Evaluation of Proton Dose Fall-off Optimization Structures

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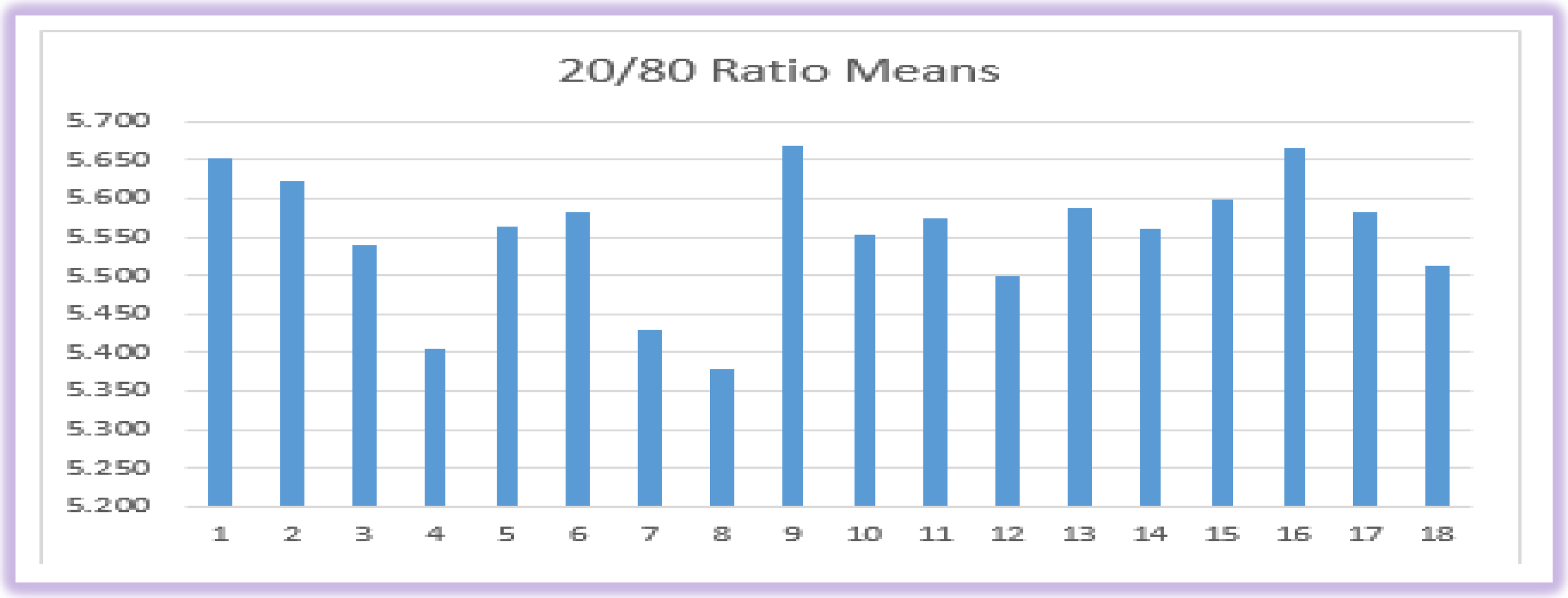
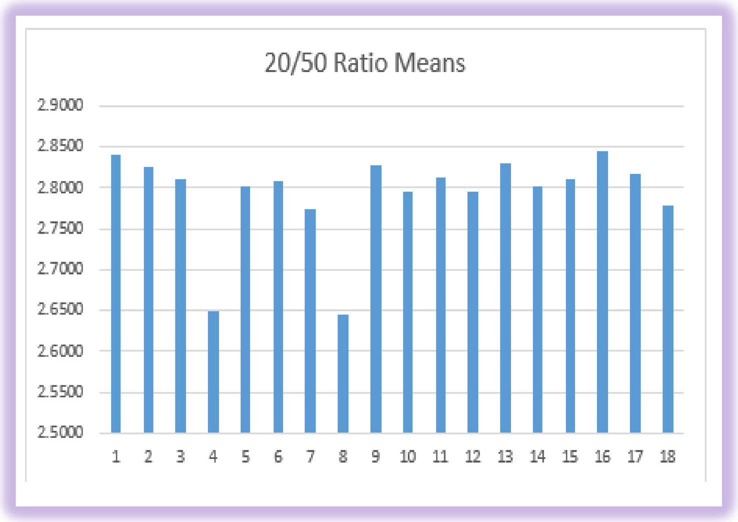
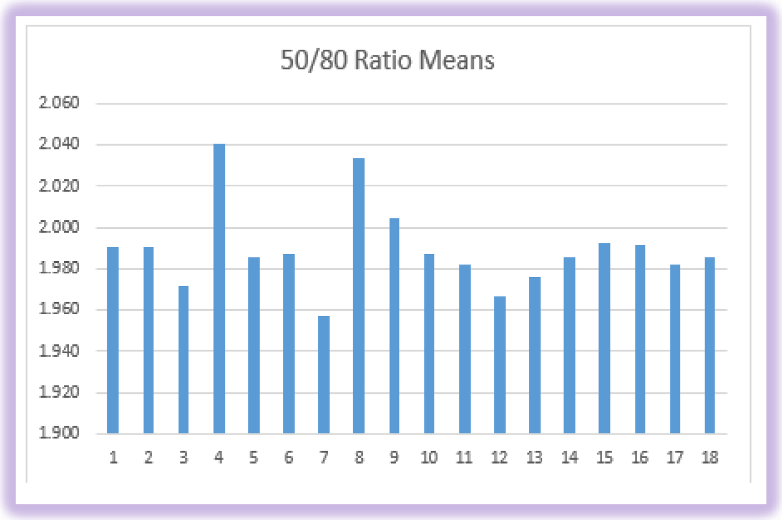
Introduction

