Fracture and retrieval of an Achieve circular mapping catheter in and from a pulmonary vein during cryoballoon ablation for atrial fibrillation

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Introduction
Fracture of an electrophysiological catheter is a rare adverse event in the electrophysiology laboratory.1,2 To date, only a few cases of entrapment and/or fracture of a circular mapping catheter have been reported.3–5 Herein, we describe the fracture and removal of an Achieve catheter from a pulmonary vein during cryoballoon ablation for atrial fibrillation (AF).

Case report
A 48-year-old man underwent cryoballoon ablation for symptomatic recurrent drug refractory paroxysmal AF. He was previously treated with flecainide, but it was discontinued because of inefficacy and adverse effects. Other than AF, his medical history was pertinent only for Bright disease as a child and cervical vertebral fusion.

In the electrophysiology laboratory, vascular access was obtained via the right internal jugular (6 French), right femoral (Medtronic Flexcath Advance LA 15 French), and left femoral veins (7 and 9 French sheaths). A Medtronic 12-F FlexCath steerable sheath was used to cross the atrial septum under guidance with a Siemens Acuson intracardiac ultrasound probe. A 20-mm Achieve circular mapping catheter and a Arctic Front Advance cryoballoon (28 mm) catheter were advanced into the left atrium via the transseptal sheath. The patient was heparinized to achieve an activated clotting time of >300 seconds throughout the catheter ablation procedure.

Additional diagnostic electrophysiology catheters were positioned in the high right atrium, right ventricular apex, coronary sinus, and His bundle region for pacing and recording. Electrophysiologic testing was then performed. A shell of the pulmonary veins and the left atrium was made using the Endocardial Solutions EnSite 3-dimensional mapping system. The pulmonary vein anatomy included a left common antrum with branches of left superior and inferior pulmonary veins. The right superior and inferior pulmonary veins were connected individually to the left atrium.

A 20-mm Achieve circular mapping catheter was initially positioned within the proximal superior branch of the left pulmonary venous system, and two 180-second successive cryoablation lesions were delivered using a “freeze-thaw-freeze” approach. The system was removed from the superior branch and positioned in the left inferior branch, and a similar diagnostic and ablation strategy was applied to this region. After isolation of this vein, attempts were made to withdraw the Achieve catheter from the proximal left inferior pulmonary vein branch. The catheter tip was immobile and could not be withdrawn with significant resistance. Numerous attempts to reduce the catheter, including reversal of torque with forward and backward translational displacement, failed. It became apparent that the tip of the catheter was likely lodged and fixed in a small side branch or diverticulum of this vessel. Repeated attempts to reduce and withdraw this catheter resulted in a fracture of the distal portion of the circular mapping catheter from the catheter shaft. The majority of the catheter (the shaft and the proximal portion) was successfully removed from the transseptal catheter. A snare was introduced via the transseptal catheter, but efforts to capture the distal catheter fragment were unsuccessful. The snare was then removed, and a biotome was introduced into the left atrium via the transseptal sheath. The distal portion of the fractured Achieve catheter was captured using the biotome, successfully withdrawn by applying retrograde traction from the transseptal catheter, and safely removed from the patient without embolism (Figures 1 and 2; Video 1). This maneuver was performed using fluoroscopic and echocardiographic imaging. The patient remained hemodynamically stable without any recorded hypoxia and hypotension, and there was no evidence of pericardial effusion as visualized by intracardiac echocardiography.

The ablation procedure was therefore resumed and completed, with successful isolation of the right inferior
and superior pulmonary veins. After the completion of the procedure, the patient recovered uneventfully from anesthesia and was sent to the recovery room where sheaths were removed when the activated clotting time was \( <170 \) seconds.

Postprocedural evaluation included a posterior-anterior, lateral chest radiography, and 2-dimensional echocardiography, neither of which showed any retained foreign body, pleural effusion, or pericardial effusion. A pulmonary consultation was requested, and the patient also underwent computed tomography (CT) imaging of the chest without contrast. No residual foreign body was seen, although a small left pleural effusion and atelectasis were noted. The CT scan of lung parenchyma was interpreted as possible left lower lobe pulmonary contusion versus infarction by the radiologist. Postablation, the patient received anticoagulation therapy with rivaroxaban (20 mg/d), which was tolerated well without incident. Postprocedure, the patient developed a severe cough lasting several weeks and complained of mild shortness of breath. After this period, the patient recovered completely and showed no pulmonary symptoms. CT imaging of the chest was repeated remotely, showing complete resolution of postprocedure abnormalities. The patient remained well for more than 1 year postablation without recurrence of AF after the discontinuation of antiarrhythmic medications.

Discussion
Our case describes a rare complication when using the Achieve circular mapping catheter during cryoballoon ablation for paroxysmal AF. Although entrapment and fracture of an Achieve catheter has been described before,4 the mechanism of its fracture and subsequent retrieval are of particular interest. During ablation procedures, this catheter can be advanced deeply into the pulmonary veins, potentially placing the patient at risk for entrapment or pulmonary injury, though in our procedure it was positioned proximally. We theorize that the distal portion (tip) of the catheter became lodged in a small side branch or diverticulum and could not be reduced using traditional approaches. The catheter fractured at the junction of the distal portion (soft and pliable) and the shaft (stiff), a possible weak point in the design of this catheter that obviously was not intended to be repeatedly torqued under significant traction. Fortunately,

![Figure 1](image.png)

**Figure 1** A: The fractured 20-mm Achieve catheter after removal. The shaft of the catheter appears to have separated from the distal portion. B: Photograph of the Achieve catheter with the biotome attached.

**KEY TEACHING POINTS**
- Entrapment and fracture is a possible complication when a “lasso-like” Achieve mapping catheter is used in a pulmonary vein during cryoablation for atrial fibrillation.
- Although the distal portion of the Achieve mapping catheter is pliable and maneuverable, the junction of the distal portion and the stiffer shaft may be an inherent weak point.
- There are multiple options to retrieve a fractured catheter. The use of a biotome may prove successful in a setting where it is necessary to capture a smooth section of the catheter.
this is an extremely rare occurrence and we were able to successfully retrieve the lodged fractured distal portion using a biotome, with minimal postprocedural sequelae. The snare, which was used initially in an attempt to retrieve the fractured portion, was unsuccessful in the retrieval. The smooth design and pliability of the distal portion of the Achieve circular mapping catheter did not provide an adequate substrate for the snare to grip. The biotome was able to both fit through the sheath and capture the fractured portion of the catheter securely. This case may serve to aid in troubleshooting and problem solving if this event were to occur again during future procedures.

Appendix
Supplementary data

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.hrcr.2014.11.001.

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