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Case Report

The Balloon Paradox-A Case Series

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Abstract

Background: Once regarded as the final frontier of coronary intervention, the success rates of chronic total occlusion (CTO) angioplasties have been steadily increasing. Understandably, the use of specialized hardware makes this an expensive undertaking. We propose a novel, creative, and inexpensive method to address this issue, by simply using a balloon, differently.

Case summary: While specialized wires facilitate crossing the CTO segment, lesion preparation remains a challenge. Vigorous manipulation of routine PCI balloons for lesion entry can be detrimental. Tapered micro-catheters are successful as they rely on rotational forces and maintain guide stability.

Newer CTO PCI balloons have crossing profiles comparable to most micro-catheters. Hence, applying rotational force on these kink-resistant balloons, facilitates their use as low-cost micro-catheters. We employed this technique, with surprisingly good results. While not all the lesions could be successfully crossed, the financial implications of this study on a small cohort of patients are, in our humble opinion, quite significant.

Discussion: The aforementioned method uses inexpensive hardware, which can be used further, for lesion preparation. The balloon functions on the principle of a Tornus catheter, burrowing deep into the occluded segment. While this technique has higher failure rates in heavily calcified lesions, we were able to cross the lesion in a fair number of cases. We believe this technique, which is safe and simple, can reduce the dependence on complicated and expensive CTO hardware in a significant number of cases.

Learning Points

1. Balloon can be used like a corsair and tornus in balloon uncrossable lesions
2. It provides a safe and inexpensive way to cross such lesions.

Keywords: Balloon uncrossable lesion; CTO; Micro-catheter; Corsair; Tornus; Penetrability.

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Introduction

Balloon uncrossable lesions and Balloon uncrossable Chronic Total Occlusions (BU-CTO) from time immemorial have been regarded as the final frontier for coronary interventions. The extensive calcification and fibrosis and long segments of occlusion make revascularization particularly challenging. In patients with significant angina, CTO intervention has proven to be highly effective for the relief of symptoms. Even considering the procedural costs, it has been argued that BU-CTO PCI is likely to be cost-effective. In patients with demonstrable ischemia in a territory supplied by an occluded vessel, BU-CTO intervention is likely to offer prognostic benefit, but this has not yet been confirmed in a large-scale randomized trial [1]. BU-CTO interventions are now routinely attempted with a fair degree of success.

Failure to cross the CTO, with a balloon, after successful guidewire crossing is the second most common cause for CTO PCI failure, occurring in 2-10% of cases. Balloon-uncrossable chronic total occlusions (BU-CTOs) are lesions that cannot be crossed with a balloon after successful guidewire crossing and confirmation of guidewire placement into the distal true lumen. The incidence of such BU CTO is not uncommon even with rapid advances in technique and technology. [2,3] The balloon-uncrossable (BU) lesion is often due to severe calcification at the occlusion site or a significant tortuosity or a combination of both [4].

This article intends to propose a simple technique of crossing a BUC lesion, that too, with armamentarium easily available as described below, using basic concepts of physics and the consistently improving design of balloon catheters.

Methodology

The inability to deliver a balloon to the desired segment is conventionally dealt with using microcatheters or enhancing support with a guide-liner. The microcatheters currently available have been well designed and enhance the ease of guidewire crossing and negotiation of the distal tortuosity. Of course, this adds an additional cost to the procedure and may not always be successful.

A simpler, more prudent technique was used which has come in handy multiple times. This method has been tried in 42 of our patients with good results and without the need for intervening expensive hardware Initially, this method was employed in a few of our BUC lesions where Corsair, Tornus, anchor wire, etc. had failed/ were not available. While a CTO balloon such as Sapphire or Across CTO balloons are ideal, even a regular compliant rapid exchange 1.25/1.5 mm PTCA balloon can be used for this purpose. The balloon is passed as deep as possible into the lesion and is wedged against the CTO segment. Thereafter, the balloon shaft is rotated clockwise for 8 to 10 turns at a time which may be repeated as per discretion with a very gentle forward pressure (Figure 1). Keeping count of the number of rotations is imperative as the balloon must be unwound with the same number of rotations. This prevents wire wrapping and adhesion between the balloon shaft and the angioplasty wire thereby preventing inadvertent loss of wire position while pulling the balloon out. Following are two salient cases which we wish to discuss (Figure 2).

