



External calcium modification technique to overcome a balloon uncrossable chronic total occlusion: a report of two cases and review of the literature

Técnica de modificación externa del calcio para superar una oclusión total crónica no superable con balón

Arash Hashalemi,* Ahmet Karagoz,‡ Baktash Bayani,§
Nihan Turhan Calar,¶ Mehdi Zoghi,|| Melisa Ucar**

Keywords:

chronic total occlusion,
balloon, uncrossable
lesion, external
calcium modification.

Palabras clave:

oclusión total
crónica, balón,
lesión incruzable,
modificación externa
del calcio.

ABSTRACT

Introduction: chronic total occlusion is the most challenging part of percutaneous coronary intervention. In balloon uncrossable lesions, the wire can be advanced throughout the lesion to the distal part of the vessel, while the balloon can not.

Case report: in this scenario, there are very few options to perform. Herein, we present two cases of balloon uncrossable chronic total occlusion, in which all the other methods were unsuccessful. **Conclusion:** we called this technique «external calcium modification» in which a balloon uncrossable lesion was overcome by cracking the calcified plaque via balloon inflation in the subintimal area over an intentionally directed wire around the calcium in subintimal space.

RESUMEN

Introducción: la oclusión total crónica es la parte más desafiante de la intervención coronaria percutánea. En lesiones que no se pueden cruzar con balón, el alambre puede avanzar a lo largo de la lesión hasta la parte distal del vaso, mientras que el balón no. **Reporte de un caso:** en este escenario, hay muy pocas opciones para realizar. En este documento presentamos dos casos de oclusión total crónica no superable con balón en los que todos los demás métodos no tuvieron éxito. **Conclusión:** llamamos a esta técnica «modificación externa del calcio» en la que la lesión que no se puede cruzar con el balón se superó rompiendo la placa calcificada mediante el inflado del balón en el área subintimal sobre un alambre dirigido intencionalmente alrededor del calcio en el espacio subintimal.

INTRODUCTION

Developing novel equipment and techniques enables more challenging chronic total occlusion (CTO) lesions. On the other hand, despite these improvements, uncrossable lesions still remain to be a problem. Herein, report the rechanneling of a balloon uncrossable heavily calcified left anterior descending artery (LAD) artery CTO by cracking the calcified plaque with balloon inflation in the subintimal area, and we call this technique «external calcium modification».

CASE REPORT

A 66-year-old male with typical angina and a history of failed CTO percutan was referred to our CTO tertiary center for retry. Echocardiography revealed an ejection fraction of 45%. MRI study demonstrated viability in the LAD region. Coronary angiography revealed a long LAD CTO over 20 mm with heavy calcification (Figure 1A). The J-CTO score was four since the first attempt in another center had failed due to the inability of the wire passage.¹ The cap of the CTO was

How to cite: Hashalemi A, Karagoz A, Bayani B, Turhan CN, Zoghi M, Ucar M. External calcium modification technique to overcome a balloon uncrossable chronic total occlusion: a report of two cases and review of the literature. Cardiovasc Metab Sci. 2024; 35 (1): 27-30. <https://dx.doi.org/10.35366/115002>

* Interventional
Cardiologist,
Department of
Cardiology, Erfan
General Hospital,
Tehran, Iran. ORCID:
0000 0002 7498 1863

‡ Professor of Medicine,
Department of
Cardiology, Samsun
University Faculty of
Medicine, Samsun,
Turkey. ORCID: 0000
0002 3548 1276

§ Department of
Cardiology, Mehr
Hospital, Mashhad,
Iran. ORCID: 0000
0001 7096 9552

¶ Department of
Cardiology, Dr. Sadi
Konuk Training and
Research Hospital,
Bakirkoy Istanbul,
Turkey. ORCID: 0000
0001 7925 2398

|| Department of Cardiology, Ege University Hospital, Izmir, Turkey. ORCID: 0000 0002 8156 2675
 ** Cardiology Resident, Samsun University Education and Research Hospital, Samsun Turkey. Department of Cardiology, Samsun University Faculty of Medicine, Samsun, Turkey. ORCID: 0000 0003 2257 3021

