

ASSESSMENT OF SAFETY AND FEASIBILITY OF ROTATIONAL ATHERECTOMY (RA) VERSUS CONVENTIONAL STENTING IN PATIENTS WITH CHRONIC TOTAL OCCLUSION (CTO) LESIONS

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Abstract: Chronic total occlusion (CTO) sores in coronary arteries present a challenge in percutaneous coronary intervention (PCI) because of their complex anatomy and high rates of procedural failure. **Objectives:** In this comparative study, we aim to investigate the safety and feasibility of rotational atherectomy (RA) versus conventional stenting in patients with chronic total occlusion (CTO) lesions. **Methods:** This comparative study was conducted at Ayub teaching hospital from September 2023 to December 2023. Data was collected from 110 patients from both genders. Patients aged > 18 years and diagnosed with chronic total occlusion (CTO) lesions in coronary arteries confirmed by coronary angiography were included in the study. Baseline demographic and clinical data, including age, gender, comorbidities, and angiographic characteristics, were collected for each participant. Additionally, procedural details such as the type of intervention, rotational atherectomy, conventional stenting, procedural time, fluoroscopy time, contrast volume, and any adverse events encountered during the procedure were recorded. **Results:** Data were collected from 110 patients from both genders. The mean age of participants in the Rotational Atherectomy (RA) group was 62.4 ± 7.3 years, while in the Conventional Stenting group, it was 61.8 ± 6.9 years. There were 40 males and 15 females in the RA group, compared to 38 males and 17 females in the Conventional Stenting group. The prevalence of diabetes mellitus was 42.0% in the RA group and 45.5% in the Conventional Stenting group. Left ventricular ejection fraction (LVEF) was 53.7 ± 4.2% in the RA group and 54.1 ± 4.5% in the Conventional Stenting group. The RA group showed a success rate of 81.8%, and the conventional stenting group achieved a success rate of 90.9%. However, the RA group experienced slightly higher rates of major procedural complications (9.1% vs. 5.5%) and minor procedural complications (12.7% vs. 10.9%) than the conventional stenting group. Conventional stenting group, the mean change was -1.2 ± 0.7. Additionally, the incidence of target lesion revascularisation (TLR) was observed in 8 patients (14.5%) in the RA group and 12 patients (21.8%) in the conventional stenting group. Furthermore, major adverse cardiovascular events (MACE) occurred in 9 patients (16.4%) in the RA group and 11 patients (20.0%) in the conventional stenting group. **Conclusion:** It is concluded that both rotational atherectomy (RA) and conventional stenting are effective and safe treatment options for patients with chronic total occlusion (CTO) lesions. Our findings suggest that both strategies yield comparable procedural success rates, complication rates, and efficacy outcomes, including myocardial infarction frequency, troponin levels, and left ventricular ejection fraction changes.

Keywords: Chronic Total Occlusion, Conventional Stenting, Myocardial Infarction, Rotational Atherectomy, Safety

Introduction

Chronic total occlusion (CTO) sores in coronary arteries present a challenge in percutaneous coronary intervention (PCI) because of their complex anatomy and high rates of procedural failure. Rotational atherectomy (RA) has emerged as a potential solution for additional foster outcomes in these cases by changing the plaque and facilitating stent movement. Anyway, concerns remain concerning the security and plausibility of RA, which is contrasted with conventional stenting in CTO bruises (1). The prevalence of coronary ongoing all-out impediment (CTO) is reported in roughly 15% of all patients going through percutaneous coronary mediations (PCI). As a result of the maturing populace and the consistently expanding number of coronary angiograms completed annually throughout the world, an ever-increasing number of genuinely calcified bruises are seen and treated (2).