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Figure 1: Balloon shaft rotated over the wire.

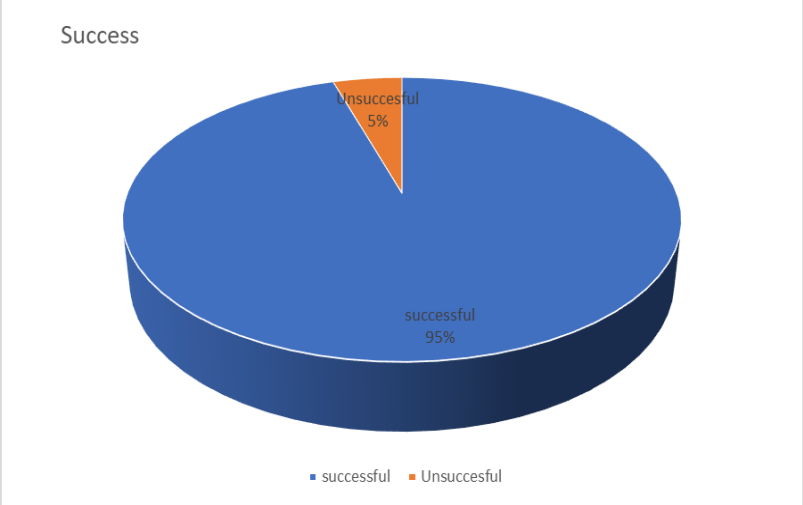

Figure 2: Pie diagram depicting Success rates in our case study.

Case 1

A 65-year-old healthy gentleman presented with stable angina and NYHA Class II. ECG was normal. His treadmill stress Test was positive as per the Dukes Criteria. Further evaluation was advised and undertaken after obtaining consent from the patient. Coronary angiography revealed a 50% lesion in the LAD and RCA was diffusely diseased with a subtotal stenosis in mid-segment (Figure 3). It was heavily calcified. PCI was planned. The RCA was cannulated with a 7 F JR 4 through a 7 F femoral arterial sheath. Run through floppy NS wire was used to cross the lesion.

A 2x15 millimeter(mm) compliant balloon was passed to predilate the stenotic segment; however, it could not be advanced at level of subtotal stenosis of RCA. The wire was replaced to a support wire (Grand Slam© ASAHI INTEC). Despite this the balloon could not cross the stenosis. A guide-liner was

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used to augment the support but was unsuccessful (Figure 4). Before considering rotational Atherectomy, we used the following method with success.

The same 2 mm Compliant Balloon was passed over the workhorse wire. It was wrapped clockwise 10 times applying a gentle push over the shaft. This was followed by anti-clock rotation of the balloon on the wire. Following which, the balloon could be freely passed through the subtotal stenosis (Figure 5), and with incremental inflations the lesion was opened, and PCI successfully performed (Figure 6).

Figure 3: Angiography image of diseased RCA.

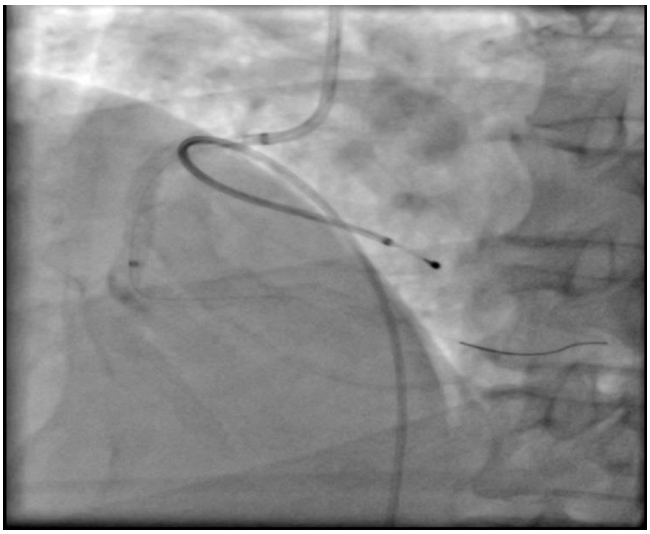

Figure 4: Guideliner in RCA for support.