rmal Tissue Objective (NTO) does not often produce ults for proton therapy, particularly when considering uncertainty management techniques, such as robust ation. At our institution, the method to achieve adequate -off is at the discretion of the individual planner, consisting of a single or multiple rings. Within the r, using a DVH-style objective often allows too much for the optimizing algorithm and yields non-specific particularly for large structures such as "body" or ". This study aims to systematically review different -off control methods within a phantom to determine method to apply to treatment plans. The beam selection centrally located brain tumors, as seen in haryngioma patients.





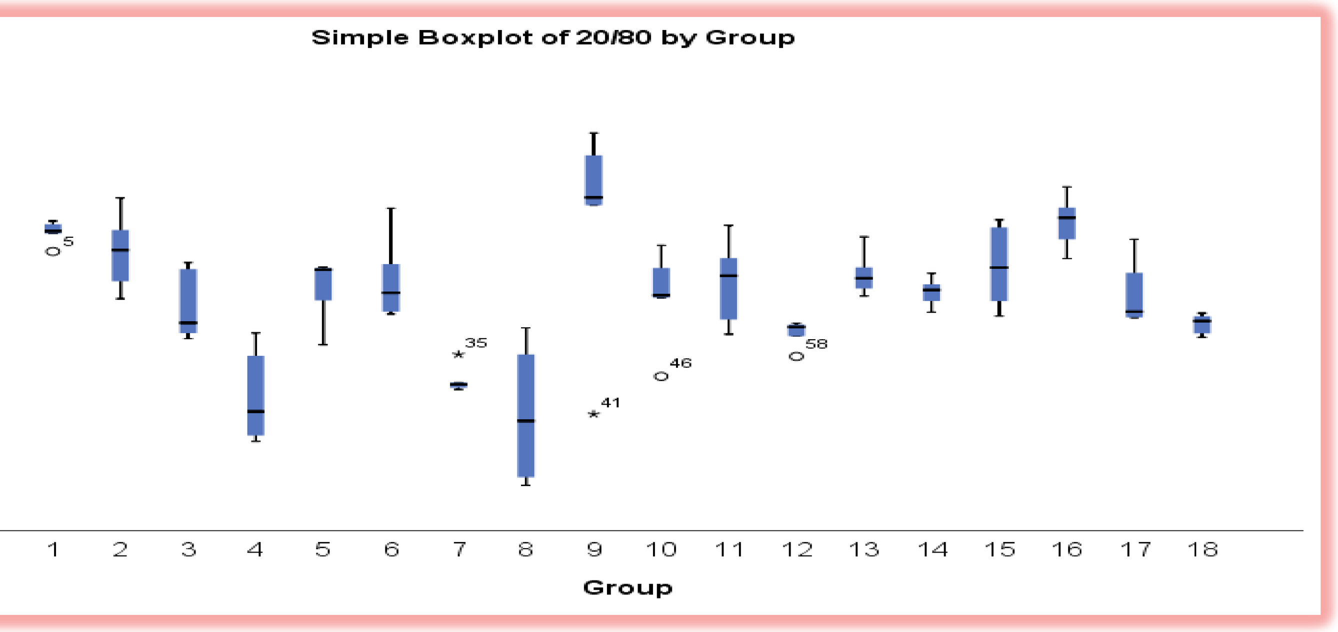


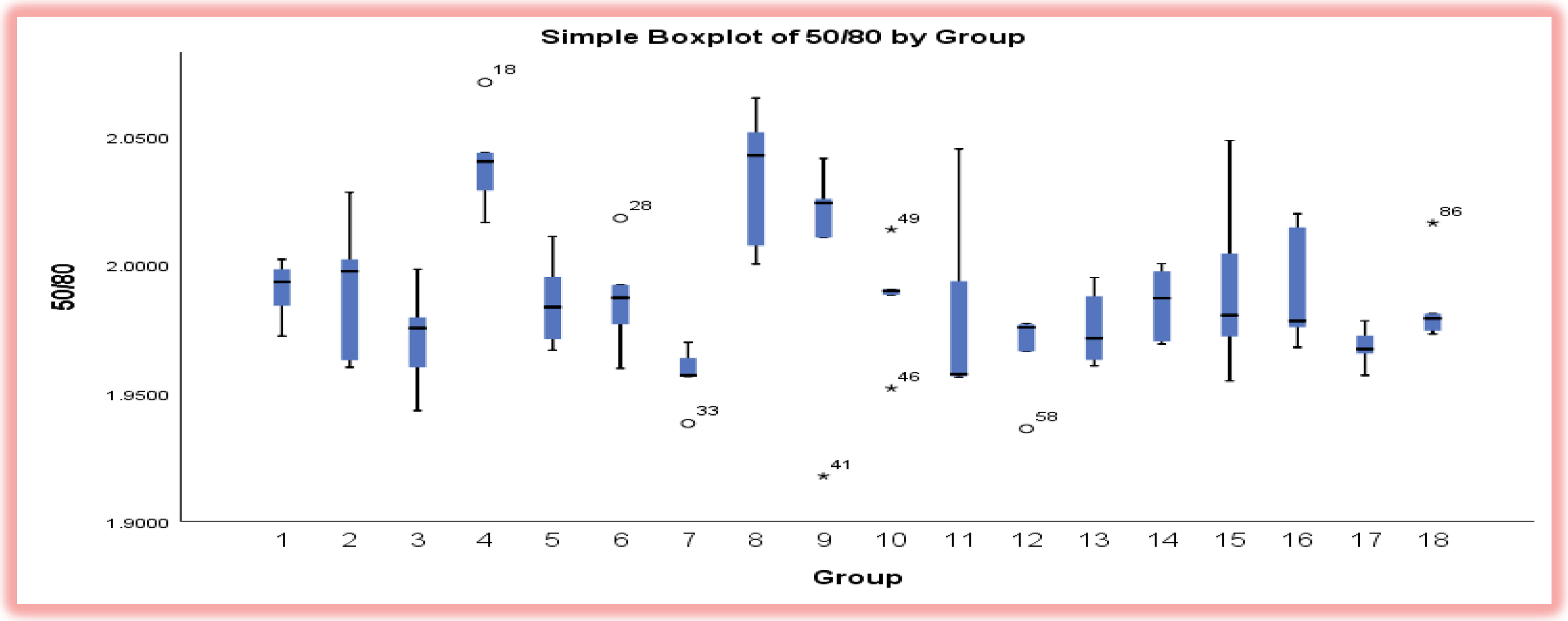
Results

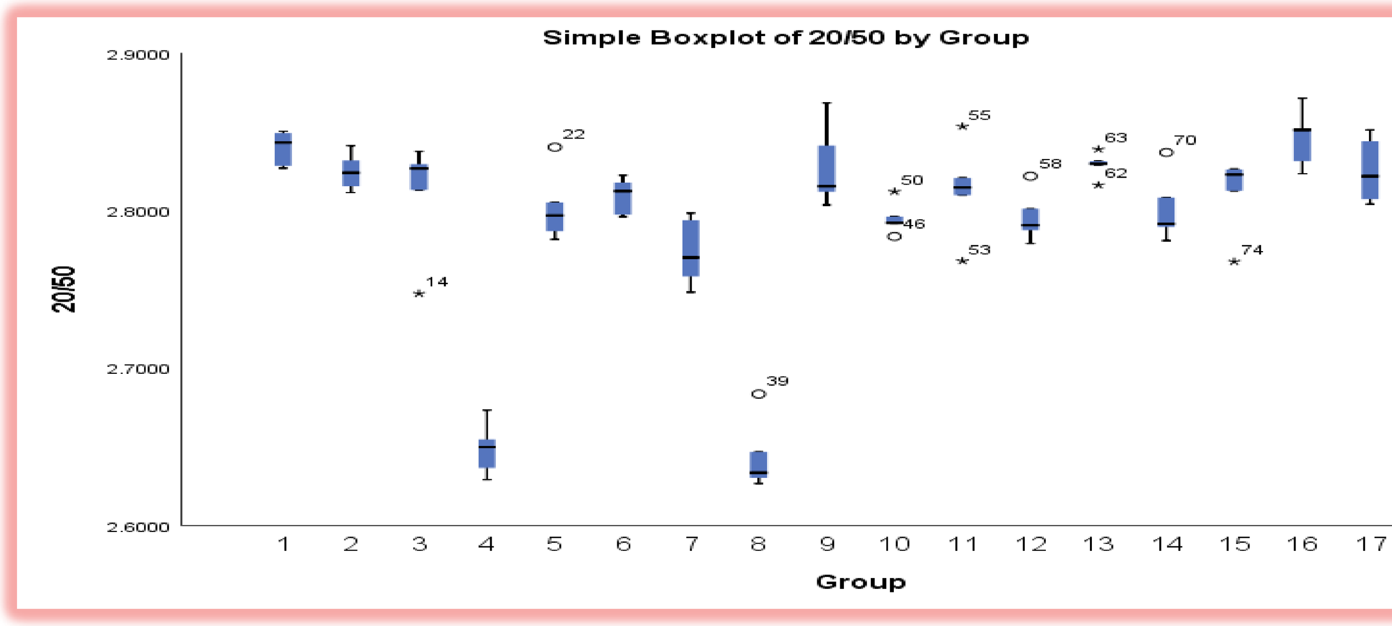
The dependent variables, excluding HI, either did not r homogeneity of variance or normal distribution assumptio Non-parametric Welch ANOVA test was ran which yielde significant p-values for each test variable (Table below). Games-Howell was used for post hoc analysis (alpha 0.5).

Robust Tests of Equality of Means

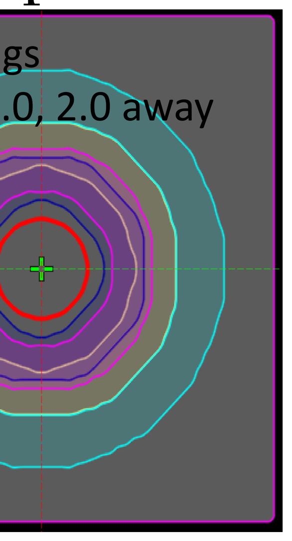
		Statistic[a]	df1	df2	Sig
20/80	Welch	19.584	17	26.693	
50/80	Welch	4.425	17	26.730	
20/50	Welch	34.273	17	26.748	
ΔV20-80%	Welch	4.333	17	26.446	
ΔV20-50%	Welch	3.981	17	26.660	
ΔV50-80%	Welch	8.311	17	26.661	
HI	Welch	2.505	17	26.793	
R50%	Welch	6.508	17	26.647	



