

Summary:

Point type and line type LDR seed models were generated in Varian BrachyVision to answer the question: are point type calculations good enough for COMS eye plaques?

At the COMS standard 5mm apex Rx point, the agreement was quite good. At tumor distances below that value, the point and line type models diverged. That divergence was more pronounced with smaller COMS plaques.

Our conclusion would be in line with AAPM TG43U1 that line type calculations are preferred, as they retain accuracy even in the short distance regime.

METHODS AND MATERIALS

IsoAid I-125 line seed parameters were configured in Varian Aria RT-Admin utilizing the manufacturer’s data and characteristics from AAPM TG43U1. A duplicate seed with the same parameters but point type calculation was also configured.

The COMS seed pair coordinates from AAPM TG129 were then entered into BrachyVision for the COMS 10mm and 22mm eye plaques. Sk units were unchanged between the line and point-type calculations and were selected to represent a standard COMS treatment: 120-hour implant, 85Gy to 5mm depth. Reference points moving out along the axis perpendicular to the plaque at 1mm intervals were generated.

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Commissioning COMS Eye Plaques In Varian BrachyVision: Are Point Type Calculations Sufficient?

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INTRODUCTION

Point source models offer the advantage of simplicity of commissioning, as they do not require rotational information be manually entered for each COMS configuration. However, line sources are a more accurate description of LDR seed reality.

Our goal is to quantify the impact of LDR seed line vs point calculation types in Varian BrachyVision for COMS eye plaque geometry.

