# Thermal Response of the Arthrex® ApolloRF™ MP90 and Smith & Nephew Super TurboVac90 Bipolar Ablation Probes in a Simulated Joint Space

Arthrex Research and Development

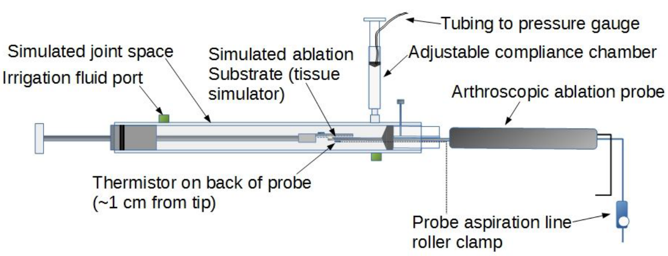
## Purpose

During radiofrequency ablation procedures, management of intra-articular fluid temperature is critical due to the onset of cellular and tissue damage at temperatures ranging from 45-55°C.[1,2] The purpose of this testing was to compare the temperature change in a simulated joint space environment between the Arthrex ApolloRF™ MP90 and Smith & Nephew Super TurboVac90 (STV90) bipolar ablation probes.

## Materials and Methods

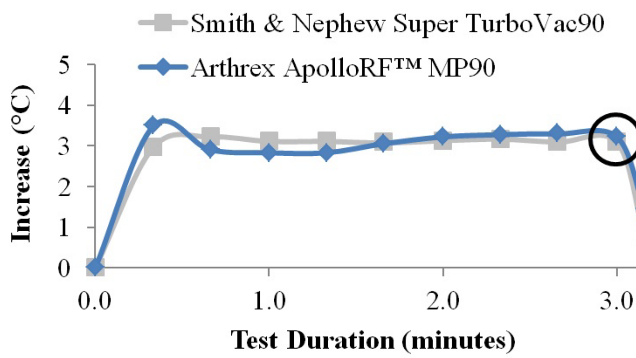
The simulated joint space was a clear plastic tube with a volume of approximately 115 mL, within the range of knee joint-space volumes.[3] Irrigation fluid pressure was set at 35 mmHg for all tests and aspirated material was measured at the end of the test to determine an aspiration rate. The probe was placed into an inorganic fiberglass cloth test substrate used to simulate tissue and provide a consistent testing environment. Probes were used no more than three times and each probe had a thermistor bonded 1 cm from the distal tip (Figure 1).

**Figure 1: Experimental test setup**




A range of device ablation settings (6, 7, 8, 9) and device aspiration vacuum settings (50, 200, 300, 400, 500 mmHg) were evaluated. Starting temperature ranged from 20-22°C with the increase in temperature calculated to account for any differences in starting temperature. While the device power and aspiration were active, temperature was measured every twenty seconds for three minutes. The increase in temperature measured at the end of the three minute test provides a measure of how much the simulated joint space temperature changed with each of the probes and test conditions and this temperature was compared for all conditions tested. A final temperature was also measured after 10 seconds of the device being completely off (Figure 2, sample profile for ablation setting 7 at 300 mmHg aspiration vacuum).

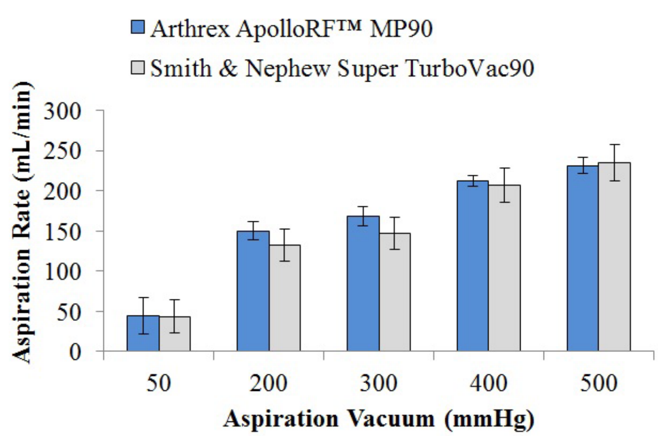
**Figure 2: Sample temperature profile, with final 3 minute temperature indicated.**