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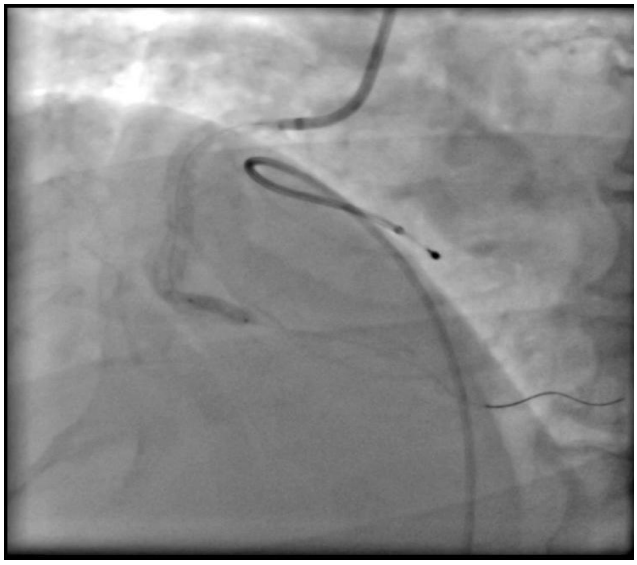

Figure 5: After using rotation technique.

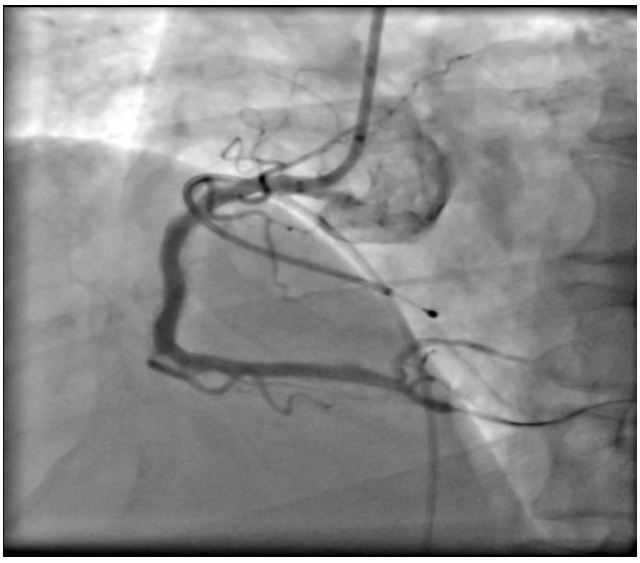

Figure 6: Final shoot post PCI.

Case 2

A 72-year gentleman underwent an annual health evaluation, where a 2 D echo suggested moderate left ventricular systolic dysfunction with anterior and inferior wall hypokinesia, this contrasted with the echo done a year ago which was normal. He had a previous coronary angioplasty to LCx seven years ago details of which were not available. The patient gave a history of dyspnoea on exertion. ECG showed LVH. Due to advanced osteoarthritis, he was unable to perform a TMT. He was prepared for coronary angiography, which was suggestive of LAD 90% lesion. LCx showed 90% ISR. RCA was dominant and diffusely diseased with total occlusion in proximal segment (Figure 7). The choice of CABG was offered to the patient

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who did not consent for it hence PCI was planned in staged manner. After informed written consent was obtained it was decided to perform PCI of LAD, LCx and RCA. LAD and LCx were revascularized. RCA was cannulated with 7 F JR4. Initial attempt at crossing Fielder XT wire failed even with balloon support (Figure 8).