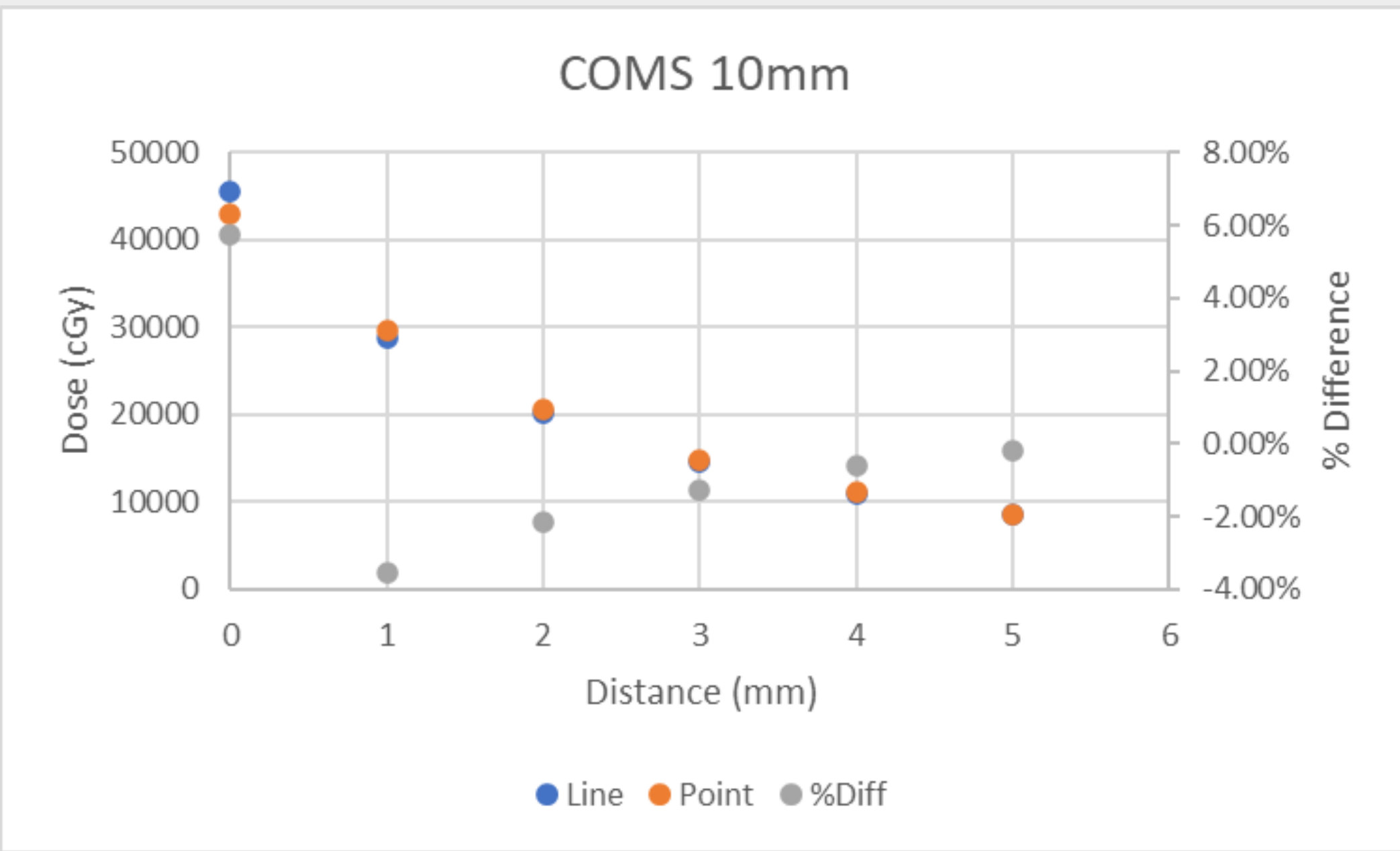


Figure 1. COMS 10mm dose results for line and point calculations, and % difference from line calculations, for increasing perpendicular distance.

RESULTS

For the COMS 10mm geometry: the line type calculation reports a dose 5.72% higher than the point type calculation. Moving out axially, the line type calculation reports lower doses of 3.52% at 1mm, 2.18% at 2mm, 1.26% at 3mm, 0.62% at 4mm, and 0.18% at 5mm.

For the COMS 22mm geometry: line type calculation reports lower doses of 4.71% at the origin, 2.21% at 1mm, 1.18% at 2mm, 0.65% at 3mm, 0.32% at 4mm, and 0.1% at 5mm.

Figures 1 and 2 show the improving agreement with increasing distance between the line and point type calculations. The COMS 22mm plaque converges sooner than the 10mm. This can likely be attributed to the increased physical distance of lateral seed locations of the larger plaque, and the improved agreement with the point source approximation therein.

