Thermal Response of the Arthrex Apollo$^{RF®}$ MP90 and Smith & Nephew Super TurboVac 90 Bipolar Ablation Probes in a Simulated Joint Space

Arthrex Research

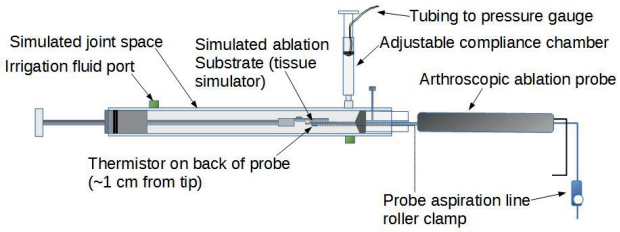
PURPOSE

Effective management of intra-articular fluid temperature is crucial during radiofrequency ablation procedures, as temperatures between 45-55 °C can cause cellular and tissue damage.[1,2] This study aimed to compare the temperature changes in a simulated joint space environment between the Arthrex Apollo^{RF} MP90 and Smith & Nephew Super TurboVac 90 bipolar ablation probes.

MATERIALS AND METHODS

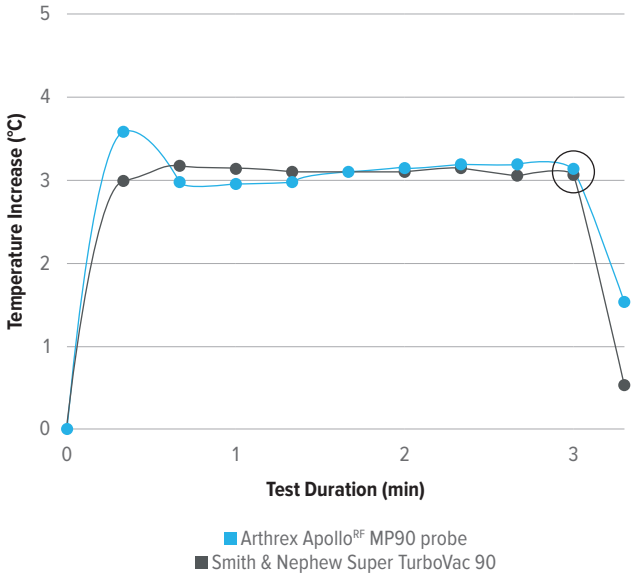
A clear plastic tube with a volume of approximately 115 mL, which was within the knee joint-space volumes,[3] simulated the joint space. Irrigation fluid pressure was maintained at 35 mmHg for all tests. Aspirated material was measured at the end of each test to determine the aspiration rate. The probe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

Figure 1: Experimental test setup.



A range of device ablation settings (6, 7, 8, and 9) and device aspiration vacuum settings (50, 200, 300, 400, and 500 mmHg) were evaluated. Starting temperature ranged from 20-22 °C, with the increase in temperature adjusted to account for any initial differences. The temperature was measured every 20 seconds for 3 minutes while the device power and aspiration were active. The temperature increase at the end of the 3-minute test indicates how much the temperature of the simulated joint space changed under each probe and test condition. This temperature was compared across all conditions tested. Additionally, a final temperature was recorded 10 seconds after the device was completely turned off (Figure 2).

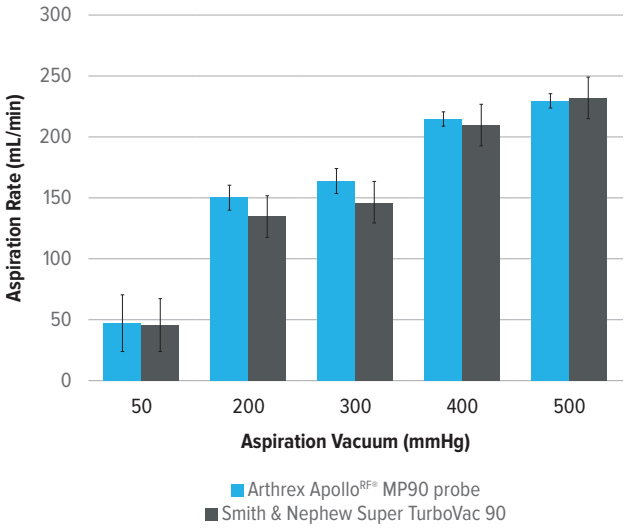
Figure 2: Sample temperature profile for ablation setting 7 at vacuum setting 300 mmHg, with final 3-minute temperature indicated.



