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6 **Unexpected Entrapment of Caravel Microcatheter in Percutaneous Chronic**  
7 **Total Coronary Intervention**

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15 A 60-year-old male with known hypertension, diabetes, and atrial fibrillation was electively  
16 admitted for his PCI to the left anterior descending/diagonal 2 (LAD/D2) bifurcation chronic  
17 total occlusion (CTO).

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19 A Caravel microcatheter (Asahi Intec Co., Japan) was passed down to the first septal perforator  
20 (S1) of LAD over a Runthrough guidewire (Terumo Corporation, Japan), and the ipsilateral  
21 collateral channel to LAD was marked by the contrast microinjection technique (Figure 1). A  
22 Sion Black (Asahi Intec Co., Japan) guidewire was traversed through the ipsilateral collateral  
23 into the 2nd Diagonal beyond the CTO. The Caravel microcatheter failed to negotiate the acute  
24 bend in the distal part of the first septal perforator, and we then decided to exchange the Caravel  
25 microcatheter with a coil-based braided microcatheter in order to apply rotational push to  
26 overcome the bend. However, during removal, the tip of the Caravel microcatheter unexpectedly  
27 became trapped in the calcified ostial part of the first septal perforator (S1) of LAD (Figure 2).  
28 After several failed gentle pulling efforts, we cut the proximal shaft of the Caravel microcatheter  
29 and passed a 6F guide catheter extension, GuideLiner (Teleflex, Morrisville, USA) to reach close  
30 to the origin of S1. The distal part of the microcatheter's tip was detached and left behind in the

proximal part of S1 (Figure 3). There was a loss of flow in the first septal perforator. The patient, however, remained clinically and hemodynamically stable with no chest pain or ECG changes. The procedure was completed antegradely by wire escalation technique leaving the detached tip of the microcatheter in situ (Supplementary Videoclip 1).

Microscopic examination of the retrieved microcatheter at Asahi Intec Co.'s lab revealed approximately 2 mm of the distal part of the Caravel's tip was dislodged. There was a scratch originating from the torn end of the tip suggesting that the tip of the Caravel microcatheter was hooked by a protruding calcium nodule (Figure 4). Patient's consent was obtained for publication purpose.

## **Comment**

CTO interventions are challenging, marked by steep learning curves and lower success rates, due to the complexity of chronically occluded vessels.<sup>1</sup> Microcatheters are indispensable in CTO interventions, providing essential flexibility and agility to navigate complex and tortuous coronary anatomy. They act as conduits for guidewires, significantly enhancing the procedure by offering better support to the CTO guidewire, improving penetration capacity, facilitating the reshaping of the guidewire tip, enabling easy guidewire exchanges, and safeguarding the proximal vessel from injuries induced by stiff CTO guidewires.<sup>2,3</sup> The Caravel microcatheter, with its thin-walled, hydrophilic design and tapered tip, is valued for its ability to smoothly navigate especially through retrograde micro-channels.

Microcatheter over-torquing is the most common cause of entrapment, particularly when undue rotation is applied to microcatheters, including the Caravel, that are not designed for rotational use.<sup>4</sup> In our case, no rotational force was applied to the Caravel during its advancement in the septal channel. We decided to remove it after its failure to navigate the acute bend in the distal part of the first septal perforator. However, while it was being removed, it unexpectedly became trapped in the calcified ostial part of the S1 segment of the LAD, most likely by a protruding speck of calcium in the angulated part of S1. Various techniques for retrieving entrapped microcatheters have been described. The pulling technique involves traction on the entrapped microcatheter, but strong traction can result in vessel dissection or perforation and may also

cause fracture of the microcatheter tip, especially with softer microcatheters like the Caravel.<sup>4</sup> The telescoping technique involves using a guide catheter extension, which is advanced over the microcatheter's shaft after cutting its proximal end.<sup>5</sup> This technique helps safeguard against potential dissection or perforation of the vessel during the retrieval of entrapped microcatheters. In our case, despite the use of a combination of the pulling and telescoping techniques, the tip of the Caravel was fractured. The eventual successful management of the situation, opening the CTO through an antegrade approach and leaving the detached tip of the microcatheter in situ, demonstrates a pragmatic approach to an unforeseen complication. This case serves as an educational example of the technical difficulties encountered during CTO PCI, highlighting the need for careful planning, the availability of alternative strategies, and the readiness to manage complications to ensure patient safety and procedural success.