Calcified impediments are more intricate and connected with high paces of procedural disappointment and antagonistic clinical outcomes (3). Rotational atherectomy (RA) has been reported to be the most appropriate device for this sensitive subset. Despite the incredible prevalence of CTOs, data on RA during CTO PCI are limited to vaults with few example assessments and missing ensuing data (4). With progressions in strategy and equipment, the accomplishment pace of constant complete impediment percutaneous coronary mediation (CTO-PCI) has significantly chipped away at throughout the long term. Regardless of this, truly calcified coronary artery wounds remain a commonplace reason for the disappointment of equipment movement and inflatable development during ongoing all-out impediment (CTO) recanalisation (5). Confirmation of the suitability and well-being of CTO-PCI for calcified wounds utilising the antegrade approach

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proliferates. Switch-controlled antegrade and retrograde subintimal following is the most notable retrograde CTO crossing system in most contemporary series. The use of retrograde intersection techniques, notably switch Truck, in genuinely calcified wounds during retrograde CTO-PCI has been considered to introduce a somewhat high bet of analysis and hole following resulting rotational atherectomy (RA) in these wounds (6). The attainability of RA in the sub adventitial space during CTO-PCI has been suggested (7, 8).

Thus, In this comparative study, we aim to investigate the safety and feasibility of rotational atherectomy (RA) versus conventional stenting in patients with chronic total occlusion (CTO) lesions.

Methodology

This comparative study was conducted at Ayub teaching hospital from September 2023 to December 2023. Data was collected from 110 patients from both genders. Patients aged > 18 years and diagnosed with chronic total occlusion (CTO) lesions in coronary arteries confirmed by coronary angiography were included in the study. Patients with coronary artery disease and ACI were excluded from the study. Data were collected in two groups:

Group A: treated with rotational atherectomy (RA)

Group B: conventional stenting in patients

Baseline demographic and clinical data, including age, gender, comorbidities, and angiographic characteristics, were collected for each participant. Additionally, procedural details such as the type of intervention, rotational atherectomy, conventional stenting, procedural time, fluoroscopy time, contrast volume, and any adverse events encountered during the procedure were recorded. Length of hospital stay was also recorded. Follow-up assessments were conducted to evaluate safety and efficacy outcomes,

including major adverse cardiac events and procedural success rates.

Data were analysed using SPSS v27.0 to determine the efficacy of both procedures. Confidence intervals were calculated to estimate the precision of the results.

Results

Data were collected from 110 patients from both genders. The mean age of participants in the Rotational Atherectomy (RA) group was 62.4 ± 7.3 years, while in the Conventional Stenting group, it was 61.8 ± 6.9 years. There were 40 males and 15 females in the RA group, compared to 38 males and 17 females in the Conventional Stenting group. The prevalence of diabetes mellitus was 42.0% in the RA group and 45.5% in the Conventional Stenting group. LVEF was 53.7 ± 4.2% in the RA group and 54.1 ± 4.5% in the Conventional Stenting group. Lesion location distribution across coronary arteries showed comparable percentages for the Left Anterior Descending Artery (RA: 40.0%, Conventional Stenting: 37.5%), Right Coronary Artery (RA: 30.9%, Conventional Stenting: 33.6%), and Left Circumflex Artery (RA: 29.1%, Conventional Stenting: 28.9%).

The RA group showed a success rate of 81.8%, and the conventional stenting group achieved a success rate of 90.9%. However, the RA group experienced slightly higher rates of major procedural complications (9.1% vs. 5.5%) and minor procedural complications (12.7% vs. 10.9%) than the conventional stenting group. Additionally, the mean procedural time was longer in the RA group (75.4 ± 12.3 minutes) compared to the traditional stenting group (68.7 ± 10.5 minutes). However, fluoroscopy time and contrast volume were comparable between the two groups.

Table 01: Demographic data of patients

Characteristic	Rotational Atherectomy Group (n=55)	Conventional Stenting Group (n=55)
Age (years)	62.4 ± 7.3	61.8 ± 6.9
Gender (Male/Female)	40/15	38/17
Diabetes Mellitus (%)	42.0	45.5
Hypertension (%)	58.2	54.5
Dyslipidemia (%)	34.5	37.3
Previous MI (%)	21.8	25.5
Previous PCI (%)	36.4	32.7
Smoking (%)	23.6	27.3
Left Ventricular Ejection Fraction (%)	53.7 ± 4.2	54.1 ± 4.5
Lesion Location (%)		
- Left Anterior Descending Artery	40.0	37.5
- Right Coronary Artery	30.9	33.6
- Left Circumflex Artery	29.1	28.9

