction, PCI: percutaneous coronary intervention

* Defined as left ventricular ejection fraction of ≤35%, as measured by peri-procedural transthoracic echocardiography.

Table 2. PCI procedure characteristics

	Whole group (n=243)	Burr size <1.75 (n=118)	Burr size ≥1.75 (n=125)	P value
Radial access	179 (73.7)	84 (71.2)	95 (76.0)	0.467
Access size, Fr				
6	45 (18.5)	38 (32.2)	7 (5.6)	<0.001
7	179 (73.7)	71 (60.2)	106 (84.8)	
8	19 (7.8)	9 (7.6)	12 (9.6)	
Size of Burr used	1.7±0.23	1.46±0.088	1.86±0.15	<0.001
Treated vessel				
LAD	201 (82.7)	91 (77.1)	110 (88.0)	0.028
LCx	89 (36.6)	37 (31.3)	52 (41.6)	0.111
Other	52 (21.4)	23 (11.9)	29 (9.5)	0.481
Bifurcation	208 (85.6)	100 (84.7)	108 (86.4)	0.719
Bifurcation strategy				
Provisional	176 (72.4)	94 (79.7)	82 (65.6)	0.011
Culotte	18 (7.4)	3 (2.5)	15 (12.0)	
T stent/ TAP	49 (20.2)	21 (17.8)	28 (22.4)	
2-stent technique	67 (27.6)	24 (20.3)	43 (34.4)	0.015
Intracoronary Imaging (IVUS)	71 (29.2)	26 (22.0)	45 (36.0)	0.024
Adjunctive device use	52 (21.4)	16 (13.5)	36 (28.8)	0.005
LM stent size	3.9±0.4	3.8±0.4	4.1±0.4	<0.001
Stents number	2.7±1.4	2.5±1.3	2.8±1.5	0.087
Post-dilatation balloon size	4.6±0.6	4.4±0.5	4.7±0.6	<0.001
Post-dilatation pressure	18.0±2.7	18.2±2.5	17.8±2.8	0.484

Values are mean ± standard deviation or n (%). LAD=Left Anterior Descending artery;
LCx=Left Circumflex Artery; TAP= T and small protrusion; LM=Left Main.

Table 3. In-hospital and long-term complications

	Whole group (n=243)	Burr size <1.75 (n=118)	Burr size ≥1.75 (n=125)	P value
Overall procedural complications	23 (9.5)	13 (11.0)	10 (8.0)	0.512
Slow flow/No flow	5	2	3	NS
Cardiogenic shock	2	0	2	
Pericardial tamponade	1	1	0	
Major bleeding from femoral access site	1	1	0	
Coronary perforation	4	2	2	
In-hospital death	4	4	0	
Bradycardia requiring TPW	2	2	0	
Renal failure requiring dialysis	1	0	1	
CVA	1	1	0	
Resuscitated cardiac arrest	1	0	1	
Rotablation wire fracture	1	1	0	
Stent dislodgement	1	0	1	
Long Term Outcome				
Revascularization at 4 years	12 (4.9)	7 (2.9)	5 (2.1)	0.473
Mortality at 4 years	75 (31%)	40 (34%)	35 (28%)	0.267

Values are n (%).

Table 4. Independent predictors for 4-year mortality in patients undergoing left main stem rotablation.

	Hazard Ratio	95% Confidence Interval
Age	1.034	0.997 to 1.072
Female Gender	1.918	1.004 to 3.664
Hypertension	1.330	0.554 to 3.193
Diabetes	1.544	0.978 to 2.436
Cerebrovascular disease	1.852	0.933 to 3.676
Peripheral vascular disease	2.278	1.194 to 4.346
Chronic kidney disease	1.759	1.108 to 2.791
Previous MI	2.060	1.124 to 3.776
Previous PCI	0.418	0.212 to 0.822
Previous CABG	0.827	0.364 to 1.875
Two-stent techniques	0.889	0.528 to 1.496
Imaging	0.668	0.389 to 1.146
Rota Burr $\geq 1.75\text{mm}$	0.782	0.461 to 1.327
Rota Burr $\geq 2.0\text{mm}$	0.975	0.496 to 1.917

Values are Hazard Ratio and 95% Confidence Interval. MI=Myocardial Infarction; PCI=Percutaneous Coronary Intervention; CABG=Coronary Artery Bypass Grafting.