RESULTS

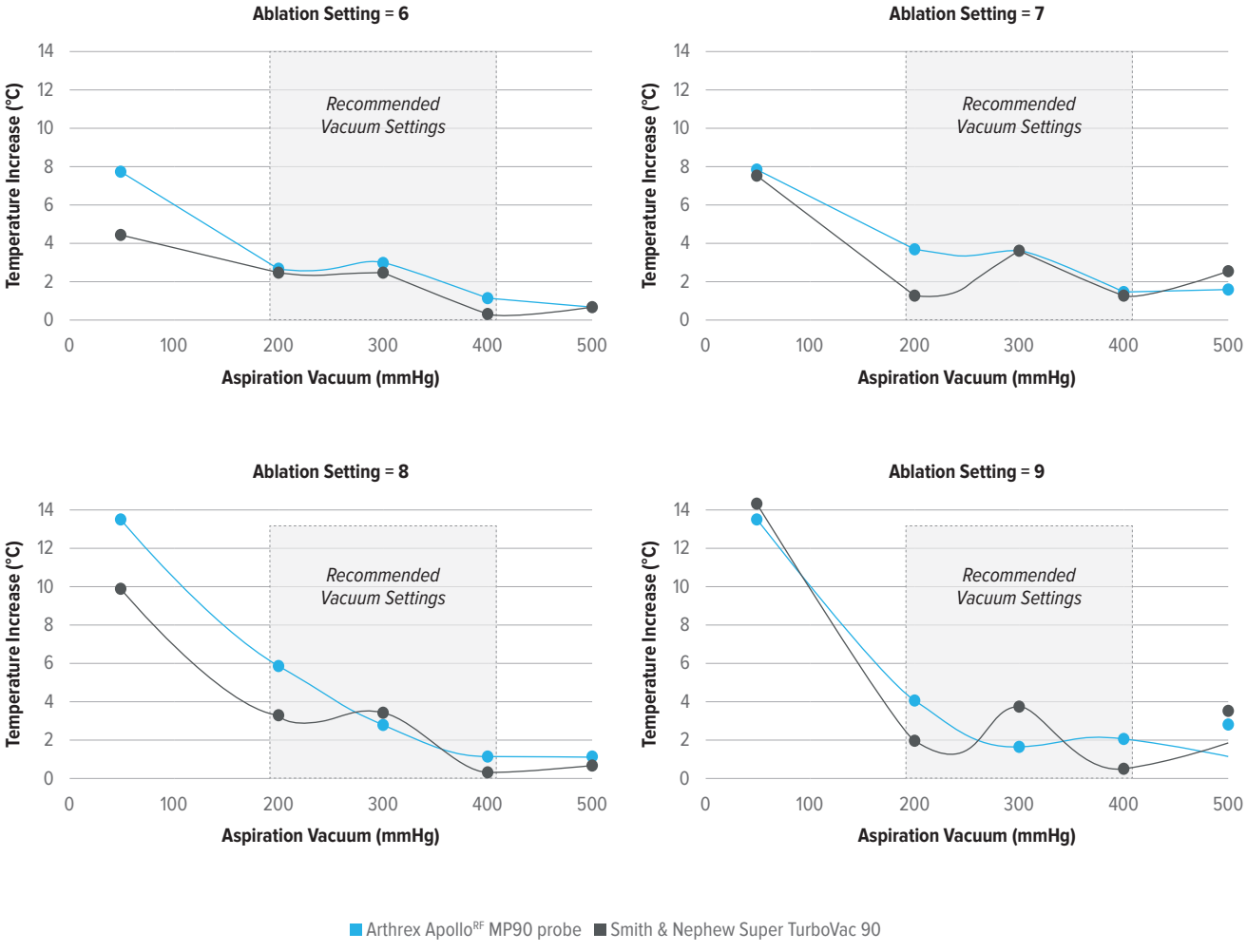
Aspiration rate increased with higher aspiration vacuums, with no significant difference between the devices, as determined by two-way ANOVA ($P = 0.158$).

Figure 3: Average aspiration rates at each aspiration vacuum.



Temperature within the simulated joint remained fairly constant throughout the test, except at the lowest aspiration vacuum (50 mmHg). Figure 4 summarizes the final 3-minute temperature increase for all ablation settings and aspiration vacuums tested, showing no considerable temperature differences between the devices. Notably, 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 3-minute temperature measured at the tip of the aspiration probe for all tested conditions.



CONCLUSION

Temperatures measured for the Arthrex Apollo$^{RF®}$ MP90 probe and Smith & Nephew Super TurboVac 90 were similar across conditions tested. At the recommended vacuum settings (200-400 mmHg), the temperature increase at the probe tip was less than 5 °C, compared to increases as high as 15 °C at lower vacuum settings. Although this study used a fixed inflow of irrigation fluid to replace what was aspirated by the device, additional fluid flow through the joint is clinically possible with the use of outflow tubing, which can further moderate temperature increase.

References

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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