The Impact of Real-Time Contact Force Feedback on Cardiac Ablation: U.S. Physician Experience Interviews

ABSTRACT

In early 2011, a group of physicians from the US began evaluating a new technology for radiofrequency ablation of atrial fibrillation measuring tip-tissue contact force in real time and displaying it on a 3D electroanatomical mapping system. Five of these physicians were interviewed to share their experiences and how they applied contact force to their procedures.

Participants

Dr. Rodney Horton, St. David’s Medical Center, Austin, TX • Dr. Daniel Melby, Minneapolis Heart Institute, Minneapolis, MN
Dr. George Monir, Florida Hospital Orlando, Orlando, FL • Dr. Andrea Natale, St. David’s Medical Center, Austin TX
Dr. Scott Pollak, Florida Hospital, Orlando, Orlando, FL

BACKGROUND

For years, physicians have been treating atrial fibrillation (AF) with radiofrequency (RF) catheter ablation. RF energy is used to create long, continuous lesions in the left atrium, but long term success rates leave room for improvement. Follow up procedures are often required when the initial procedure fails to eliminate the arrhythmia. Better understanding of the physical processes that take place during ablation may help improve the procedure outcome.

In addition to RF power and application time, a significant factor affecting lesion formation is tip-to-tissue contact force. While power and time can be directly measured, electrophysiologists rely on indirect measurements such as tactile feedback, fluoroscopy, impedance, and electrogram reduction to determine contact force.

Cardiac mapping may also be affected by contact. As was shown by Perna and Heist, physicians exhibit varying force ranges during catheter manipulation and ablation. Since the size of the map depends on pressure exerted on the catheter, map size fluctuates based on contact force.

A new catheter, which directly measures contact force and direction, was utilized in 114 procedures at 21 investigational sites in the United States. Five electrophysiologists who participated in the evaluation were interviewed to discuss their experience with this new technology.

SOFTWARE INTERFACE

The ThermoCool® SMARTTOUCH™ 3D Module (Biosense Webster Inc., Diamond Bar, California) consists of two components: the ThermoCool® SMARTTOUCH™ Catheter and the CARTO® SMARTTOUCH™ 3D Software.

A precision spring allows for both axial and lateral movement in response to tip-tissue contact. Using an electromagnetic field, these small movements are then translated into contact force quantity and direction.
**KEY OBSERVATIONS FROM INITIAL CLINICAL USE OF THE CONTACT FORCE SENSING TECHNOLOGY**

**Dr. Andrea Natale**  
*St. David’s Medical Center, Austin TX*  
Signal amplitude and change in impedance are completely unreliable indicators of lesion formation. Conversely, contact force is a very reliable indicator that helps me to optimize energy delivery in every location. When I began using the THERMOCOOL® SMARTTOUCH® Catheter, I was consistently surprised to see that my perceived contact did not match the actual force measurement. It was, however, relatively simple to make the necessary adjustments to maintain proper contact force ranges while mapping and ablatting. As I gained experience, I learned to rely less on my perceived contact and more on the contact force as displayed on the CARTO® System.

**“Signal amplitude and change in impedance are completely unreliable indicators of lesion formation. Conversely, contact force is a very reliable indicator that helps me to optimize energy delivery in every location.”**  
– Dr. Andrea Natale

**Dr. Scott Pollak**  
*Florida Hospital Orlando, Orlando, Florida*  
For me, the biggest surprise was to see that 50% of the time, my perceived contact did not match the actual contact measured by the catheter. By minimizing contact force while mapping in the left atrium, I was able to minimize anatomic distortion and quickly create extremely detailed, high resolution maps.

**Dr. George Monir**  
*Florida Hospital Orlando, Orlando, FL*  
During my procedures with the THERMOCOOL® SMARTTOUCH® Catheter, I consistently saw how minor manual changes in my catheter orientation had significant impacts on the overall force, and that my perceived contact force rarely matched the force readings. Catheter manipulation became very intuitive, and helped me to deliver lesions in very challenging anatomies. Additionally, it was convenient to have the contact force information integrated into the CARTO® System screen in several locations, eliminating the need to check multiple monitors to ensure catheter location and contact force.