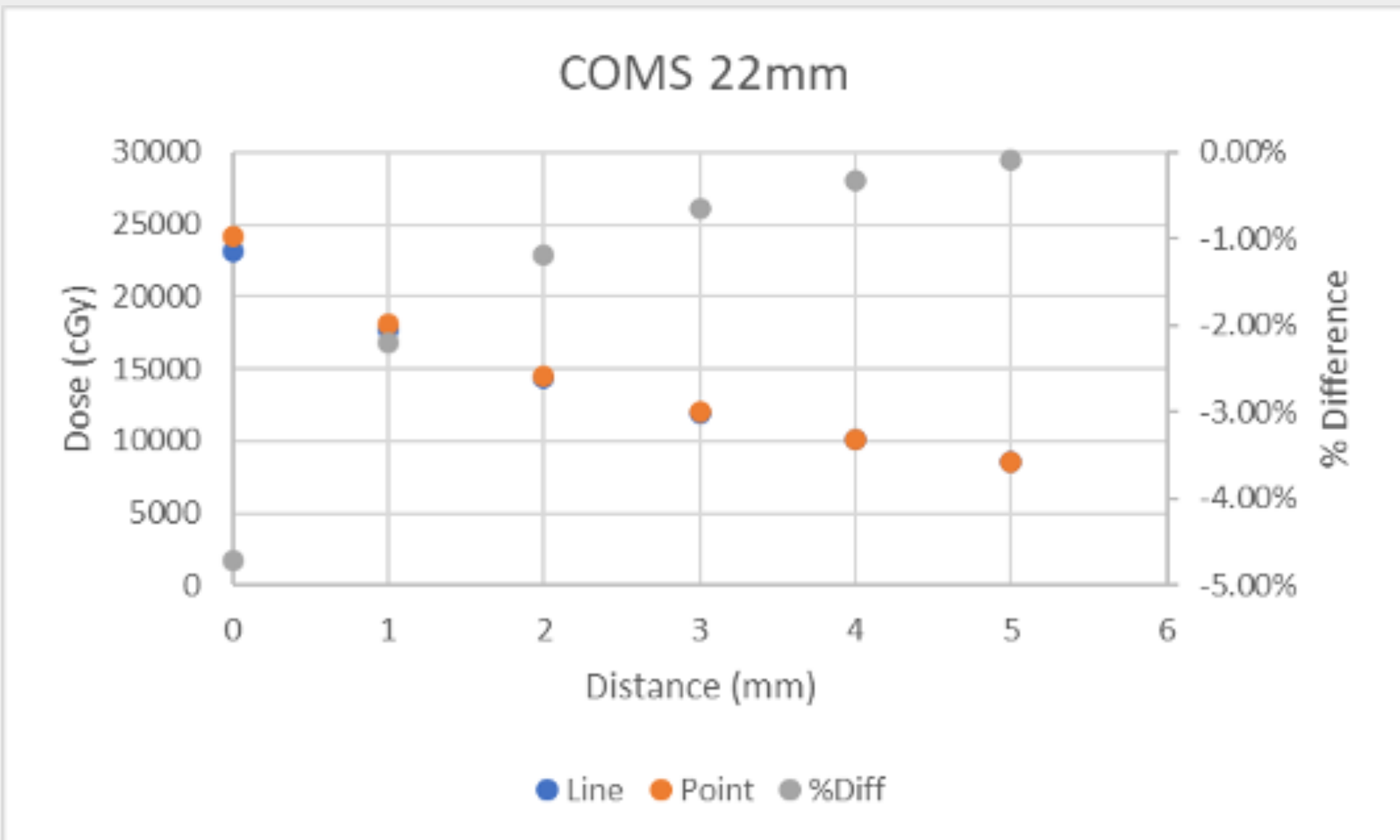


Figure 2. COMS 22mm dose results for line and point calculations, and % difference from line calculations, for increasing perpendicular distance.

DISCUSSION

During this project an issue with the IsoAid Advantage seed and BrachyVision was discovered.

BrachyVision can only accept coordinate pairs of the seed’s active length. As TG129 selected 4.5mm physical length, when entering the coordinate pairs, BrachyVision non-symmetrically fits the coordinates to the active length. Coordinates must be manually remapped for your seed’s active length to ensure accuracy.

Figure 3 demonstrates the automatic shift BrachyVision applies when the active length does not match the physical distance of the seed end coordinate pairs. This shift is not symmetric about the seed center, as visualized by the central seed box relative to the origin. As Varian support has confirmed, there is no method to enter separate physical and active lengths for the seeds, commissioning physicists must manually scale the TG 129 geometry about the seed center to match their seed’s active length.

This study provides data demonstrating that line type calculations are preferred for eye plaque dose calculation in Varian BrachyVision, despite the additional commissioning time burden. While the standard 5mm reference point shows good agreement, tumor apex locations less than 5mm (a common clinical scenario) can show increasing discrepancies as the distance is reduced. While this issue is referred to in the eye plaque literature, there is a lack of specific evidence quantifying its magnitude.

CONCLUSIONS

As expected per AAPM TG43U1, the agreement gets better with distance as the line source collapses to a point approximation. The larger plaque showed better agreement axially. At the COMS standard 5mm, point type calculations would be acceptable, but for tumors below 5mm apex distance, point type calculations are not recommended.