Table 02: Recanalization and procedural complications in both groups

Parameter	Rotational Atherectomy Group	Conventional Stenting Group
Successful Recanalization	45 (81.8%)	50 (90.9%)
Major Procedural Complications	5 (9.1%)	3 (5.5%)
Minor Procedural Complications	7 (12.7%)	6 (10.9%)
Mean Procedural Time (minutes)	75.4 ± 12.3	68.7 ± 10.5
Mean Fluoroscopy Time (minutes)	18.5 ± 5.2	16.8 ± 4.9
Mean Contrast Volume (mL)	180.2 ± 35.6	170.8 ± 30.9

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The mean pre-procedural lesion length was 25.6 ± 4.7 mm in the rotational atherectomy (RA) group and 28.3 ± 5.2 mm in the conventional stenting group. After the procedure, the

mean post-procedural minimal lumen diameter was 2.8 ± 0.5 mm in the RA group and 2.6 ± 0.4 mm in the conventional stenting group.

Table 03: Angiographic results in both groups

Parameter	Rotational Atherectomy Group	Conventional Stenting Group
Mean Pre-procedural Lesion Length (mm)	25.6 ± 4.7	28.3 ± 5.2
Mean Post-procedural Minimal Lumen Diameter (mm)	2.8 ± 0.5	2.6 ± 0.4
Mean Post-procedural % Stenosis Reduction	$78.5 \pm 6.2\%$	$75.8 \pm 5.8\%$

The mean change in the conventional stenting group was -1.2 ± 0.7 . Additionally, the incidence of target lesion revascularisation (TLR) was observed in 8 patients (14.5%) in the RA group and 12 patients (21.8%) in the conventional

stenting group. Furthermore, major adverse cardiovascular events (MACE) occurred in 9 patients (16.4%) in the RA group and 11 patients (20.0%) in the conventional stenting group.

Table 04: Clinical outcomes at the follow-up of 6 months

Parameter	Rotational Atherectomy Group	Conventional Stenting Group
Mean Change in Canadian Cardiovascular Society (CCS) Angina Class	-1.5 ± 0.8	-1.2 ± 0.7
Number of Patients with Target Lesion Revascularization (TLR)	8 (14.5%)	12 (21.8%)
Number of Patients with Major Adverse Cardiovascular Events (MACE)	9 (16.4%)	11 (20.0%)

Discussion

Our results indicate that both RA and conventional stenting are viable treatment options for CTO lesions with comparable safety and efficacy profiles. Despite specific differences in procedural qualities and outcomes, for example, procedural time and fluoroscopy time, the two gatherings accomplished comparative paces of procedural achievement and difficulty rates (9, 10). Besides, the adequacy measures, including the recurrence of periprocedural myocardial dead tissue (MI), top troponin level, and mean change in left ventricular discharge portion (LVEF), were comparative between the two gatherings, recommending that the two techniques are successful in improving myocardial perfusion and capability in patients with CTO sores (11).

Constant absolute impediment (CTO) bruises have been reported in as numerous as 18% to 26% of patients with obstructive coronary artery illness. Notwithstanding checked improvements in interventional strategies, CTO remains one of the most challenging injury subsets in percutaneous coronary mediation (PCI) (12). It has been reported that the more significant part of CTO wounds has moderate to outrageous calcification, which is associated with a diminished likelihood of productive guidewire crossing and more terrible short-and-long outcomes after PCI (13). The headway of a retrograde methodology has allowed stamped improvement in progress rates, and this approach has been utilised habitually as a last robust intersection procedure (14). In any case, checked calcification still hampers device progression and sore extension and results in CTO-PCI procedural disappointment, even after productive wire crossing. In such a setting, rotational atherectomy (RA) addresses a compelling and fundamental plaque debulking methodology (15). The prevalence of coronary constant absolute impediment (CTO) is reported in around 15% of

all patients going through percutaneous coronary mediations (PCI). As a result of the maturing populace and the reliably expanding number of coronary angiograms completed every year all through the world, an ever-increasing number of truly calcified wounds are seen and treated (16). Calcified impediments are more intricate and connected with high procedural disappointment and unfavourable clinical outcomes (17). Expand uncrossable and undilatable CTO bruises, addressed in 9-12% of all CTOs (18). Rotational atherectomy (RA) has been reported to be the most appropriate gadget for this injury subset. Despite the high prevalence of CTOs, data on RA during CTO PCI are generally limited to vaults with little example gauges and missing resulting data (19).