Received:
 23/11/2023
 Accepted:
 26/01/2024

semi-ambiguous. The wire was able to be advanced through the highly calcified lesion with the support of a microcatheter, but the microcatheter and even low-profile balloons could not be advanced despite good backup with 7 fr femoral access and an EBU catheter in place (*Figure 1B*). First of all, the microcatheter was exchanged with a more supportive one, and the calcified lesion was tried to be drilled. The second step was using a guide extension catheter in order to increase support. Upon failure, an anchor balloon was inflated in the septal branch. A blimp scoring balloon was used in combination with an anchor balloon and deep-seated guide extension.² Leopard crawl technique and grenadoplasty were also tried, but both failed.³ The other options were the STAR technique, which will probably lead to the loss of many side branches, and the retrograde approach, with a low chance of success due to unfavorable collaterals. If we wanted to use a rotaablator, we first had to pass

a rotawire through the microcatheter, and since the microcatheter could not be advanced, there was a risk of losing the original wire, which was in the true lumen due to the long distance of the CTO. Moreover, the patient refused.

Since the balloon uncrossable lesion was covered with a high calcium burden, cracking the calcification with a balloon advanced over a subintimal hydrophilic wire was another option. A fielder XT-A guidewire was advanced around the CTO lesion in the subintimal area (*Figure 1C*). A 2*12 mm balloon was inflated at 8 atm over the wire in the subintimal area to crack the calcification from outside. After extraluminal plaque modification, the subintimal wire and the balloon were withdrawn. A microcatheter was then advanced with the support of an anchor balloon over the original true lumen wire (*Figure 1D*). Then the procedure was successfully completed with balloon predilatation and stent implantation (*Figure 1E-F*).

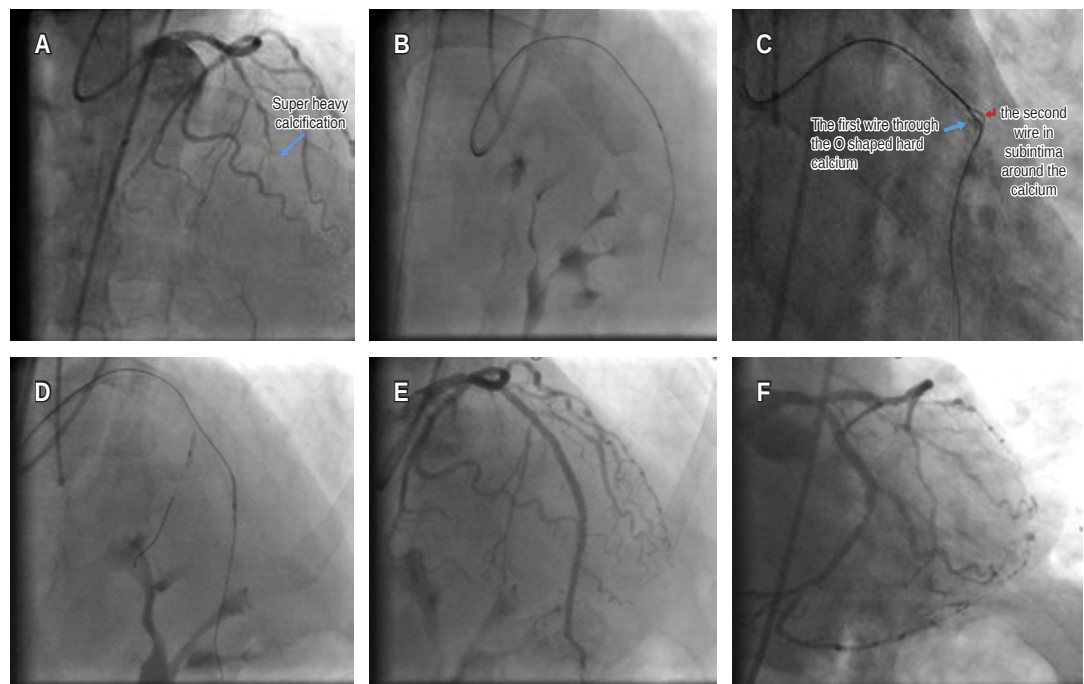


Figure 1: **A)** The blue arrow shows super heavy calcification. **B)** The wire could be advanced, but the microcatheter failed to pass the chronic total occlusion body. **C)** The blue arrow shows the second wire in the subintima around the calcium. **D)** Following balloon inflation in the subintimal area, the microcatheter then could be advanced with the support of an anchor balloon. **E-F)** Final appearances in cranial and caudal views.

