



# Image-Guided Cryoablation for Desmoid Tumors: Successes, Challenges, and Lessons Learned

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## PURPOSE

In this exhibit, we review selected cases from our experience to date treating extra-abdominal desmoid tumors with cryotherapy. Imaging and treatment outcomes of several illustrative cases will be shown highlighting technical considerations and lessons learned.

## BACKGROUND

- Desmoid tumors, or aggressive fibromatosis, are rare benign fibrous neoplasms originating from the musculoaponeurotic structures throughout the body, most commonly in the rectus abdominus<sup>1</sup>.
- Although desmoid tumors have no metastatic potential, they are locally aggressive and recurrence is common following surgical excision, necessitating investigation of alternative forms of therapy<sup>2</sup>.
- Aside from watchful waiting and surgical excision, alternative treatment methods include radiation therapy, chemotherapy, hormone therapy, NSAIDs, and most recently, percutaneous and non-invasive ablation, including cryotherapy<sup>3</sup>.
- While several groups have reported successful treatment of desmoid tumors with cryoablation, the literature remains limited<sup>4-5</sup>.

## WHAT IS CRYOTHERAPY?

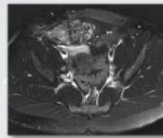
- Utilizing rapid expansion of argon gas (Joule Thompson effect), multiple repetitive cycles of rapid tissue cooling (-40°C) followed by slow thawing result in cell death.
- At -40°C intracellular ice forms. As temperatures approach -7 to -10°C during thawing, ice forms outside cells creating a hyperosmolar environment, drawing intracellular water out. With further thawing, extracellular ice temporarily melts creating a transiently hypotonic environment and water reenters and expands the damaged cells resulting in membrane rupture.
- With multiple freeze-thaw cycles, extracellular ice accumulates, cells shrink, and cell membranes and organelles are severely damaged.
- Ice also forms in small blood vessels feeding the tumor resulting in compromised blood supply with tissue ischemia and cell death.

## REFERENCES

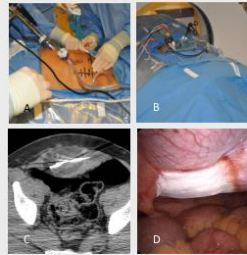
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## CASE 1 - How to avoid nearby structures

- 16 year old male with enlarging superficial abdominal mass.



T2W MRI (left) shows a desmoid tumor that recurred locally after surgery and was enlarging despite medical management. A creative multi-disciplinary strategy was employed to spare abdominal contents from potential harm in the setting of cryoablation.

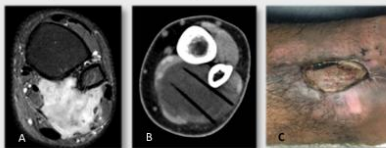


Laparoscopy and abdominal insufflation were used to separate the viscera from the site of cryoablation (A & B). Hydrodissection could be used similarly but was unsuitable in this location. CT guides probe placement and shows the ice ball separated from bowel by adequate insufflation. Images C and D show CT and corresponding laparoscopy depiction of ice formation after a freeze cycle.

This post treatment T2W MRI (left) shows the mass 3 years later, smaller and with less bright T2 signal. The mass has become quiescent, no longer enlarging. A second lesion (not depicted) continues to grow.

## CASE 2 - Potential complication and re-treatment

- 17 year old male with enlarging left posterolateral ankle mass.



Initial MRI evaluation (A) shows a desmoid tumor in the posterior compartment between the Achilles tendon and syndesmosis. In this case, the surgical option was amputation thus aggressive cryoablation was performed with emphasis on maximal debulking and less so on neurovascular preservation. All parties were aware that ablation would likely result in skin necrosis requiring wound vac or skin graft. Image B demonstrates 2 of several probe tracks in the treatment ice ball. Post-treatment complication is shown in image C; skin breakdown occurred at the treatment site.

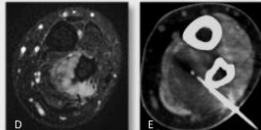
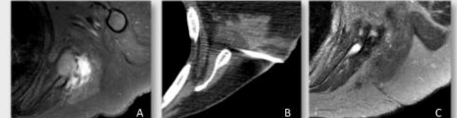


Image D shows recurrence at the treatment site 3 years later. This dancer elected repeat cryotherapy (E) rather than amputation to maintain quality of life. Despite skin complications, he was pleased with his initial functional result.

## CASE 3 - Cure

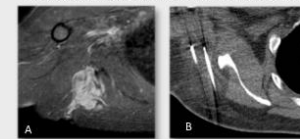
- 69 year old female presents with worsening left shoulder pain.



Axial T1+C MRI (A) through the left shoulder shows an enhancing mass adjacent to the scapula consistent with a desmoid tumor. Axial CT with cryotherapy probe in place (B) after 10 minute freeze cycle shows an ice ball encompassing the tumor with wide margins. Post-treatment axial T2 MRI (C) has been stable for 2 years with retracting scar. No recurrence to date. This case represents an ideal candidate for this modality, small lesion removed from vital structures allowing larger treatment area.

## CASE 4- Recurrence

- 53 year old female with shoulder soreness and palpable mass.



This patient sought out an alternative therapy so cryoablation was offered as an experimental treatment.

Axial T1+C MRI (A) of the left shoulder shows an avidly enhancing, infiltrative mass between the teres minor and major muscles consistent with a desmoid tumor. Image B shows the ice ball formation after 3 freeze-thaw cycles of 10-10 minutes, 10-9 minutes, and 8-7 minutes, respectively.

Follow-up T1+C MRI performed 11 months after cryoablation shows a rim of enhancement around a hypointense contracting fibrotic focus (\*). Subsequent studies showed continued contraction. However, there was relatively rapid growth/recurrence of enhancing desmoid (#) at the deep treatment margin. The margins of both the desmoid and the "thermal kill zone" are difficult to precisely delineate with CT during treatment. The kill zone isn't as large as the ice ball. We hypothesize that necessary caution exercised when treating tumor margins near critical structures may result in recurrences in those areas most unfavorable to treatment in the future, essentially steering tumor growth into inaccessible places.

## CONCLUSIONS/LESSONS LEARNED

- Percutaneous cryoablation is a potential alternative treatment, as a first line option for growing, symptomatic desmoids or for recurrent/refractory cases as a salvage option.
- Patients may be predisposed to recurrence at the periphery of the treatment zone. Small lesions away from vital structures are most amenable to this modality.
- Following therapy, continued imaging surveillance is required as treatment related denervation of the lesion may mask early recurrence.
- Long-term treatment outcomes are unknown, further research is needed to determine the efficacy of this modality.