Figure Legend

Figure 1. All-cause mortality at 4 years. No difference in patients with burr size <1.75 compared to those with burr size ≥ 1.75 (*Log Rank test, $p=0.267$*).

Figure 2. All-cause mortality at 4 years. No difference in patients with burr size <2.0 compared to those with burr size ≥ 2.0 (*Log Rank test, $p=0.544$*).

Figure 1. All-cause mortality at 4 years. No difference in patients with burr size <1.75 compared to those with burr size ≥ 1.75 (*Log Rank test*, $p=0.267$).

4-year mortality after left main stem rotablation

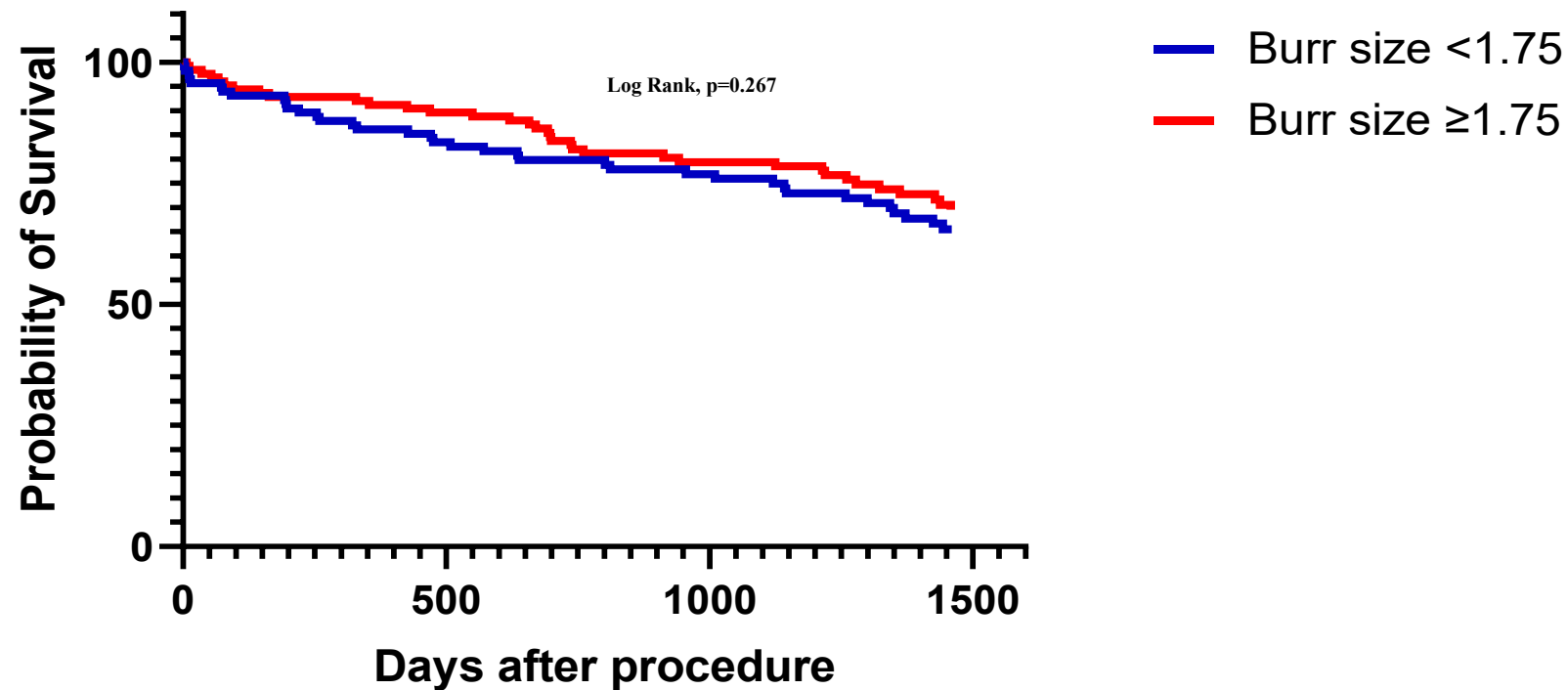


Figure 2. All-cause mortality at 4 years. No difference in patients with burr size <2.0 compared to those with burr size ≥ 2.0 (*Log Rank test*, $p=0.544$).

4-year mortality after left main stem rotablation with large burr size