REFERENCES

1. BrachyVision™ Treatment Planning System [V16], Varian Medical Systems, Palo Alto, CA.
2. Rivard, M.J., Coursey, B.M., DeWerd, L.A., Hanson, W.F., Saiful Huq, M., Ibbott, G.S., Mitch, M.G., Nath, R. and Williamson, J.F. (2004), Update of AAPM Task Group No. 43 Report: A revised AAPM protocol for brachytherapy dose calculations. Med. Phys., 31: 633-674.

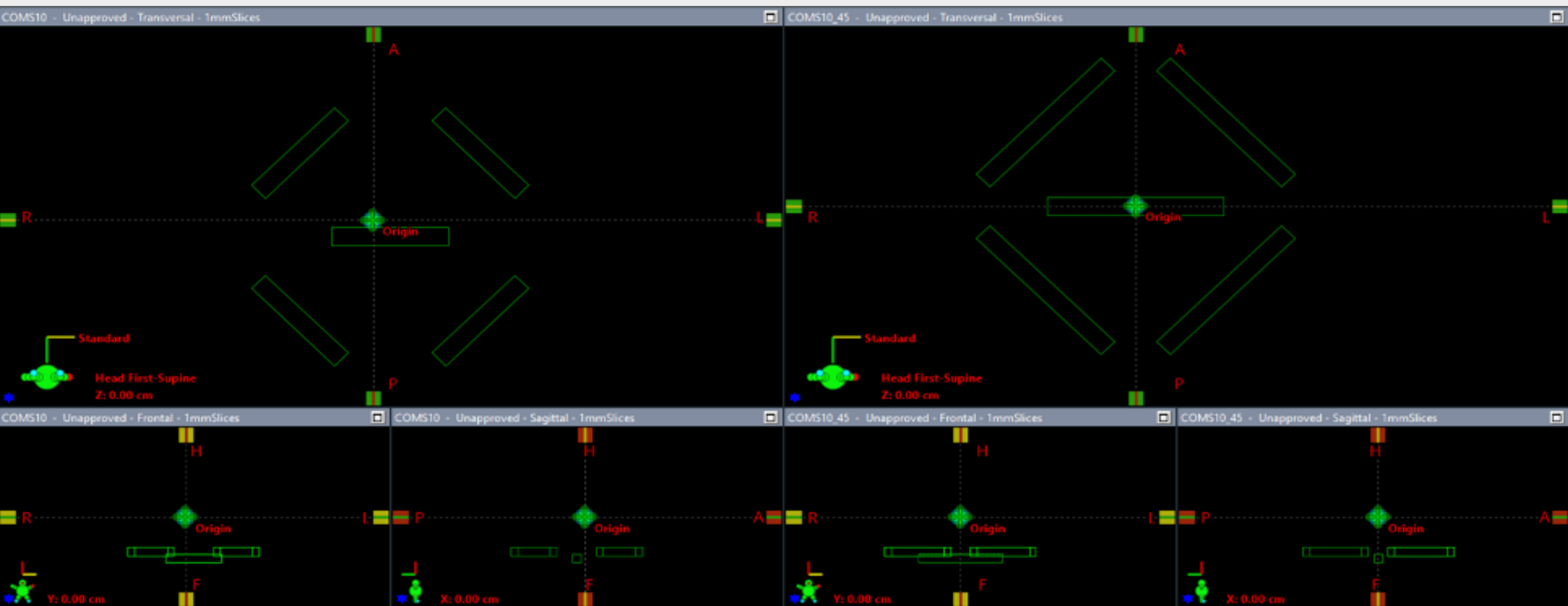


Figure 3. (Left) 3mm active length seed geometry with coordinates directly entered from TG 129 and shifted by BrachyVision. (Right) 4.5mm seed geometry with coordinates directly entered from TG 129 and no shift applied by BrachyVision. Refer to the green user origin crosshair to appreciate the magnitude of offset.