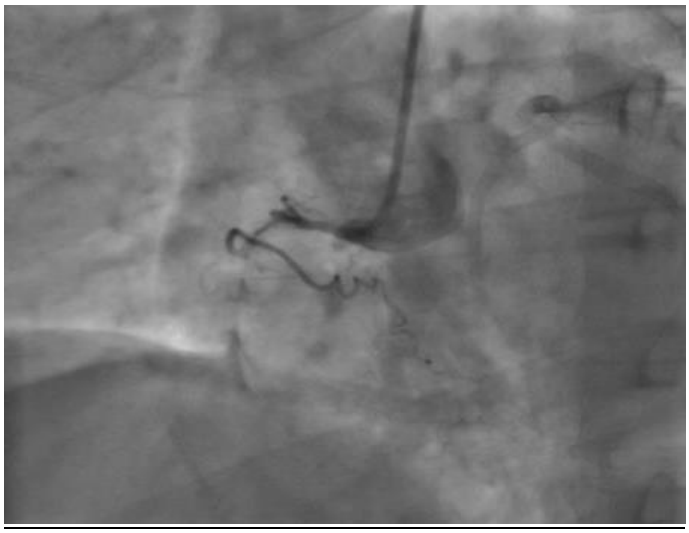

Figure 7: Totally occluded proximal RCA which is calcified.

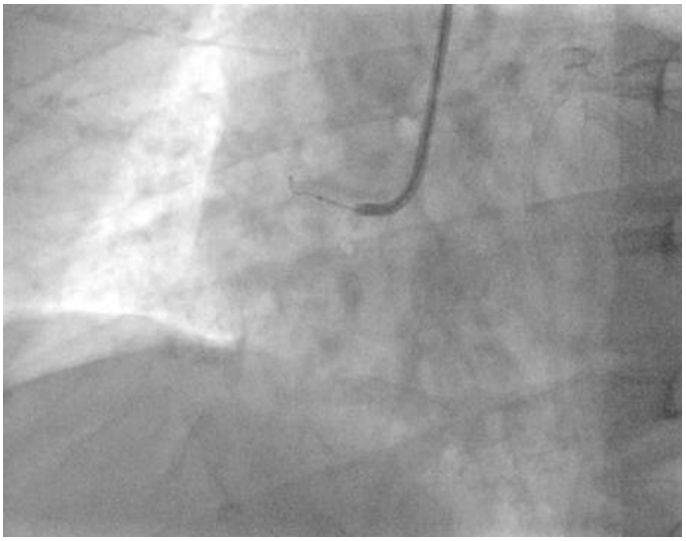

Figure 8: Using balloon support to advance Fielder XT-R.

It was upgraded to GAIA I which crossed the lesion (Figure 9). A 1.25x10 mm Balloon was unable to cross the lesion (Figure 10). A corsair was employed, without any good outcome (Figure 11). Thereafter, over the workhorse wire parked in the RCA the 1.25 mm compliant balloon was passed up to the lesion and the aforementioned technique was employed. This proved fruitful and PCI could be performed successfully thereafter (Figure 12,13).

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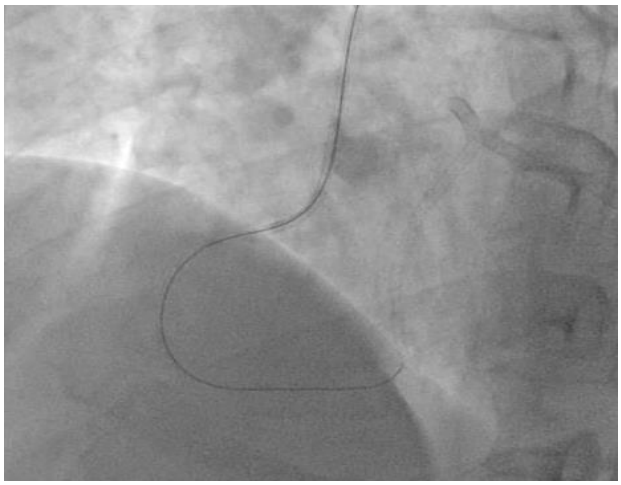

Figure 9: Gaia 1 successfully crossing the lesion.