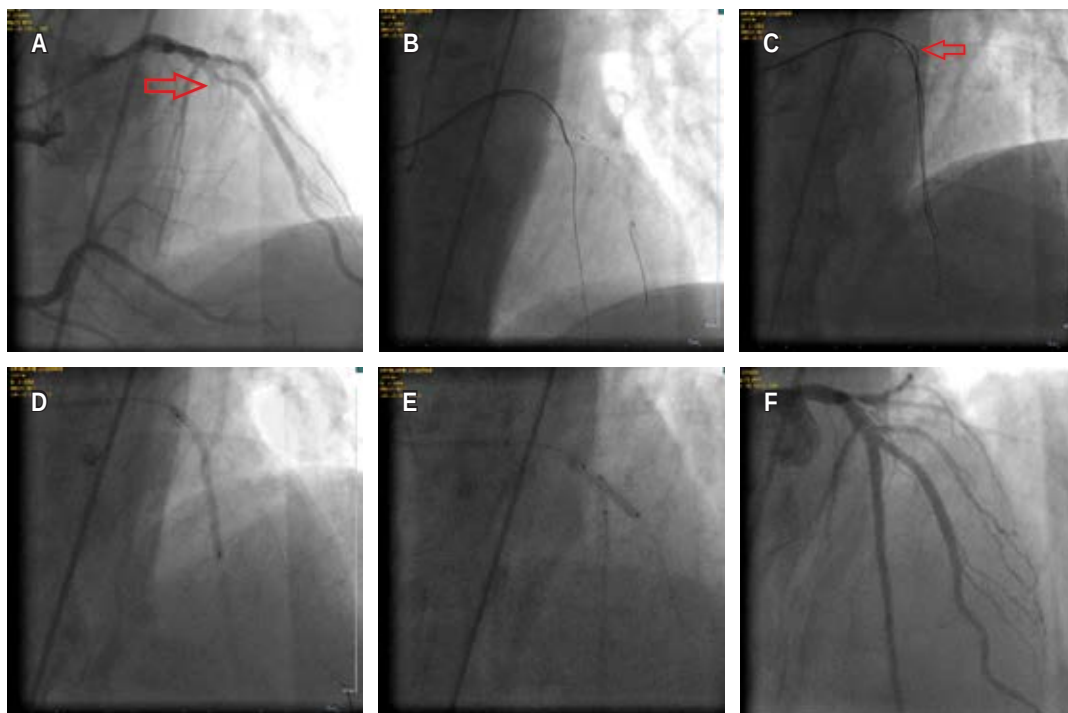


Figure 2: **A)** The red arrow shows the ambiguous proximal cap. **B)** The microcatheter could not be advanced despite the support of an anchor balloon. **C)** The red arrow shows the knuckled hydrophilic wire going down in the subintimal area around the calcium. **D)** Implantation of a 3×38 mm DES in the left anterior descending artery. **E)** Implantation of a 2.75×20 mm DES in the diagonal branch via TAP technique. **F)** Final appearance.

The second case was a 55-year-old male with a history of cerebrovascular disease. He was also referred to our CTO tertiary center for retry PCI of LAD CTO lesion with heavy calcification and a J-CTO score of 3 (*Figure 2A*). MRI revealed viability in the anterior wall and a large diagonal at the proximal cap. Again, all the steps mentioned above failed to advance the microcatheter over the wire, which could be advanced to the distal part of the vessel through the true lumen (*Figure 2B*). A hydrophilic wire was again knuckled and advanced around the CTO body in the subintimal space (*Figure 2C*). A 2×12 mm balloon was advanced over this wire and inflated at 6 atm. After cracking the external calcium, the microcatheter could be advanced over the wire in the true lumen. A 3×38 mm Drug-Eluting Stent (DES) was implanted in the LAD (*Figure 2D*). Then, a 2.75×20 mm DES was implanted in the diagonal branch using the TAP technique, and the procedure was finished successfully (*Figure 2E-F*).