## Results

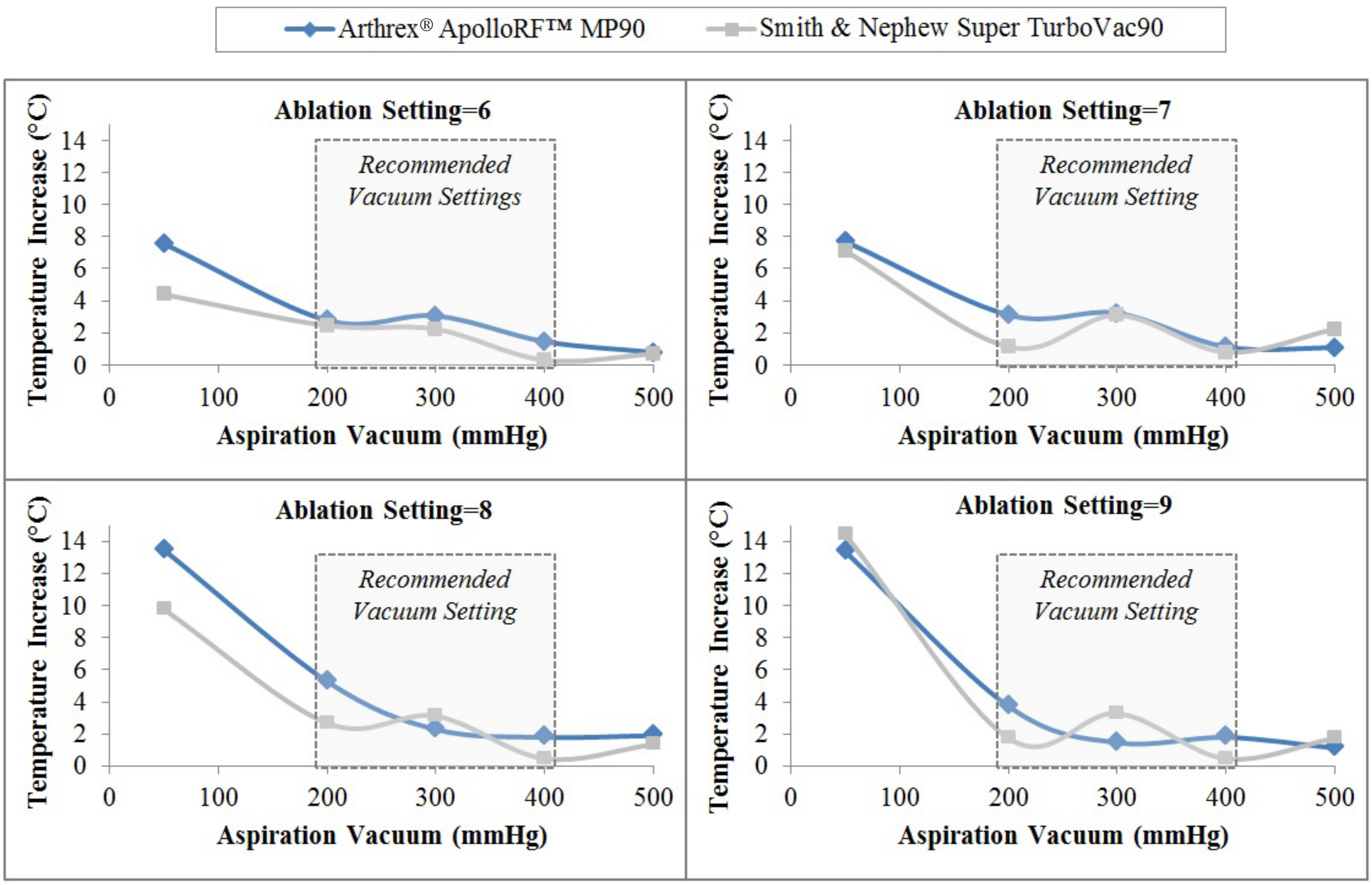
Aspiration rate increased with higher aspiration vacuums, and there was no significant difference in aspiration rate between the devices (Figure 3, no statistically significant difference between devices determined by two-way ANOVA, p=0.158).

**Figure 3: There was no significant difference in average aspiration rate between devices (data shown is averaged for all power settings).**




Temperature within the simulated joint remained fairly constant over the duration of the test, except at the lowest aspiration vacuum (50 mmHg). A summary of the final three minute temperature increase for all ablation settings and aspiration vacuums tested are shown in Figure 4, with no obvious temperature differences seen between the devices. It is also to be noted that vacuum settings below the recommended 200-400 mmHg resulted in large temperature increases above the threshold for potential tissue damage in both devices.

**Figure 4: Final three minute temperature measured at the tip of the aspiration probe for all tested conditions**




## Conclusion

Temperatures measured for the Arthrex ApolloRF™ MP90 and Smith & Nephew Super TurboVac90 were similar over all of the conditions tested. At recommended vacuum settings (200-400 mmHg), temperature increase over baseline at the probe tip was less than 5°C in contrast to lower vacuum settings which resulted in temperature increases as high as 15°C. While this study only used a set inflow of irrigation fluid to replace what was aspirated by the device, additional fluid flow through the joint is clinically possible when outflow tubing is used to further moderate temperature increase.

## 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;9(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.
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.