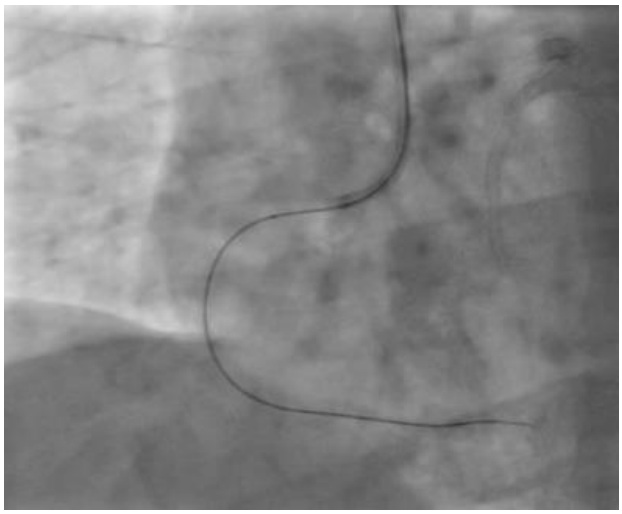

Figure 10: Balloon not crossing the CTO segment.

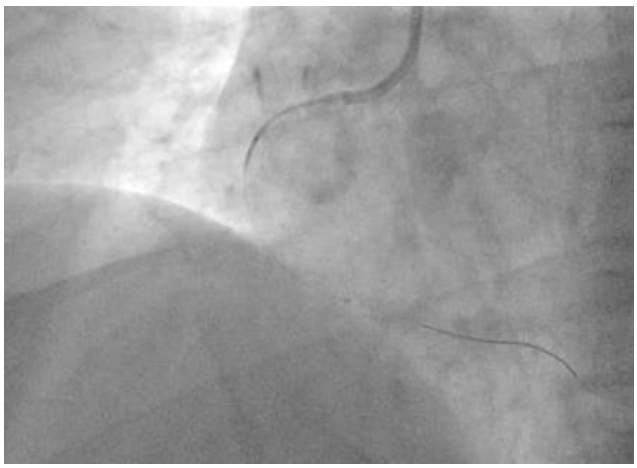

Figure 11: Corsair used without success.

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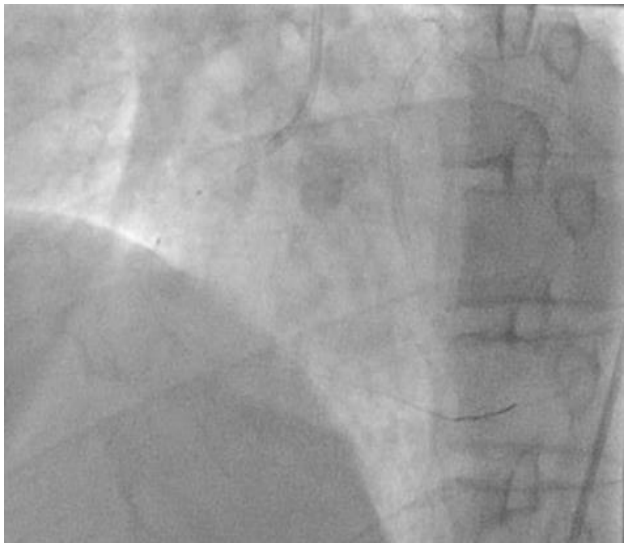

Figure 12: Balloon crossing after using our technique.

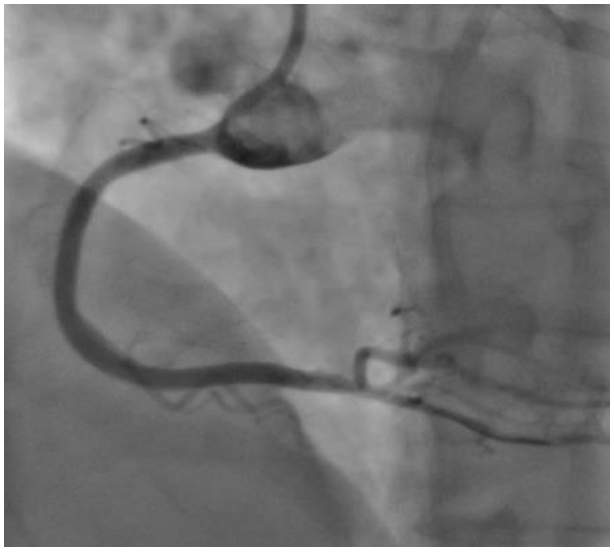

Figure 13: Final shoot post PCI.