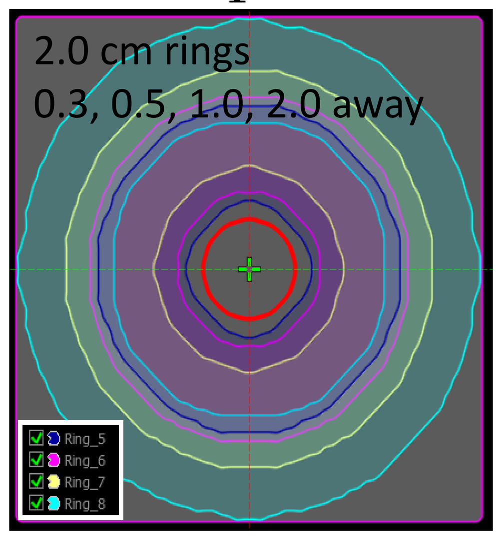




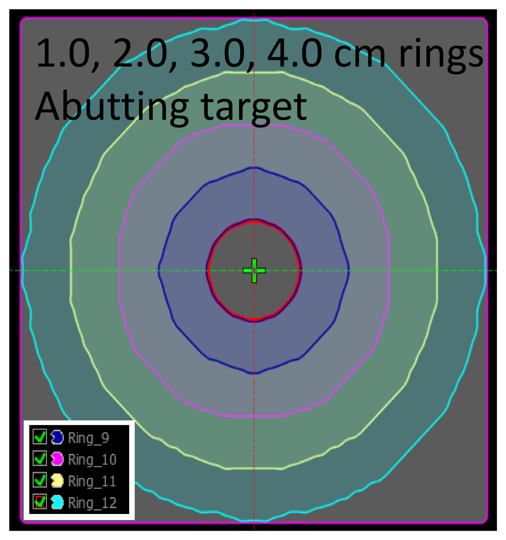
ups 1-4:



Groups 5-8:



Groups 9-12:



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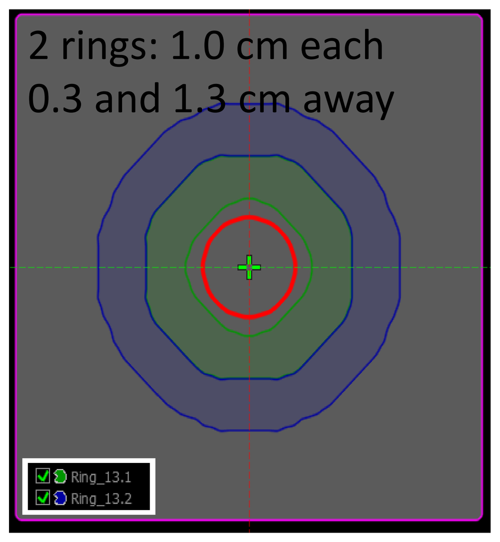

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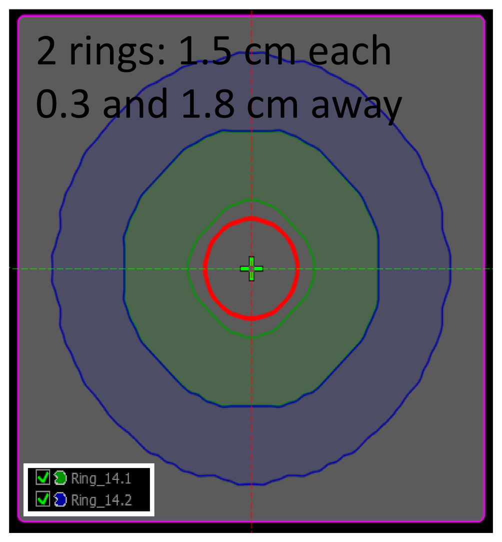