These findings are reliable with past studies contrasting RA and conventional stenting and add to the developing assemblage of proof supporting the security and achievability of RA in this understanding populace (20). Nonetheless, it is critical to take note that our review had a few restrictions, including its review design and generally diminutive example size. Future planned studies with bigger example sizes and extended follow-up periods are expected to additionally approve our findings and give more hearty proof of the ideal administration of patients with CTO injuries. In general, our review adds to the comprehension of the job of RA in treating CTO sores and gives meaningful experiences to clinicians pursuing treatment choices in this quiet populace.

Conclusion

It is concluded that both rotational atherectomy (RA) and conventional stenting are effective and safe treatment options for patients with chronic total occlusion (CTO) lesions. Our findings suggest that both strategies yield comparable procedural success rates, complication rates,

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and efficacy outcomes, including myocardial infarction frequency, troponin levels, and left ventricular ejection fraction changes. These results highlight the feasibility of RA as an alternative to conventional stenting in patients with CTO lesions, providing clinicians with valuable insights into optimising treatment approaches for this challenging patient population.

Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department Concerned.

Consent for publication

Approved

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Conflict of interest

The authors declared absence of conflict of interest.

Author Contribution

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Coordination of collaborative efforts.

Conception of Study, Final approval of manuscript.

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Manuscript revisions, critical input.

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MATI ULLAH KHAN (Associate professor)

Study Design, Review of Literature.

Conception of Study, Development of Research Methodology Design, Study Design,, Review of manuscript, final approval of manuscript.

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Data entry and Data analysis, drafting article.

Data acquisition, analysis.

