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IMAGES IN INTERVENTION

Apically Tethered Transcatheter Mitral Valve Implantation

Detailed In Vivo Function From Cardiac CT

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A 76 year-old man with a background of hypertension, type 2 diabetes, hyperlipidemia, cigarette smoking, chronic airways limitation, and chronic renal impairment (estimated glomerular filtration rate 35 ml/min/1.73 m^2) was referred for management of severe symptomatic mitral regurgitation. He had had an inferolateral myocardial infarction and subsequent coronary bypass surgery 20 years previously, and developed severe secondary mitral regurgitation due to chordal shortening and tethering of the posterior mitral leaflet. Diagnostic angiography showed patent grafts. The left ventricular ejection fraction was 35% to 40% and the pulmonary artery systolic pressure was 55 mm Hg. He was considered a poor candidate for surgical valve repair or replacement due to his comorbidities, and was not well suited anatomically for transcatheter mitral valve repair because of the degree of leaflet tethering. He was enrolled in the Tendyne Global Feasibility Trial (1), and underwent transcatheter mitral valve implantation using a Tendyne Mitral Valve System (Tendyne Holdings, Roseville, Minnesota).

The device was implanted using a transapical approach through a left lateral minithoracotomy. It was advanced through a 34-F delivery sheath, partially unsheathed in the left atrium, retracted and fully deployed within the mitral annulus, and then tethered to an epicardial pad at the apex. The postprocedural course was uncomplicated. The patient was discharged home 7 days post-operatively.

Thirty days post-implantation, a wide-volume functional cardiac computed tomography was performed. The entire cardiac volume was captured within a single R-R interval, and images were reconstructed at 5% phase intervals. Four-dimensional image processing was then performed (PhyZiodyamics

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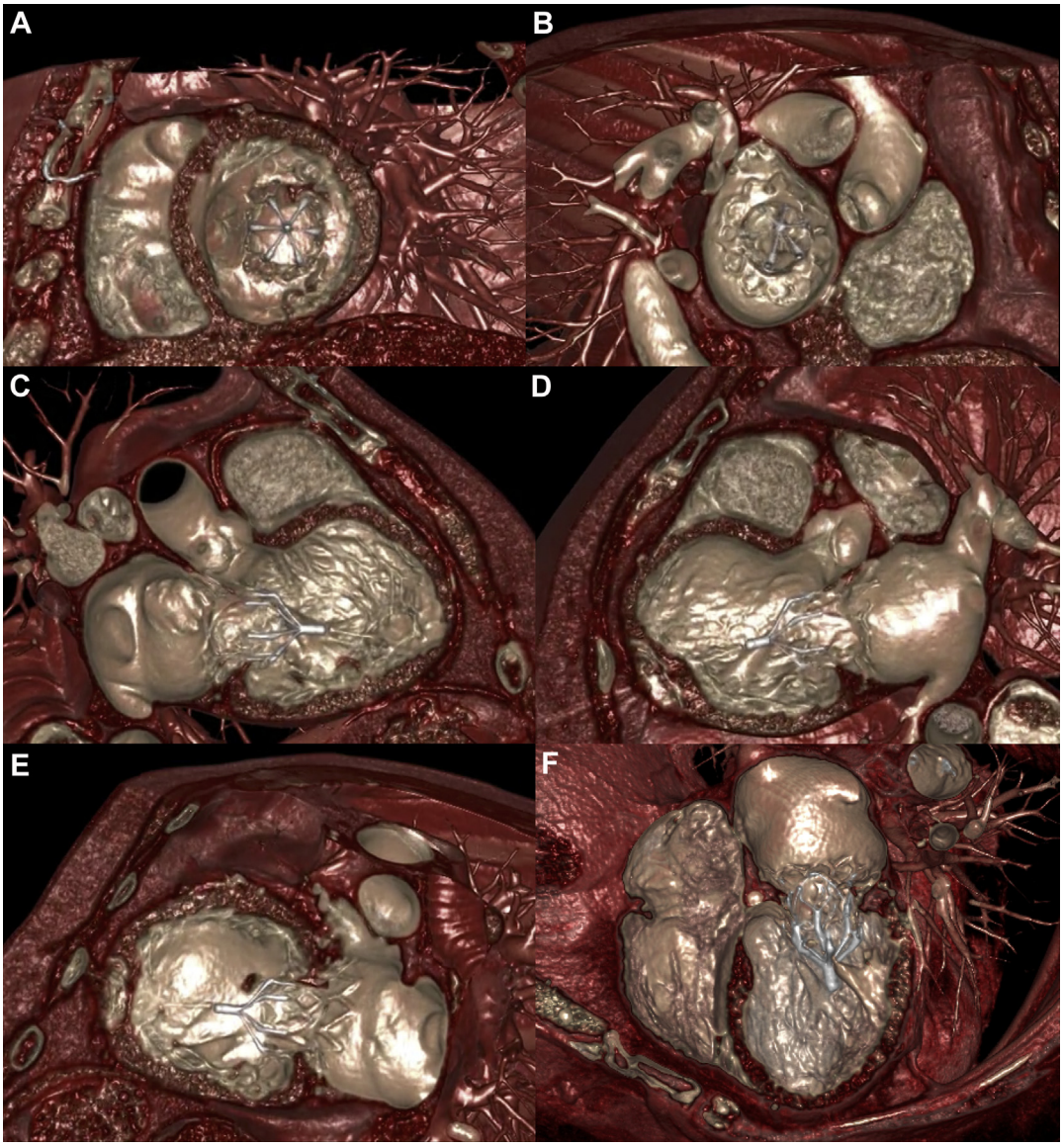
FIGURE 1 Cardiac CT of an Apically Tethered Transcatheter Mitral Valve



(A) Short-axis view of the left ventricle, viewed from the apex (Online Video 1). The Tendyne valve (Tendyne Holdings, Roseville, Minnesota) sits within the mitral annulus. A single tether is positioned at the center of the valve, preventing retropulsion of the valve into the left atrium. The left ventricular outflow tract is seen to the left of the image, adjacent to the valve position. Severe global left ventricular dysfunction is present. **(B)** Short-axis view of the atrial surface of the mitral valve, viewed from the left atrium (Online Video 2). The self-expanding outer frame seats the prosthesis within the mitral annulus. The cuff of the outer frame lies on the floor of the annulus and abuts the aortomitral curtain anteriorly. The valve leaflets are attached to a circular inner frame. **(C)** Three-chamber view of the heart and implanted valve shows the valve, left ventricular outflow tract, and tether placement (Online Video 3). The trajectory of the tether is orthogonal to the plane of the mitral annulus. The apical pad lays posterolateral to the true apex. **(D)** Pseudo three-chamber view of the heart, in plane with the valve tether, showing its insertion point lateral to the true apex (Online Video 4). **(E)** Two-chamber view of the heart showing the outer frame, tether, and epicardial pad (Online Video 5). **(F)** Four-chamber view of the heart showing apicolateral placement of the tether, perpendicular to the true mitral annular plane (Online Video 6).

and InVivo, Ziosoft, Tokyo, Japan) to reduce image noise by combining signal information over multiple time points. High-quality rendered images of the beating heart were created with the assistance of a dedicated Graphics Processing Unit (GPU) accelerator (Figures **1A to 1F**, Online Videos 1, 2, 3, 4, 5, and 6). Computed tomography and echocardiography demonstrated normal function of the implanted valve with no left ventricular outflow tract gradient.

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KEY WORDS cardiovascular CT, mitral regurgitation, transcatheter mitral valve replacement

APPENDIX For supplemental videos and their legends, please see the online version of this article.