

The Effect of Radiofrequency Use on Hip Arthroscopy Irrigation Fluid Temperature

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Background

Radiofrequency ablation (RF) in hip arthroscopy is an increasingly utilized surgical option. Developing safe hip arthroscopy practice patterns is important to *minimize any potential thermal damage to the chondrocytes*.

Recent case series have linked patient burns from heated fluid irrigation during RF use,^{1,2} and glenohumeral chondrolysis associated with RF ablation,^{3,4} a case report of chondrolysis after hip labral repair.⁷

Chondrolysis can be a devastating complication of RF use.

- The use of thermal chondroplasty using RF on articular cartilage has shown to directly cause chondrocyte death.^{8,9}
- The safety margin is considered narrow when using RF around cartilage.
- Temperatures of 45-50°C are damaging to chondrocytes
 - when intra-articular temperatures are elevated from physiologic body temperature (50°C), damage begins to occur after an elevation of only 8°C.^{10,11}

The potential for chondrocyte damage is especially relevant in the hip joint.

In the hip's central compartment, predisposing factors for chondrocyte damage include:

- limited saline volume, significant cartilage coverage, potential for poor saline flow, and direct proximity of weight-bearing cartilage to the area of RF use.

Previous research on the safe use of RF is limited.

Evidence suggests that the primary determinant for maintaining safe intra-articular temperatures is flow rate.^{12,13,14} The influence of flow rate on temperatures within the hip joint with the usage of radiofrequency ablation has not been published.

Purpose

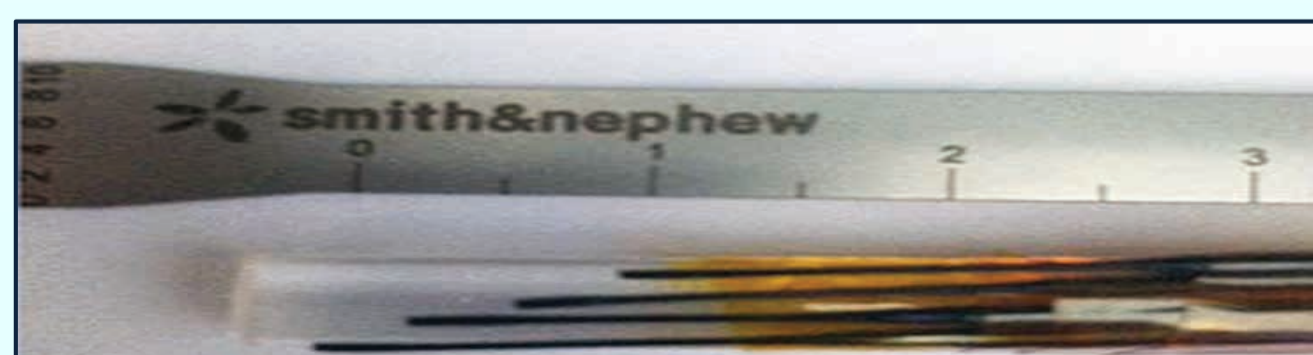
To determine the influence of joint fluid lavage with the use of RF in maintaining intra-articular temperatures $\leq 50^\circ\text{C}$.

Our null hypothesis states:

