Thermal Response of the Arthrex Apollo[RF]® SJ50 Aspirating Probe, DePuy Mitek VAPR® Wedge Effect Electrode, and Smith & Nephew Short Bevel 35

Arthrex Orthopedic Research and Development

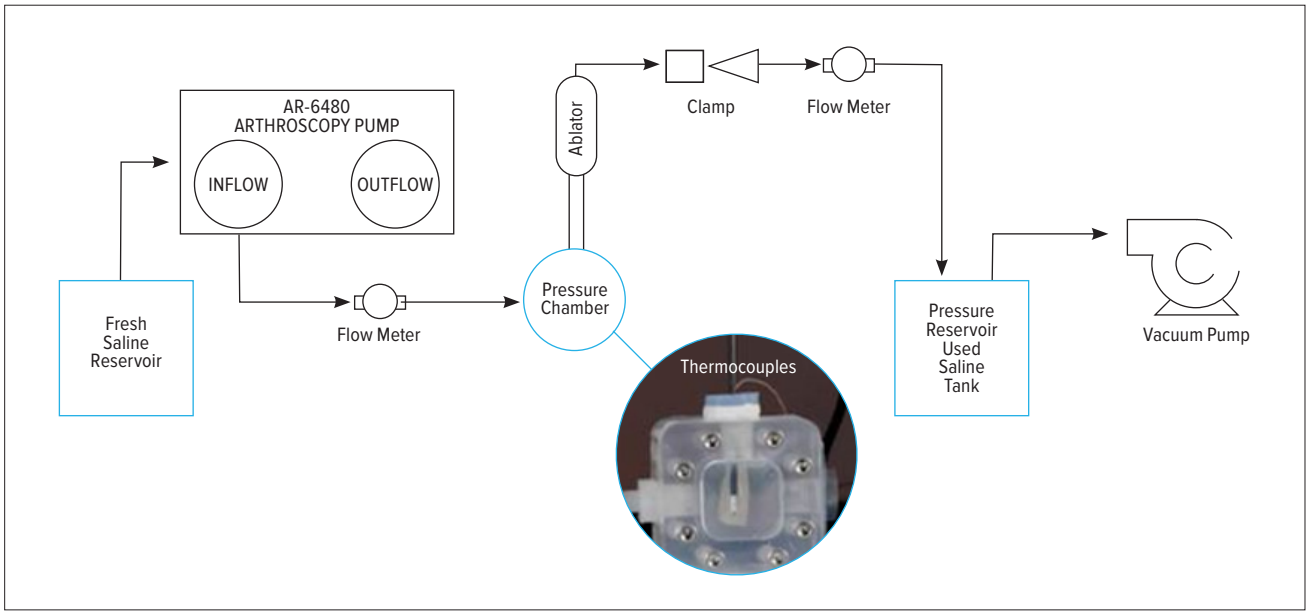
Introduction

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°C to 55°C.[1,2] The purpose of this testing was to compare the temperature change in a small joint space environment between the Arthrex Apollo[RF] SJ50 probe, DePuy Mitek VAPR 2.3 mm Wedge Effect, and Smith & Nephew Short Bevel 35 devices through two specific aims: (A) flow simulation using a fabricated small joint and (B) thermal imaging (verified by thermocouple measurements).

Methods

Each probe listed above was tested independently through this process. For specific aim A, the simulated joint space was a clear fabricated acrylic cube with a volume of approximately 25 mL, which is within the estimated volume of a distended ankle joint.[3] Thermocouples were placed inside the synthetic joint to verify data collected from the FLIR thermal imaging camera (Model T640; Ref. No. FLIR-T55901). Saline was pumped into the synthetic joint space using an Arthrex DualWave™ pump system held at 10 mmHg pressure to maintain consistent distention. For the aspirating Apollo[RF] SJ50 probe, vacuum suction was connected and set to -12 inHg (Figure 1). For each test, the probe was inserted into the joint space such that the electrodes were positioned in between the thermocouples. Then the probe was activated for 1 minute at the default ablation setting. The temperature increase from the baseline temperature (~22˚C) was measured. The change in temperature (ΔT) was the final temperature minus the baseline temperature. A custom-made LabVIEW program and National Instruments DAQ setup was used for data acquisition.

