Treatment Planning for Patients with Metal Implants Using Proton Pencil Beam Scanning

Gann, Courtney, CMD; Ichter, William, CMD; Tang, Shikui, Ph.D.; Chang, Chang, Ph.D.

Texas Center for Proton Therapy-Irving, TX

TEXAS CENTER *for* PROTON THERAPY

Purpose

To minimize dosimetric uncertainty by selectively placing proton pencil beam spots to avoid metal implants in the patient

Introduction

For pencil beam scanning in proton therapy, robustness is used in the planning process to ensure the spots are placed accurately and the plan is delivered safely.

Technique

- Metal greater than 2000 HU in the patient's body is contoured.
- The contour is expanded 2-3mm to be used as a spot avoidance structure.
- The spot avoidance structure is used to prevent the placement of any spots inside or distal to it, using the OAR range margin provided by the treatment planning system.

Discussion

When robust optimization is used to account for range uncertainty, spots can still potentially be placed beyond the target or in the avoidance structures. Manual spot editing is necessary to remove the spots inside the avoidance structures in order to ensure that pencil beam spots are not treating through or in the metal.

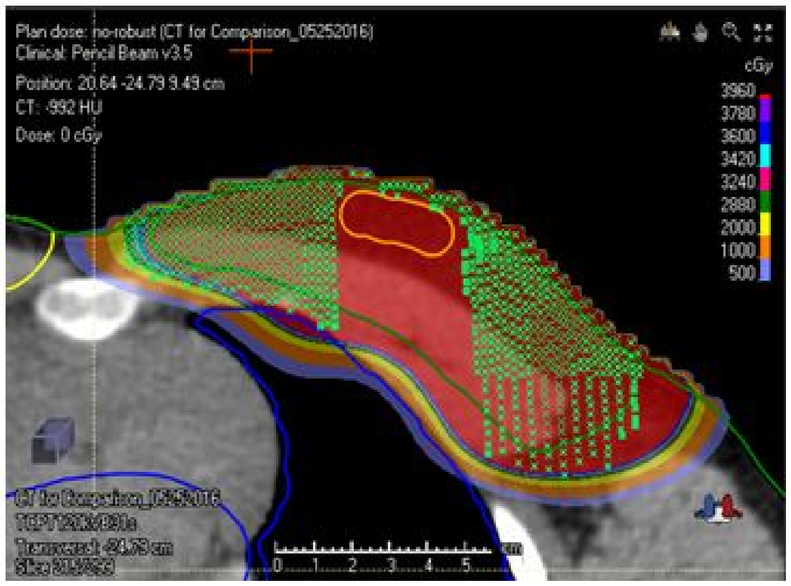

Figure 1: Spots are placed without robustness settings and the spots avoid placement inside or distal to the orange target; this is the spot placement that is desirable for the robust plans as well

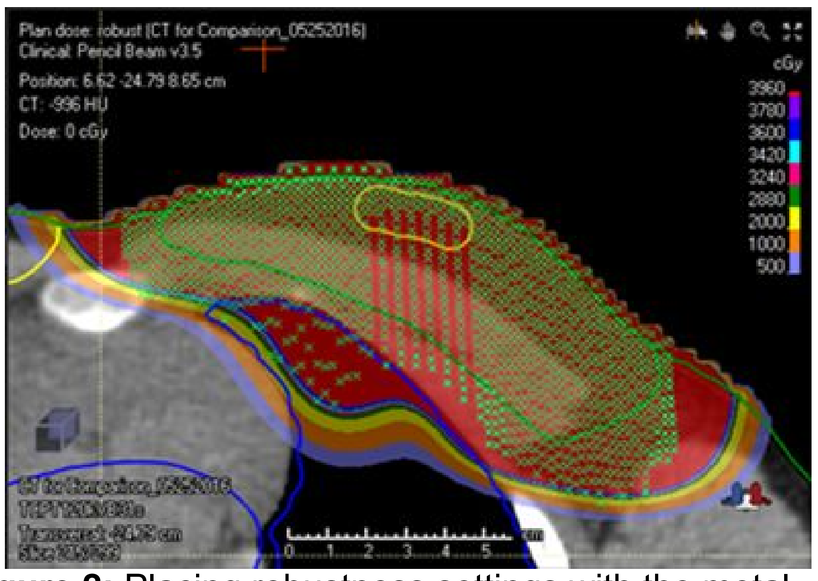

Figure 2: Placing robustness settings with the metal avoid option in the same step result in an undesirable spot placement

