Thermal Response of the Apollo$^{RF®}$ i90 Aspirating Probe

Arthrex Research and Development

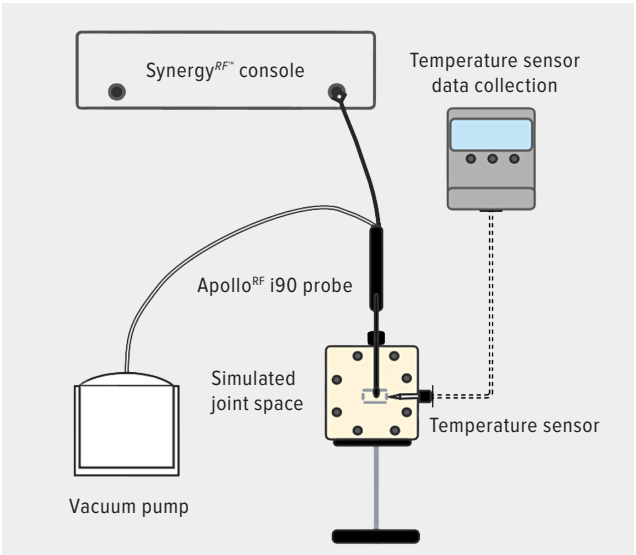
Introduction

During radiofrequency (RF) ablation procedures, management of intra-articular fluid temperature is critical due to the onset of cellular and tissue damage at temperatures ranging 45-55 °C.[1,2] The purpose of this testing was to evaluate the change in temperature in a simulated joint space environment with the Apollo^{RF} i90 probe.

Methods

The joint space was simulated using a clear acrylic cuboid with a volume of approximately 115 mL, which falls within the range of knee joint space volumes.[3] Irrigation fluid pressure was set at 35 mmHg for the tests. Each probe was placed into a silicone rubber test substrate, which was used to simulate tissue and provide a consistent testing environment. A temperature sensor was inserted through the side port of the simulated joint space at approximately 2 cm to 3 cm from the probe's distal tip (Figure 1).

Figure 1. Thermal Response Test Setup



Each Apollo^{RF} i90 probe was tested at the default ablation setting of 7, and the device aspiration vacuum was set at 304 mmHg (12 inHg). Each probe (n = 5, respectively) was activated continuously for 1 minute, and the simulated joint space temperature was measured by the temperature sensor. The maximum temperature difference was calculated by selecting the first data point from each data set and subtracting that value from the maximum temperature present in the data set for each trial run. The resultant value represents the maximum temperature increase within each trial.

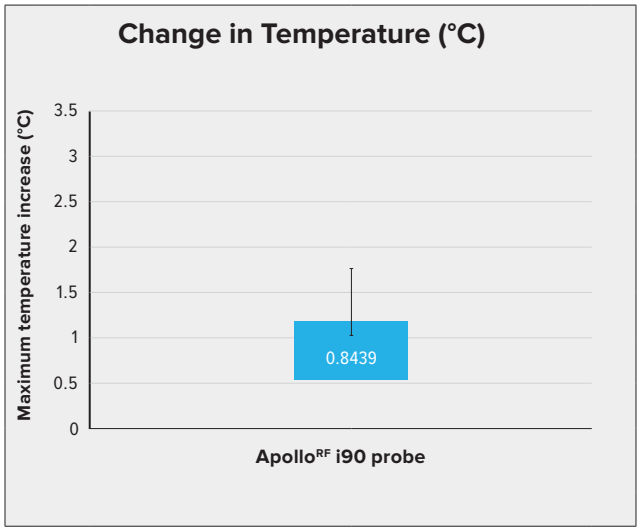
Results

The results for the temperature differences for each trial are displayed in Table 1. With the Apollo^{RF} i90 probe running for 1 minute at its default ablation setting and recommended pump setting per the directions for use, the average change in temperature was 0.8439 °C.[4]

Table 1. Maximum Temperature Differential Observed During Each Trial

Sample	Temperature Differences (°C)				
	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Apollo^{RF} i90 probe	1.7426	0.5601	0.7219	0.4730	0.7219

Figure 2. Maximum Temperature Increase With the Apollo[RF®] i90 Probe



Conclusion

At default ablation settings, the Apollo[RF] i90 probe's average temperature change was less than 1 °C. "The temperature of the irrigation fluid has been proposed as the most influential variable in intra-articular temperature variation during arthroscopic procedures."[5] The use of RF ablation devices under recommended parameters provides minimal temperature increases during ablation.

References

1. Horstman CL, McLaughlin RM. The use of radiofrequency energy during arthroscopic surgery and its effects on intraarticular tissues. *Vet Comp Orthop Traumatol*. 2006;19(2):65-71.
2. Voss JR, Lu Y, Edwards RB, Bogdanske JJ, Markel MD. Effects of thermal energy on chondrocyte viability. *Am J Vet Res*. 2006;67(10):1708-1712. doi:10.2460/ajvr.67.10.1708
3. Matziolis G, Roehner E, Windisch C, Wagner A. The volume of the human knee joint. *Arch Orthop Trauma Surg*. 2015;135(10):1401-1403. doi:10.1007/s00402-015-2272-0
4. Arthrex, Inc. Data on file (PLM107445). Naples, FL; 2024.
5. Longo UG, De Tommasi F, Salvatore G, et al. Intra-articular temperature monitoring during radiofrequency ablation in ex-vivo bovine hip joints via Fiber Bragg grating sensors. *BMC Musculoskelet Disord*. 2023;24(1):766. doi:10.1186/s12891-023-06836-6

arthrex.com