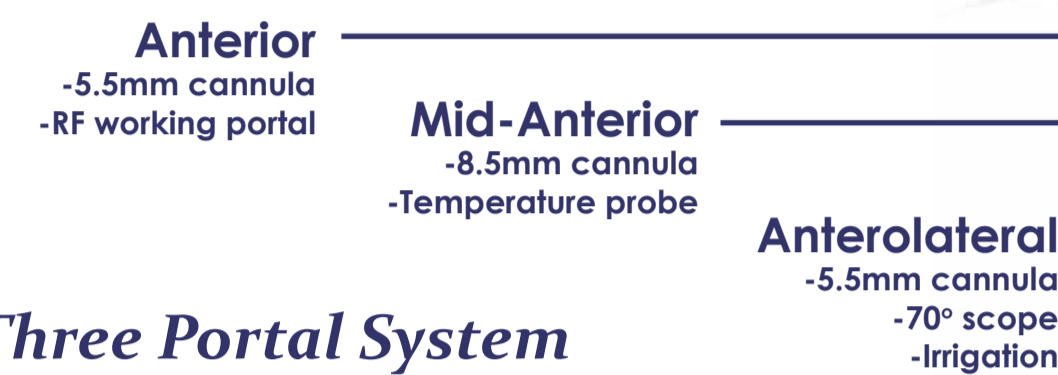
- the continuous use of RF ablation for 90 seconds will not cause the intra-articular fluid temperature to rise above 50°C
- lavage rate will not affect the intra-articular temperature

Materials

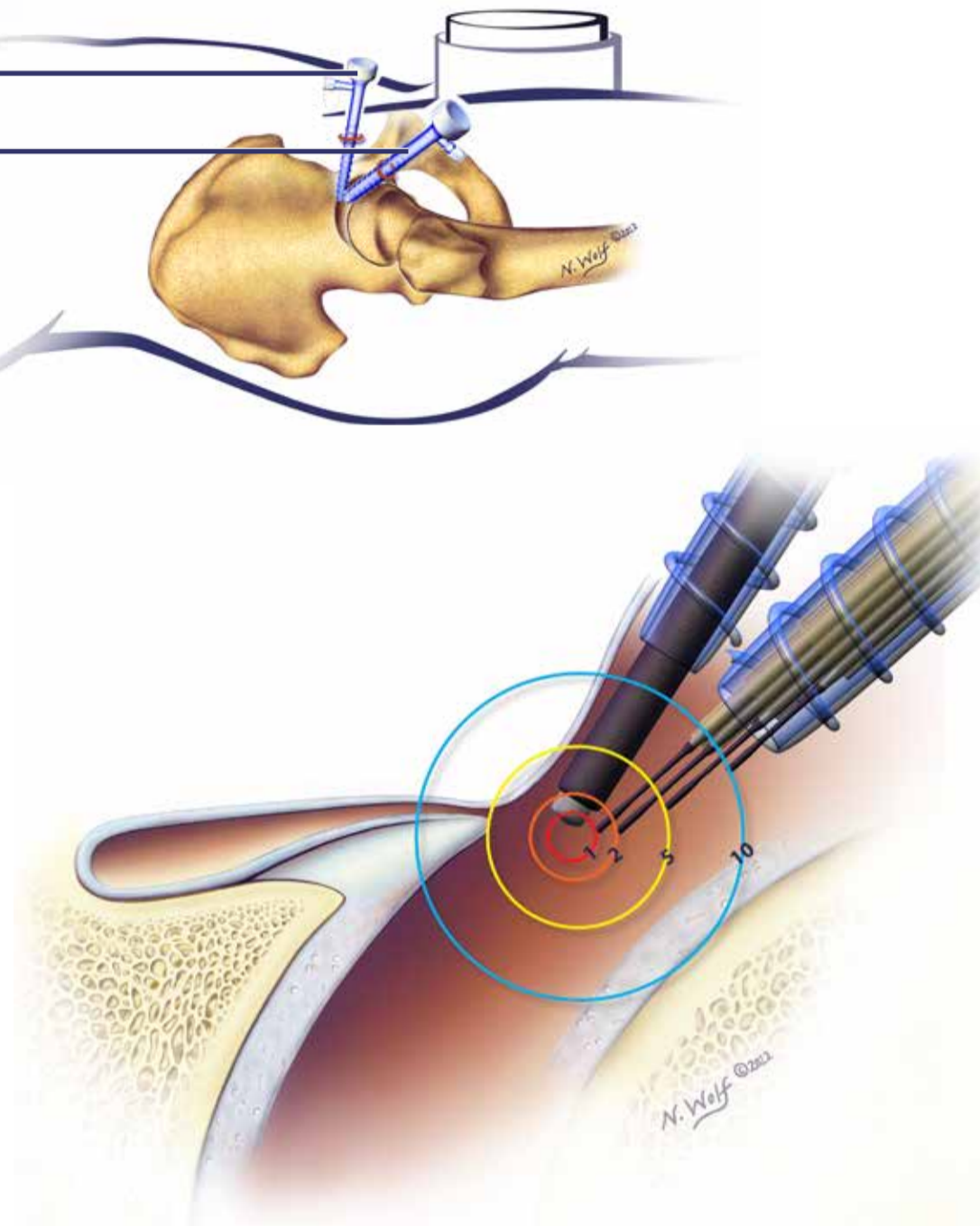
- 3 fresh human cadaveric hips at room temperature
- New Smith and Nephew DYONICS™ RF system
- Luxtron fiberoptic intra-articular thermometers at radial intervals -1, 2, 5, and 10 mm from RF probe tip