DISCUSSION

Herein, we report a bail-out intervention for overcoming an uncrossable balloon CTO by cracking the calcium with an NC balloon in the subintima. We call this technique «external calcium modification».

The usual steps to overcome this problem are increasing the support by using femoral access, longer sheaths, and stronger guide catheters such as Amplatz or EBU. Using anchor balloon or super anchor balloon technique, extra support wires, deep-seated guiding extension gears, smaller or hydrophilic coated dedicated CTO balloons, and blimp or dedicated microcatheters may also be helpful. Usually, it takes a combination of these steps to overcome the lesion, but sometimes more advanced techniques like leopard crawl and propofol-soaked or lubricated rota wire passage might be needed. Finally, intentional antegrade

dissection reentry (ADR) and external luminal plaque modification can be an option. The STAR technique was not preferred in our case, considering the absence of a stingray catheter in the cath lab and the possible loss of side branches. To the best of our knowledge, the only case in the literature was presented by Christopoulos G et al, defining the subintimal external crush technique for a balloon uncrossable chronic total occlusion. Also, in this case, high calcification that hampered the crossing of the balloon was cracked by subintimal balloon inflation that allowed subsequent balloon crossing.⁴ Some review papers presented algorithms for a balloon uncrossable lesion, which consists of augmented guide catheter support (larger guide catheter with a more supportive shape, long arterial sheaths, deep engagement, guide catheter extension, anchor wire, buddy wire, and anchor balloon) and lesion modification techniques (grenadoplasty, dedicated microcatheters, excimer laser, seesaw balloon-wire cutting technique, multi-wire plaque crushing technique and crowbar effect technique). On the other hand, this external calcium modification technique is mentioned briefly in these papers with a lack of experience.^{5,6} Thus, our paper presenting two cases of external calcium modification technique will add unique information to the balloon uncrossable CTO knowledge.

CONCLUSIONS

Consequently, the external calcium modification technique, which consists of plaque modification using a balloon in subintimal space (over an intentionally directed wire in subintima and around the calcium) and cracking the calcium from the outer vessel structure, is an advanced risky procedure that can be used as a last resort

in experienced operators' hands with high success and low complication rates.

REFERENCES

1. Morino Y, Abe M, Morimoto T, Kimura T, Hayashi Y, Muramatsu T et al. Predicting successful guidewire crossing through chronic total occlusion of native coronary lesions within 30 minutes: the J-CTO (Multicenter CTO Registry in Japan) score as a difficulty grading and time assessment tool. *JACC Cardiovasc Interv.* 2011; 4 (2): 213-221. doi: 10.1016/j.jcin.2010.09.024.
2. Dens J, Holvoet W, McCutcheon K, Ungureanu C, Coussemont P, Haine S et al. A prospective, multicenter, randomised controlled trial for evaluation of the effectiveness of the Blimp scoring balloon in lesions not crossable with a conventional balloon or microcatheter: the BLIMP study. *Acta Cardiol.* 2023; 78 (1): 86-90. doi: 10.1080/00015385.2022.2058676.
3. Kazuhiro A, Taichiro H, Takayuki S. Efficacy of lacrosse NSE using the "leopard-crawl" technique on severely calcified lesions. *J Invasive Cardiol.* 2013; 25 (10): 555-564.
4. Christopoulos G, Kotsia AP, Rangan BV, Vo M, Alaswad K, Karpaliotis D et al. "Subintimal external crush" technique for a "balloon uncrossable" chronic total occlusion. *Cardiovasc Revasc Med.* 2017; 18 (1): 63-65.
5. Dash D. Korean circ interventional management of "balloon-uncrossable" coronary chronic total occlusion: is there any way out? *J.* 2018; 48 (4): 277-286. doi: 10.4070/kcj.2017.0345.
6. McQuillan C, Jackson MWP, Brilakis ES, Eged M. Uncrossable and undilatable lesions-A practical approach to optimizing outcomes in PCI. *Catheter Cardiovasc Interv.* 2021; 97: 121-126. Available in: <https://doi.org/10.1002/ccd.29001>

Declaration of patient consent: the patient gave consent.

Funding: this article received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of interest: the authors declare no conflict of interest.

Correspondence:

Melisa Ucar, MD

E-mail: mmelisauca@icloud.com