Needle-in-needle technique: A lifeline for HDR SYED implants with unusable catheters

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Introduction:

- Our institution handles a large GYN SYED patient load (5 HDR fractions over 3 days).
- Potential logistical challenges: broken or contaminated catheters lead to disruption of treatment
- **Goal:** to develop a contingency plan to address SYED challenges and complete the patient treatment with minimal impact

Methods: Needle-in Needle(4F into 6F)

- We propose a needle-in-needle technique inserting a 4F catheter into a 6F catheters, (used for HN cases)
- We investigate scenarios with a few or all catheters broken or contaminated.
- We study several aspects of 4F into 6F technique:

-geometric: graph paper with catheter, dummies, source

-dosimetric: simulation in 10 patient plans adapting a previously developed in-house software

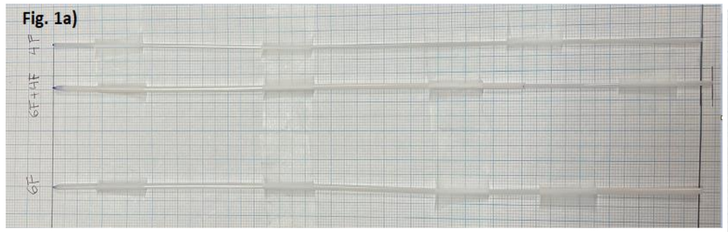
-logistical: using a phantom and SYED template

- We establish a QA process and develop a clinical procedure.

Impact/Innovation:

- first time the needle-in-needle technique (4F into 6F catheters) has been proposed for SYED implants
- this technique helps optimize/complete treatments that would otherwise be suboptimal or cancelled

Results: 1) Geometric measurements



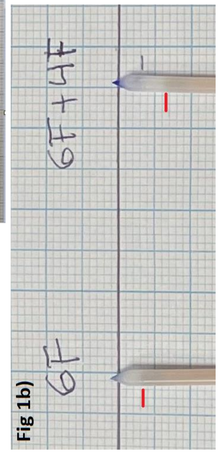


Fig 1. (a) Overall setup **(b)** Dummy wire measurements. Two 6F HDR catheters and one 4F HDR catheter, all 240mm length, taped to graph paper with 1mm resolution. The tips aligned with each other to within 0.2mm With the 4F catheter inserted in the 6F, its open end protruded by 3mm and consequently the dummy wire and the real sources (not shown) had 3mm shifts (shallower) from the planned positions.

Results: 2) Dosimetric impact calculations

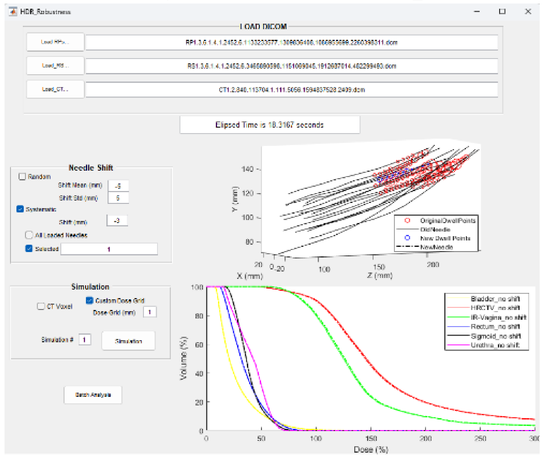


Fig. 2 (left) GUI MATLAB script previously developed in-house. By shifting the catheters by 3mm we simulate 4F into 6Fcatheters

Script calculates dosimetry for:

a) All needles retracted by 3mm.

b) The WCS (worst case scenario): three needles with highest weight retracted 3mm

c) The RND (random) 3 random needles retracted by 3mm

Conclusion: A needle-in-needle (4F into 6F) technique for HDR-SYED treatments with broken/contaminated catheters has been developed and its geometric, dosimetric, and logistical aspects investigated. This approach allows to 'rescue' treatments that would otherwise need to be replanned or even aborted.

Results: 2) Dosimetric impact results

Volume	Change in DVH Metric	All needles retracted		3 needles worst case scenario		3 random needles	
		Average(%)	Range(%)	Average(%)	Range(%)	Average(%)	Range(%)
HR-CTV	ΔV90%	-1.4	-3.6 to 1.1	-0.3	-1.9 to 1.0	-0.1	-0.6 to 1.0
	ΔD90%	-2.5	-6.9 to 2.4	-0.5	-3.1 to 2.3	-0.1	-0.9 to 2.6
Bladder	ΔD2cc	-1.7	-10.3 to 4.5	0.1	-2.8 to 2.6	-0.5	-2.8 to 1.3
Rectum	ΔD2cc	1.1	-2.9 to 5.8	1.1	0.1 to 4.9	0.8	-1.3 to 4.9
Sigmoid	ΔD2cc	-5.7	-13.9 to 8.8	-2.0	-10.2 to 12.8	0.1	-3.3 to 12.8

Table1 Shows results for the 3mm retraction of all needles, worse-case scenario of 3 needles with largest weight and 3 random needles. Overall, the dosimetric changes are small and the script can be used for QA at the time of clinical use of this needle-in-needle technique if deemed necessary.

Results: 3) Logistical Aspects

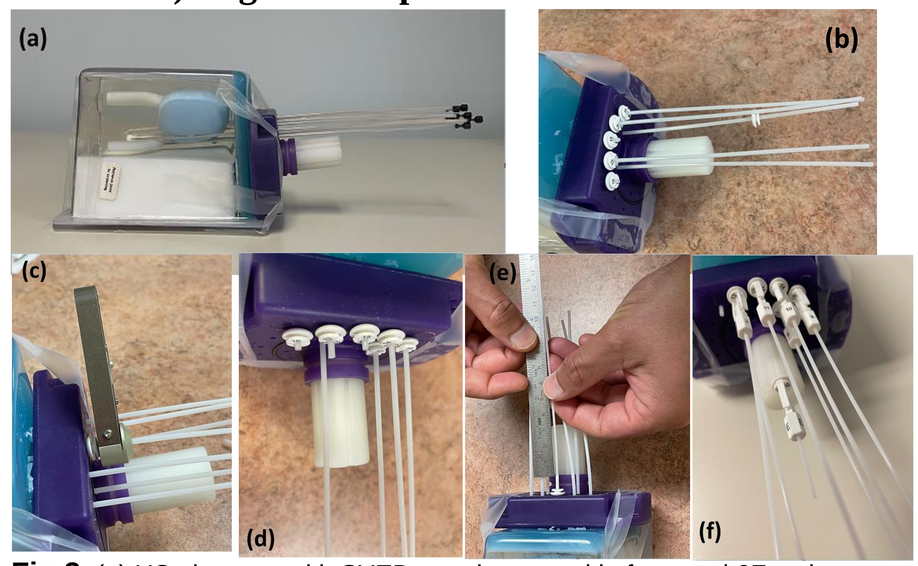


Fig 3. (a) US phantom with SYED template taped in front and 6F catheters with dummies. (b) button insertion. (c) 6F catheter cut with dedicated tool (d) remaining 6F length test (should be less than 5mm). (e) after 4F catheter insertion, measurement of the 4F protruded length for QA. (f) dedicated clips used to secure 4F catheters in place.