**Dr. Rodney Horton**  
*Minneapolis Heart Institute, Minneapolis, MN*  
Overall, this technology has greatly impacted my procedure workflow. By closely monitoring my contact force and ensuring my force vector was perpendicular to the heart tissue, I was able to avoid delivering unnecessary lesions, drastically decreasing my procedure time.

I am looking forward to using the THERMOCOOL® SMARTTOUCH® Catheter with the CARTO® VisiTag™ module in the new CARTO® SMARTTOUCH™ 3D software. With this, I am able to incorporate catheter stability, which is another key component of lesion formation. For example, if I know my contact force, power, and time, I still need to know the ablation tip is in a single location to ensure adequate lesion formation. These two parameters are vital to lesion formation, and when combined, will be very powerful.

**Dr. Daniel Melby**  
*Minneapolis Heart Institute, Minneapolis, MN*

**Dr. George Monir**  
*Florida Hospital Orlando, Orlando, FL*  
During my procedures with the THERMOCOOL® SMARTTOUCH® Catheter, I consistently saw how minor manual changes in my catheter orientation had
with this contact force resulted in transient termination of the PVCs. Eventually, I was able to increase my contact force and successfully eliminated the PVCs. Without contact force, I might have had recurrence in this location.

“I am looking forward to using the ThermoCool® SMARTTouch® Catheter with the CARTO® ViSTag™ Module in the new CARTO® SMARTTouch™ 3D Software. With this, I am able to incorporate catheter stability, which is another key component of lesion formation… These two parameters are vital to lesion formation, and when combined, will be very powerful.”

– Dr. Daniel Melby

Dr. Rodney Horton
St. David’s Medical Center, Austin TX

In my initial experience with the ThermoCool® SMARTTouch® Catheter, I was surprised to see how much contact force varied in different areas of the heart. With this technology, I was able to modify my contact force in both high and low contact applications to provide effective therapy. In spite of taking the time to adjust the catheter to achieve appropriate contact force, I was still able to reduce my procedure time.

Dr. Andrea Natale
St. David’s Medical Center, Austin TX

Mapping or ablating at high forces can contribute to perforation, steam pop, or charring. The upper limit alarm was extremely important to set because it is difficult to judge contact while ablating. Knowing how unreliable my perceived contact force was, I now feel safer maneuvering the catheter inside the heart.

Dr. George Monir
Florida Hospital Orlando, Orlando, FL

When mapping with the CARTO® 3 System, I used contact force extensively. When performing right atrial flutter ablations, I did not take an ablation point until I achieved adequate contact force. The heart movement in this area makes catheter tip contact difficult to judge. With contact force, I was able to achieve bidirectional block with a very low incidence of ‘touch ups’ or the need to draw multiple lines.

Dr. Scott Pollak
Florida Hospital Orlando, Orlando, Florida

The more I paid attention to how to maneuver and properly position the catheter, the better my contact force was before I began ablating, and the more I saw my procedure time drop. During ablation, it was fairly easy to keep the contact force within range, and I titrated power down only when a high contact force was consistently seen in a given area. I also found the high force alert very helpful. If I looked away from the screen, I could see the red in my peripheral vision and knew I needed to readjust my catheter.

Dr. Daniel Melby
Minneapolis Heart Institute, Minneapolis, MN

For one of my procedures, a patient had both AF and PVCs. After the pulmonary veins were isolated, I mapped the LV and found the PVCs were originating from the aortomitral continuity. I did my normal maneuvers to optimize contact, but was only able to achieve a very low contact force. I felt I had adequate contact, but the force number remained low. Ablating
References

1 ThermoCool® SMARTTouch® Catheter and CARTO® 3 SMARTTouch™ System andSoftware Module, Biosense Webster Inc., Diamond Bar, CA.


5 Perna F, Heist EK, Danik SB, et al. Assessment Of the Catheter Tip Contact Force Resulting In Cardiac Perforation In the Swine Atria Using the Force Sensing Technology. Circ Arrhythm Electrophysiol published online January 19, 2011; DOI: 10.1161/CIRCEP.110.959429.