Discussion

Non-Balloon crossable lesions can be challenging to treat but are also likely to be increasingly encountered given the increasing complexity of PCIs. Patients with balloon-uncrossable CTOs had longer procedure time(184.5 ± 77.9 vs 134.0 ± 69.0min, P<.01), fluoroscopy time(55.2 ± 24.9 vs 37.9 ± 20.8min, P<.01), and received high contrast volume(404.4 ± 137.9 vs 351.7 ± 138.5 mL, P=.08), but had similar incidence of major complications(8.3% vs 3.2%, P=.25) as compared with patients who did not have balloon-uncrossable CTOs [4]. The aforementioned method does not engage any expensive or specialized hardware and saves the cost of additional material. The same balloon can be used for predilatation. The balloon functions on the principle of a

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Tornus/Corsair, burrowing deep into the BU segment. While this technique has obvious limitations, which includes but is not limited to difficulty in crossing very heavily calcified lesions, entanglement, etc. it may help to negotiate a substantial number of lesions. Tornus had a success rate of 81% [5] and Corsair has a success rate of 86%. We initially started using this method when other devices were unsuccessful and thereafter moved on to use it as our primary choice.

In our Cohort of 42 individuals there were 16 females (38.09%) and 26 Males (61.91%) with an average age of 74.35 years. Among these patients RCA was target vessel in 17(40.4%), Circumflex in 9(21.43%) and LAD in 16 patients (38.09%) (Figure 14).

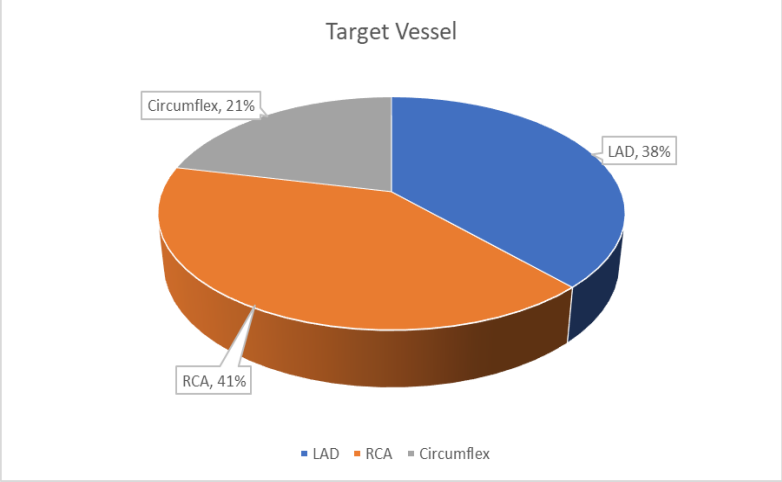

Figure 14: Lesions involved in pie chart.

The success rate of 95.24% (40/42 patients) was seen. We did not face any case where there was loss of wire position, shaft fracture or loss of access (Figure 2).

In LAD target vessels success rates were 15 out of 16 patients (93.75%); RCA 15 of 17 individuals (88.34%) and all in circumflex lesions (100%). Moreover, the cost of the entire procedure is significantly minimized due to the absence of expensive hardware.

This technique will help to avoid the use of complicated and expensive CTO hardware in a fair number of cases. It also provides a safe and new method of crossing the BU lesions. However, this method too, is not free of complications and balloon entanglement and shaft fracture is a possibility, as is with tornus or corsair. The aforesaid complications were not observed in any of our cases. Moreover, the sample size provided in this study is inadequate to judge the true success rates as compared to other methods. This needs further evaluation for cost benefits and success rates.

Conclusion

Each BU presents a unique challenge requiring creativity pertaining to a certain case. Success rates though being high, incorporate multiple hardware and are time consuming. Our method adopts the basic principle of lesion modification, however with the presence of a simple balloon which

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will be subsequently used during the procedure. Simultaneous use of various techniques enhances the chance of balloon crossing. Hence the aforesaid method is a new method in the armamentarium of BU lesions albeit providing superior results at a cost-effective mode.

Conflict of interest/Disclosures

This article has not been submitted to any other journal for publication. There is no conflict of interest, financial or otherwise.

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