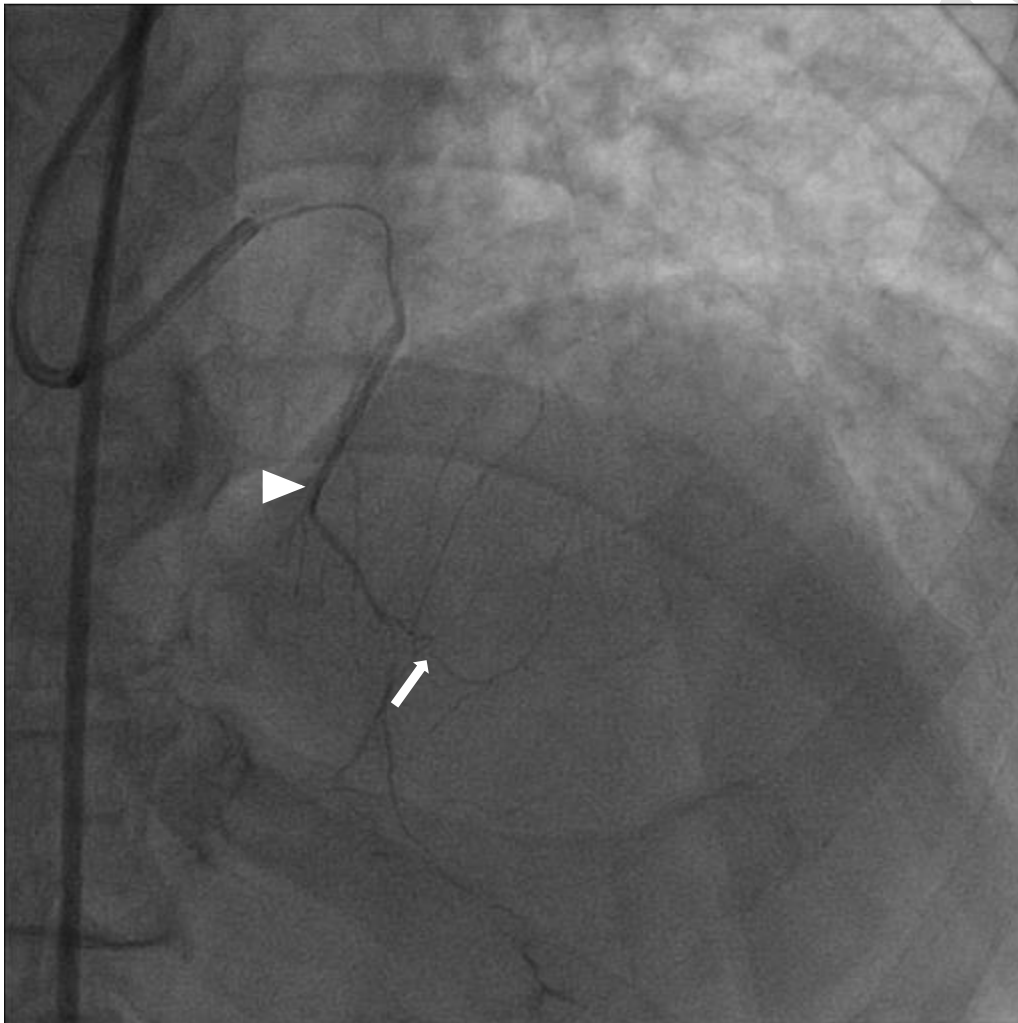
#### **Authors' Contribution**

MAS and ABAR managed the case, MAS drafted the manuscript, MAK provided the images and HBO checked the final version of the manuscript. All authors approved the final version of the manuscript.