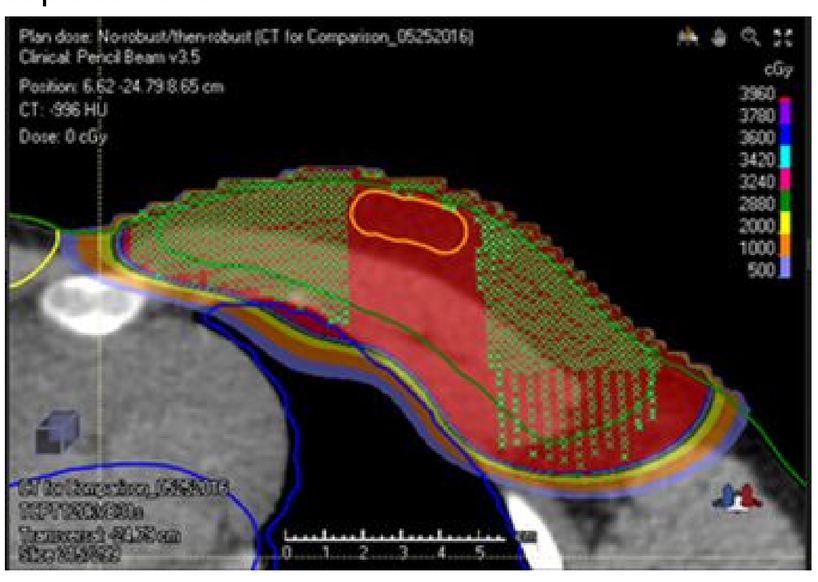

Figure 3: Placing spots with robustness settings after the metal avoid option creates a similar spot placement as Figure 1

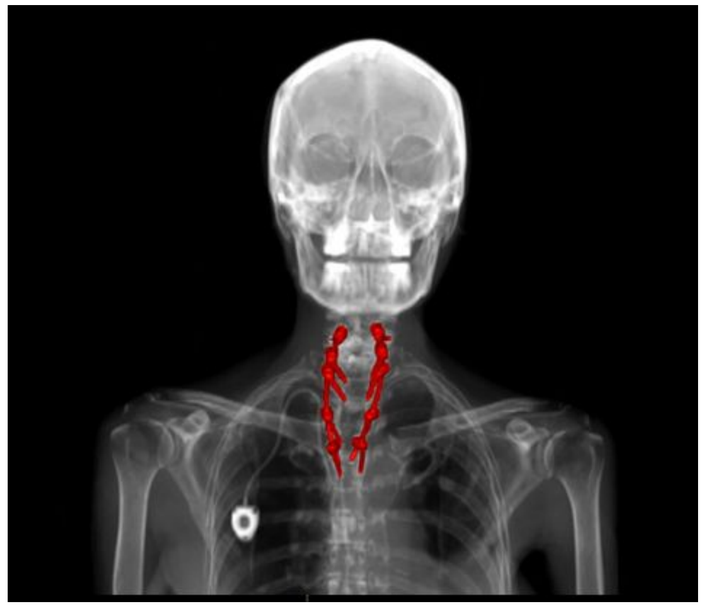

Figure 4: 3D view of metal contour (in red) that was planned with the spot avoid technique

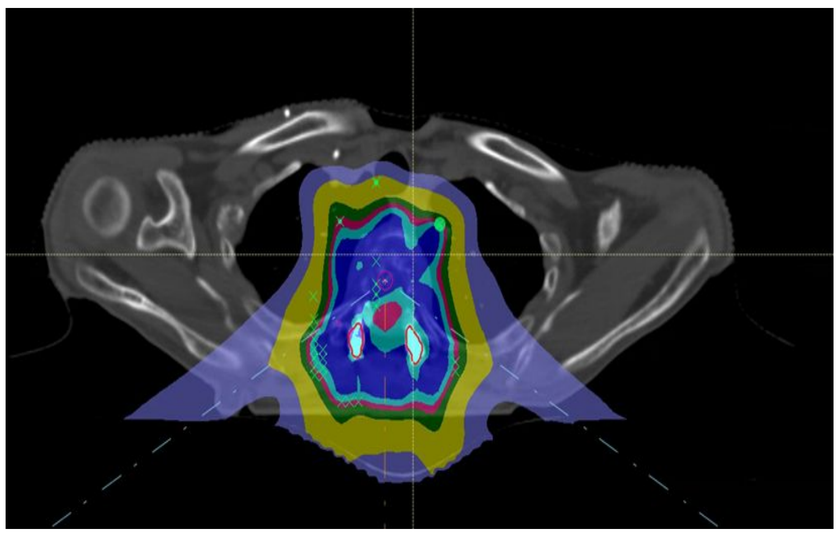

Figure 5: The dose that was achieved for the patient with hardware was optimal and the spots were placed where the metal avoid was not treated through; this is the PA beam's spots.

Conclusions

This approach creates a proton plan that does not treat through or in the metal structure, thus making the delivery more robust and the dose calculation more reliable