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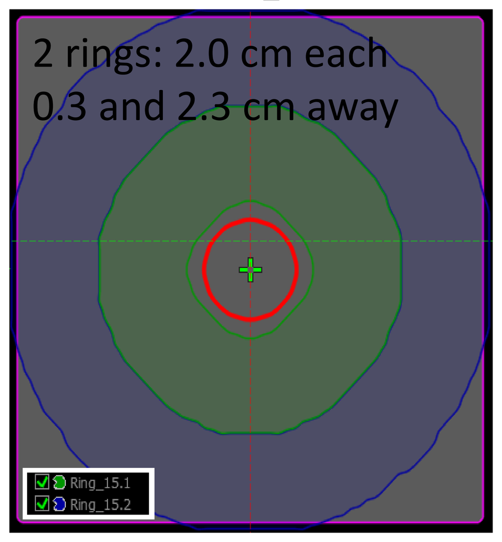
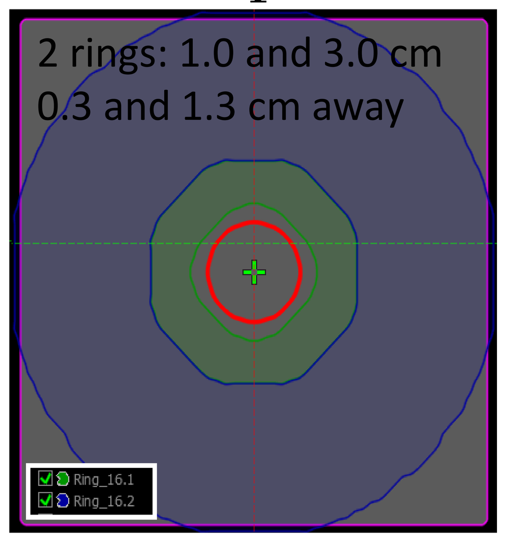
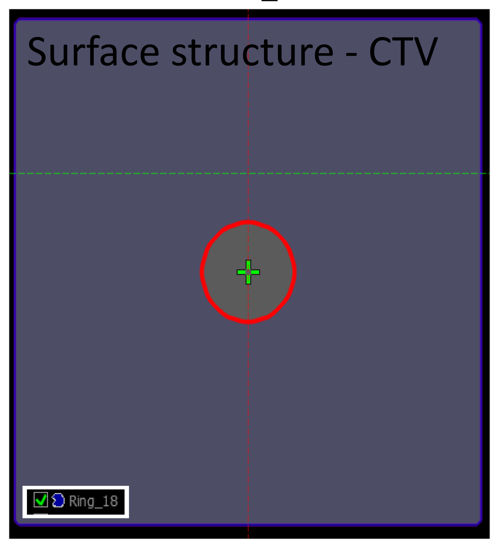


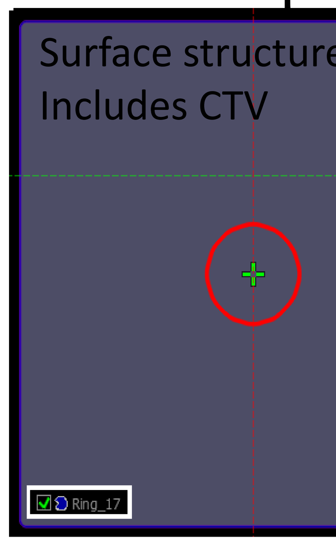
Group 16:



Group 17:

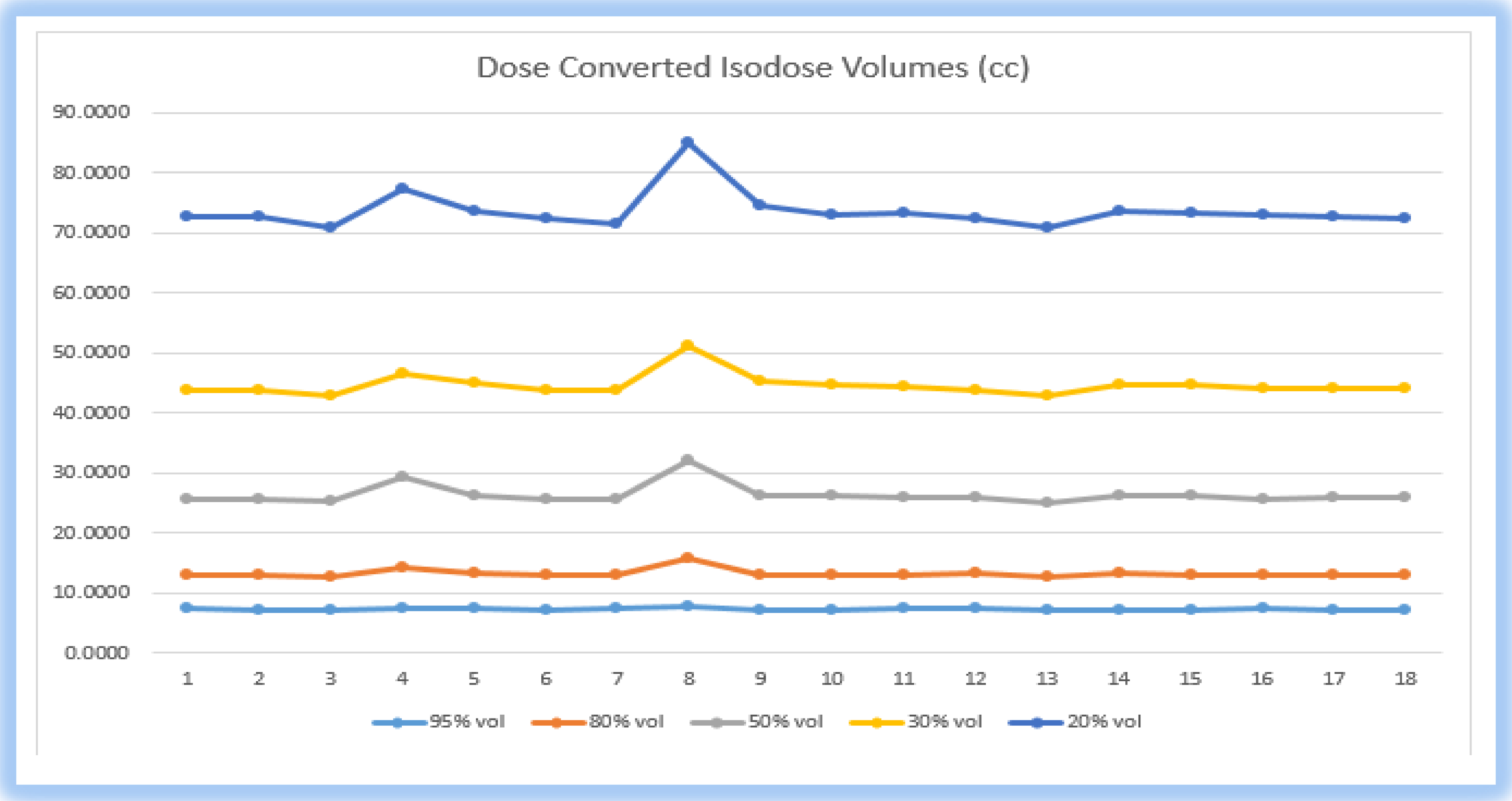


Group 1



Methods

- Phantom (10x10x10)
- obust optimization (3mm, 3%)
- ds (90°, 0°, and 270°)
- n diameter CTV
- tives:
  - ominal coverage: V98% at 98%
  - obust coverage: V95% at 95%
  - ngle mean on control structure – variable dose and ority
- oles: Isodose lines converted to structures from 80%, 20%
  - 80 ratio
  - 80 ratio
  - 50 ratio
  - Δ20-80% isodose
  - Δ50-80% isodose
  - Δ20-50% isodose
  - HI (D2-D98/D_p)
  - R50% (V50%/VPTV)
- oups – distinct dose control structures



Final Thoughts

- Limitations:
  - Single mean objective – larger rings or rings attempting to control lower isodose lines may benefit from upper objectives
- Ring priority often ended higher than target coverage

Conclusion

- Rings **2.0 cm away** showed the **worst** control of dose fa (Groups 4 and 8)
  - Highest mean isodose volumes for 80%, 50%, and 20 discreetly
  - Lowest ratios for 80/20 and 20/50
  - Highest ratio for 50/80 – due to larger increase in 50 isodose line
  - Most number of statistically significant difference be group means
  - **Larger the ring = worse control when >= 2.0 cm awa**
- Ring **1.0 cm size, 1.0 cm away** (group 3)
  - Lowest mean 20%, Second lowest mean 80%, and th lowest mean 50% isodose volumes
  - Lowest mean difference between 20-80% and 20-50 isodose volumes.
- No clear trends showing which ring is best for all variab
  - In general, rings closer to the target showed better 8 fall-off and 20%/50% fall-off