Methods



- Continuous intra-articular temperature profiles were recorded
 - At the capsulo-labral junction
 - For 90 seconds
 - With variable interval pulsed lavage
 - Interval Lavage Rate: no lavage or one every 5, 15, or 30 seconds
 - Pulsed Lavage: when applied, one second irrigative exchange with room temperature normal saline
- Each variable tested 9 times-3 times per specimen
- All statistical analyses were performed using SAS 9.2 (Cary, N.C.)



Results

Incidence of Chondrocyte Damaging Temperatures

	Individual		Means	
	First Time $\geq 50^\circ\text{C}$ (seconds)	T _{max} (° C)	Percentage $\geq 50^\circ\text{C}$	Average Temp. (° C)
5 Seconds				
1mm	1	90	44%	36.2
2mm	2	64	44%	32.2
5mm	XX	38	0%	25.9
10mm	XX	41	0%	25.4
15 Seconds				
1mm	2	86	78%	43.6
2mm	3	75	44%	35.0
5mm	16	67	22%	29.0
10mm	XX	30	0%	25.9
30 Seconds				
1mm	2	90	89%	48.4
2mm	12	89	56%	38.0
5mm	17	77	33%	30.4
10mm	27	57	33%	27.1
No Outflow				
1mm	1	99	100%	56.0
2mm	2	93	89%	56.2
5mm	23	68	33%	35.7
10mm	XX	47	0%	28.9

a) Column 2 demonstrates the time to achieve intra-articular temperatures above 50°C at both near (1-2mm) and far (5-10mm) locality for each flow rate variable; (b) Column three demonstrates the maximum joint temperature at both local and distance distances for each flow rate variable; (c) Column four shows the percentage of trial runs where temperatures reached above 50°C; (d) Column five shows the mean temperatures of the 9 trials for each flow interval and distance combination

Effect of Locality and Flow on Temperature

Distance (mm)	Log Odds	Significance (p)
2	2.81	<0.0001*
5	-3.93	0.0005*
10	-3.93	0.0005*

Log odds of various distances from the RF registering temperature profiles $\geq 50^\circ\text{C}$ when compared to 10mm. *Odds are considered significant at $p \leq 0.05$.

Flow Interval (seconds)	Log Odds	Significance (p)
5	-4.26	<0.0001*
15	-1.22	0.0067*
30	0.68	0.086

Log odds of various flow intervals registering temperature profiles $\geq 50^\circ\text{C}$ when compared to the no flow interval. *Odds are considered significant at $p \leq 0.05$.

Conclusion

With continuous RF use, 5 second interval pulsed irrigation is an effective method to cool local intra-articular fluid temperatures in the hip joint.

Clinical Relevance

Short interval pulsed irrigation is effective in maintaining intra-articular temperature profiles $\leq 50^\circ\text{C}$ during continuous RF use.

Guidelines for using RF should include:

- meticulous technique
- intermittent use
- ensuring good inflow and outflow
- employment of pulsed lavage at frequent intervals

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