Figure 1. Preparation of anatomical model



Results

Table 1. Shows the data comparison between all 3 groups for ΔT[4]

Bipolar RF Probe	Mean ΔT Increase (˚C)
Arthrex Apollo[RF®] SJ50 Probe	1.84˚C ± 0.45˚C
DePuy Mitek VAPR 2.3 mm Wedge Effect Probe	29.98˚C ± 1.72˚C
Smith & Nephew Short Bevel 35 Probe	33.95˚C ± 6.69˚C

Both thermal imaging and thermocouple measurements indicated that the Apollo[RF] SJ50 probe caused a minimal overall temperature increase whereas both the DePuy Mitek VAPR Wedge Effect and Smith & Nephew Short Bevel 35 caused higher overall temperature increases (Table 1 and Figure 2). A one-way ANOVA was performed using the SigmaPlot 14 software to check statistically significant differences between the groups.

Figure 2. Shows the statistical comparison between all 3 groups for ΔT[4]

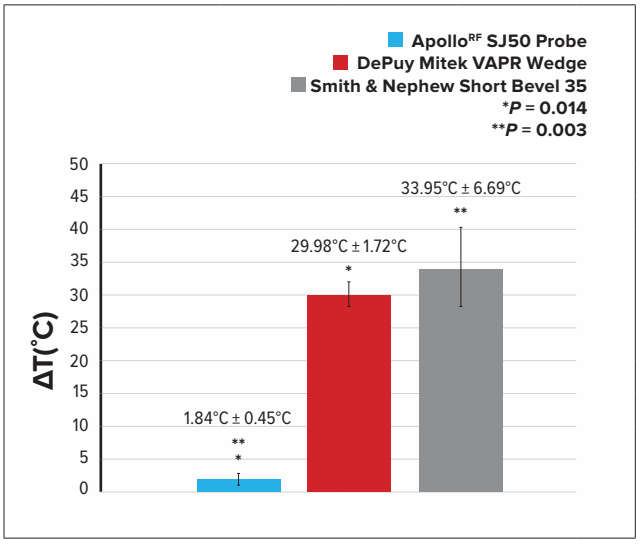
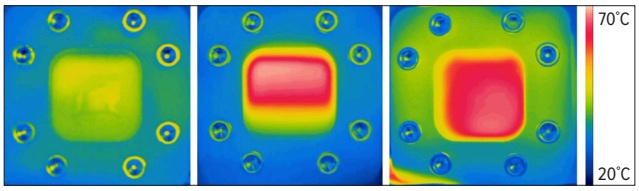


Figure 3. Shows temperature gradient across simulated joint for 3 different ablators



Apollo[RF] SJ50 Probe | DePuy Mitek VAPR Wedge Effect Probe | Smith & Nephew Short Bevel 35 Probe

Conclusion

Over a one-minute time period, the mean ΔT for the Apollo[RF] SJ50 probe ablator was statistically significantly lower when default power settings were used as compared to competitor devices (Table 1 and Figures 2 and 3). It should be noted that this study used only an inflow of saline to replace what was aspirated by the Apollo[RF] SJ50 probe. Additional fluid outflow is possible when outflow tubing is used to further moderate temperature increases. The significant difference between aspirating probes and non-aspirating probes in this study demonstrates the importance of introducing fluid outflow pathways to minimize temperature increases during arthroscopic ablation. In summary, the aspiration capability of the Apollo[RF] SJ50 probe dramatically reduces the risks of fluid temperature increases during ablation when compared to other non-aspirating bipolar RF probe designs.

References

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