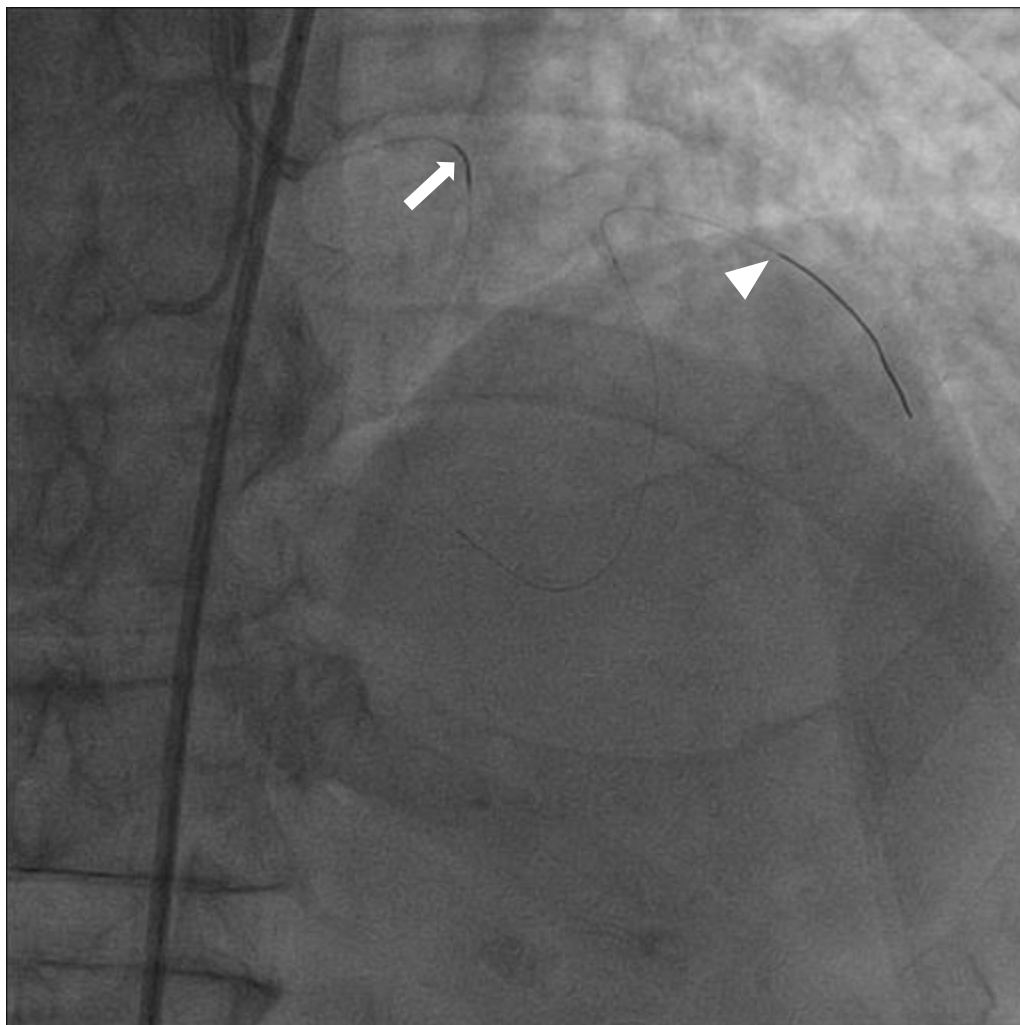
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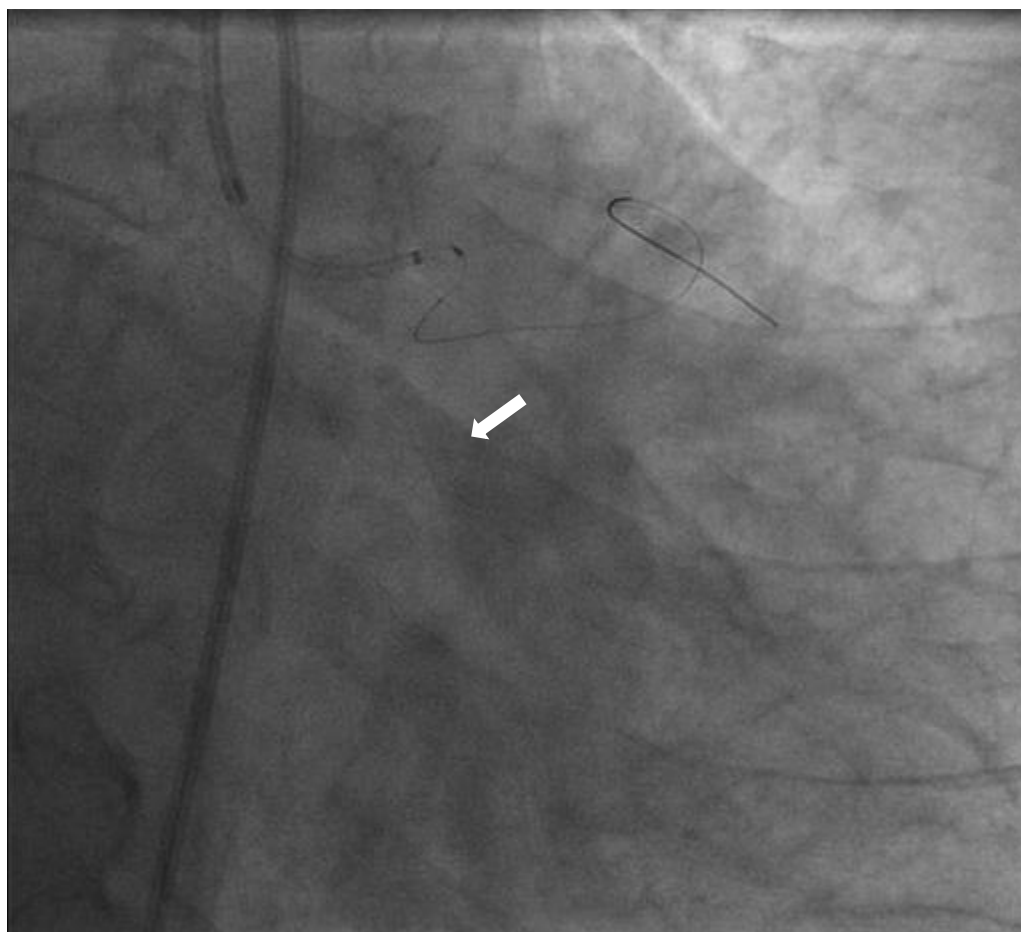