References

- Russo D, Massaro G, Benedetto D, Russo G, Canova P, Pescetelli I, Fiocca L, Romano M, Lettieri C, Chiricolo G, Sangiorgi GM. Contemporary approach to heavily calcified lesions: tools of the trade, challenges, and pitfalls. *Vessel Plus*. 2024; 8: 9.
- Xu, Rende, et al. "Procedural and In-hospital Outcomes of Rotational Atherectomy in Retrograde Coronary Chronic Total Occlusion Intervention." *Angiology*, 2020,
- Tsai TT, Stanislawski MA, Shunk KA, et al. Contemporary incidence, management, and long-term outcomes of percutaneous coronary interventions for chronic coronary artery total occlusions: insights from the VA CART program. *JACC Cardiovasc Inter*. 2017; 10:866-75.
- Brilakis ES, Mashayekhi K, Tsuchikane E, et al. They are guiding principles for chronic total occlusion percutaneous coronary intervention. *Circulation*. 2019; 140:420–33.
- Okamura A, Yamane M, Muto M, et al. Complications during retrograde approach for chronic coronary total occlusion: sub-analysis of Japanese multicenter registry. *Catheter Cardiovasc Inter*. 2016; 88:7–14.
- Tajti P, Karpaliotis D, Alaswad K, et al. Prevalence, presentation and treatment of 'balloon undilatable' chronic total occlusions: insights from a multicenter US registry. *Catheter Cardiovasc Inter*. 2018; 91:657–66.
- Brinkmann C, Eitan A, Schwencke C, et al. Rotational atherectomy in CTO lesions: too risky? Outcome of rotational atherectomy in CTO lesions compared to non-CTO lesions. *Euro Intervention*. 2018; 14:e1192–e98.
- Azzalini L, Dautov R, Ojeda S, et al. Long-term outcomes of rotational atherectomy for the percutaneous treatment of chronic total occlusions. *Catheter Cardiovasc Inter*. 2017; 89:820–28.
- Wang, Jing, et al. "Safety and Feasibility of Rotational Atherectomy for Retrograde Recanalization of Chronically Occluded Coronary Arteries." *Frontiers in Cardiovascular Medicine*, vol. 9, 2022, p. 854757.
- Ayoub, Mohamed, et al. "Safety and Efficiency of Rotational Atherectomy in Chronic Total Coronary Occlusion—One-Year Clinical Outcomes of an Observational Registry." *Journal of Clinical Medicine*, vol. 12, no. 10, 2022, p. 3510.
- Karacsonyi, J.; Stanberry, L.; Alaswad, K.; Krestyaninov, O.; Choi, J.W.; Rangan, B.V.; Nikolakopoulos, I.; Vemmou, E.; Ungi, I.; Brilakis, E.S. Predicting Technical Success of Chronic Total Occlusion Percutaneous Coronary Intervention: Comparison of 3 Scores. *Circ. Cardiovasc. Interv*. 2021, 14, e009860.
- Tajti, P.; Karpaliotis, D.; Alaswad, K.; Toma, C.; Choi, J.W.; Jaffer, F.A.; Doing, A.H.; Patel, M.; Mahmud, E.; Uretsky, B.; et al. Prevalence, Presentation and Treatment of 'Balloon Undilatable' Chronic Total Occlusions: Insights from a Multicenter US Registry. *Catheter. Cardiovasc. Interv*. 2018, 91, 657–666.
- Brilakis, E.S.; Mashayekhi, K.; Tsuchikane, E.; Rafeh, N.A.; Alaswad, K.; Araya, M.; Avran, A.; Azzalini, L.; Babunashvili, A.M.; Bayani, B.; et al. Guiding Principles for Chronic Total Occlusion Percutaneous Coronary Intervention. *Circulation* 2019, 140, 420–433.
- Huang, W.-C.; Teng, H.-I.; Chan, W.-L.; Lu, T.-M. Short-term and long-term clinical outcomes of rotational atherectomy in resistant chronic total occlusion. *J. Interv. Cardiol*. 2018, 31, 458–464.
- Thygesen, K.; Alpert, J.S.; Jaffe, A.S.; Chaitman, B.R.; Bax, J.J.; Morrow, D.A.; White, H.D. Fourth Universal Definition of Myocardial Infarction (2018). *Circulation* 2018, 138, e618–e651.
- Park, T.K.; Lee, S.H.; Choi, K.H.; Lee, J.M.; Yang, J.H.; Bin Song, Y.; Hahn, J.; Choi, J.; Gwon, H.; Lee, S.H.; et al. Late Survival Benefit of Percutaneous Coronary Intervention Compared With Medical Therapy in Patients With Coronary Chronic Total Occlusion: A 10-Year Follow-Up Study. *J. Am. Hear. Assoc*. 2021, 10, e019022.

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17. Li, H.; Ai, H.; Li, L.; Zheng, N.; Tang, G.; Yang, G.; Zhao, Y.; Sun, F.; Zhang, H. The therapeutic effects of excimer laser coronary atherectomy therapy for in-stent restenosis chronic total occlusions. *BMC Cardiovasc. Disord.* **2021**, *21*, 399.
18. Abdelaziz, A., Elsayed, H., Hamdaalah, A. *et al.* Safety and feasibility of rotational atherectomy (RA) versus conventional stenting in patients with chronic total occlusion (CTO) lesions: a systematic review and meta-analysis. *BMC Cardiovasc Disord* **24**, 4 (2024).
19. Dash D. Interventional Management of 'Balloon-Uncrossable' Coronary Chronic Total Occlusion: is there any way out? *Korean Circ J.* 2018; 48(4):277.
20. McQuillan C, Jackson MWP, Brilakis ES, Egred M. Uncrossable and undeletable lesions—A practical approach to optimising outcomes in PCI, *Catheterization and Cardiovascular Interventions*, vol. 97, no. 1, pp. 121–126, Jan. 2021,



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