# Acute and Chronic Magnetization Transfer Ratio Observations in Canine Cryoablation

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## Introduction

Prostate cancer is the most common invasive neoplasm in men in the United States; each year over 234,000 men are diagnosed with it [1]. A potential minimally invasive treatment is cryoablation. With MR guidance, this treatment option could prove effective in locally ablating prostate tissue while preserving sensitive structures like the urethra or rectal wall. While iceball formation can be monitored with MR, assessment of tissue damage afterwards is less clear. Perfusion can be assessed with contrast enhanced (CE) imaging, but further tissue characterization of healing is desired. In previous studies, we noticed regions of low magnetization transfer (MT) contrast in cryolesions fourteen and fifty-three days after treatment [2]. This current study follows the MT effect in cryolesions created in three canines, from immediately after treatment to weeks later when the dogs were sacrificed. The purpose of this work was to investigate if the lack of MT effect was evident immediately following treatment and to monitor how it progressed over time, comparing MT effect to CE and histology.

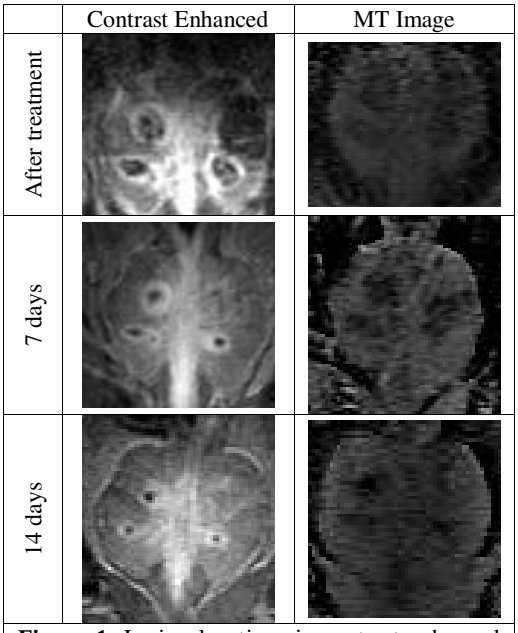


**Figure 1**. Lesion locations in contrast enhanced and MTR images for Dog 3.

## Methods

Three MRI-guided canine prostate cryoablations were performed *in vivo* on a 0.5T Signa SP scanner (GE Healthcare, Waukesha, WI). Each cryoablation procedure created multiple lesions within the prostate. After ablation, all dogs were imaged with MT pulse sequences, followed by Gadolinium CE imaging. The MT pulse sequences implemented on-resonance 1-2-1 binomial pulses alternating on and off per scan in both multislice 2D and 3D SPGR sequences. Two dogs (Dogs 1 and 2) were imaged with the same follow-up imaging protocol at seven days and at study termination - twenty-one days after treatment, while the third dog (Dog 3) was imaged at seven days and fourteen days (study termination). After the final imaging session, each dog was euthanized and the prostate harvested for histological analysis.

## Results

Images of created cryolesions are displayed in Figure 1. CE images were windowed and leveled for optimum contrast. MT ratio images were created using MATLAB (The Mathworks, Natick, MA) and ImageJ and clipped to between 0 and 1. Figure 2 is representative prostate pathology through cryolesions created in Dog 3. The slides have been stained with a Trichrome stain that depicts connective tissue (scars) in blue.

Immediately following treatment, cryolesions could be visualized with MT, which was not the finding in previous canine thermal ablation experiments [3]. Over the following weeks, MT visualization of lesions persisted. Histologically lesions after 2-3 weeks were minimally hemorrhagic and consisted of regenerating glands, granulation/scar tissue and fragmented smooth muscle fibers. In Dog 2, one lesion developed into a fluid filled cavity.

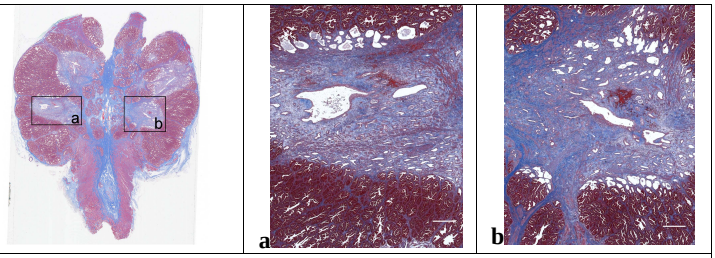


**Figure 2**. Trichrome stained section of prostate from Dog 3, with inset of two lesions.

## Conclusion

Unlike our previous work with ultrasound-ablated tissue, we have found that cryoablated tissue exhibits a decreased MTR effect immediately following lesion creation. While the regenerating tissue regains contrast enhancement, the persistent low MT effect indicates that this tissue is different from normal tissue. These results complement our previous study's results that this effect persists as the lesion changes at least two weeks out. Thus, magnetization transfer imaging could be used to monitor lesion progression over time.

## Acknowledgements

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## References

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