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101 **Figure 1:** Contrast microinjection showing ipsilateral collateral to LAD (arrow) and tip of  
102 Caravel Microcatheter at acute bend in distal part of first septal perforator (arrowhead).

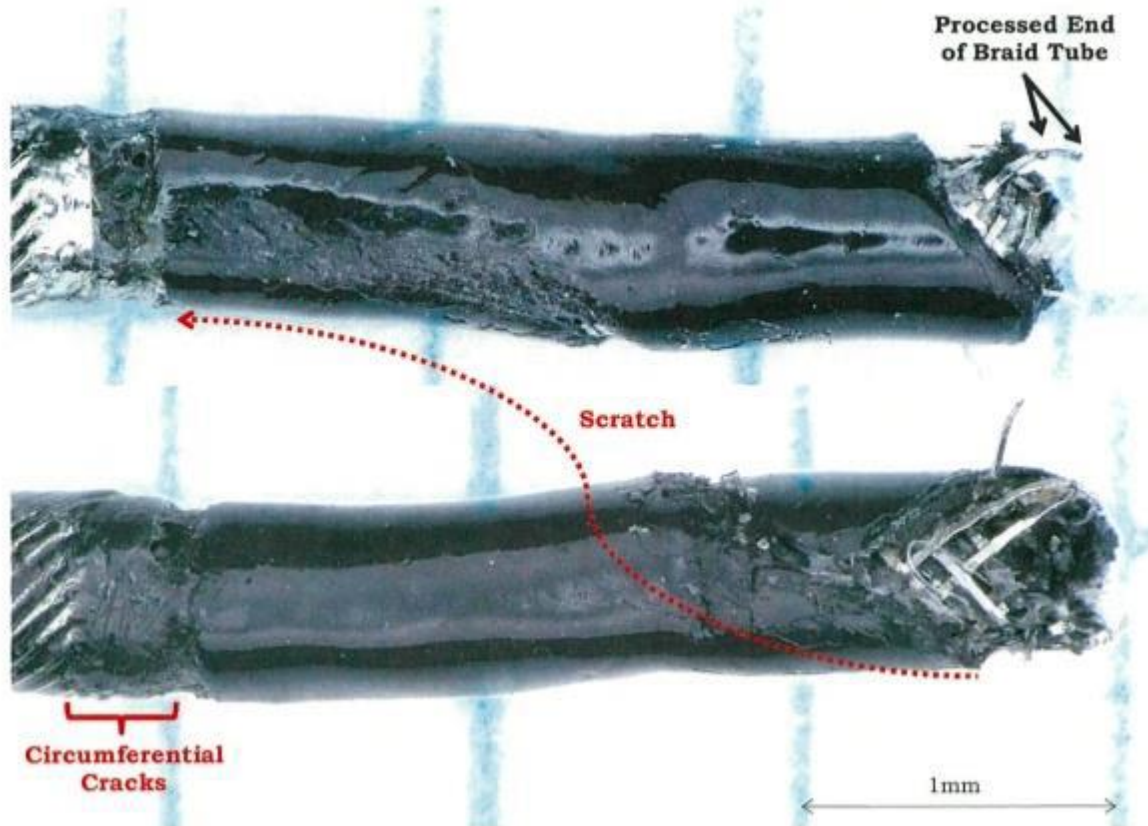


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105 **Figure 2:** Showing Caravel Microcatheter's tip entrapment position at ostium of first septal  
106 perforator (arrow) and Sion Black GW in 2nd Diagonal (arrowhead).



**Figure 3:** Anterior-posterior caudal view showing detached distal tip of Caravel microcatheter in first septal perforator.



**Figure 4:** Microscopic examination of retrieved Caravel microcatheter showing circumferential cracks resulting from stretching of tip polymer at tip-shaft junction and scratch from the torn end of tip.

**Supplementary Videoclip 1:** Demonstrates the opened LAD/D2 bifurcation chronic total occlusion and the retention of the detached tip of the microcatheter in situ within the first septal perforator.