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Impact of Wet vs. Dry Hair and Varying Hair Changes on Surface Dose and Setup Consistency in Whole Brain Radiation Therapy

Introduction

Brain metastases occur in 20%-40% of all cancer patients and are the most common tumors of the central nervous system. Whole brain radiation therapy is commonly used to treat brain metastases. Patients are simulated with current hair conditions using a thermoplastic mask for immobilization. Over the course of treatment, patients may present with changes in hair such as hair loss, haircuts, added extensions, or varying degrees of moisture.

Surface dose can be increased by using bolus. Bolus is a build-up material that acts as a tissue equivalent shifting depth of maximum dose closer to the skin surface. There is no literature on hair itself as a bolus material and how it can affect surface dose and mask reproducibility in radiation therapy.

The purpose of this research was to quantify how varying hair conditions influence surface dose during WBRT. The study evaluated mask fit differences between the varying hair parameters and the potential implications for immobilization accuracy.

Methods

Four CT scans were acquired with a water phantom and varying hair parameters. A WBRT plan was created on a dry wig human hair scan using 6MV photons and opposed lateral fields and was used as the base plan.

Thermoluminescent dosimeters (TLDs) were used to measure surface dose for each hair condition. TLDs were placed at Left Lateral, Right Lateral, and Superior regions for readings.

Gap between the water phantom and the thermoplastic mask was measured for each scan for immobilization accuracy on each CT scan at user origin, BBs.

The plan was re-calculated with fixed MU on wet hair, no hair, and added hair CT scans to quantify the difference to the whole brain.

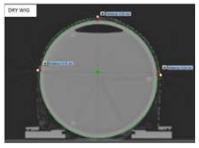

Figure 1. Dry wig with mask.
Figure 2. Mask gap measurement on water phantom. Left Lateral, Right Lateral, Superior measurements were taken.

Results

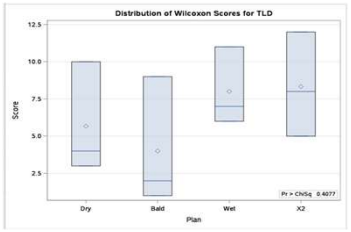

Figure 3. Distribution of Wilcoxon Scores for TLDs
The Kruskal–Wallis test yielded a test statistic of 2.897, DF of 3 and a p-value of 0.408. The Monte Carlo exact test produced a p-value of 0.455 with 99% confidence limits of 0.442 to 0.468. Since the p-values were greater than 0.05, we fail to reject the null hypothesis, indicating that surface dose was similar across the four hair conditions.

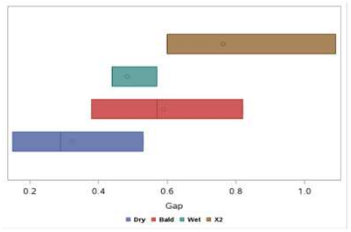

Figure 4. Distribution of Wilcoxon Scores for Gap
The Kruskal–Wallis test resulted in a test statistic of 6.621, DF of 3, and a p-value of 0.085. The Monte Carlo exact test yielded a p-value of 0.058 with 99% confidence limits of 0.052 to 0.064. Since the p-values were greater than 0.05, we fail to reject the null hypothesis, indicating that scan setup was similar across the four hair scans.

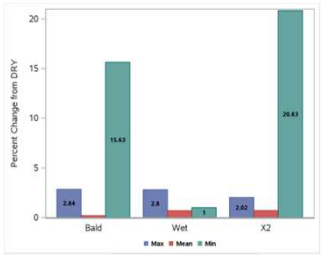

Figure 5. MU Percent Change
Maximum and mean doses were similar across all four plans, while the minimum dose demonstrated the greatest variability. A 20.83 absolute percent change was observed on the X2 wig plan, and a 15.63 absolute percent change was seen on the bald plan.

Abbreviation: X2, Two Wigs

Conclusion

Varying hair conditions did not significantly compromise surface dose, reproducibility, or treatment planning. Clinically, hair differences throughout treatment do not necessitate re-simulation or replanning.

Although there was no statistical significance in this study, the results can be used for patient education. Radiation oncology staff and radiation therapists can provide patients with detailed instructions to attempt to have the same hair condition daily and to avoid extreme hair changes if possible.

This study reinforces current clinical practices that varying hair conditions do not affect surface dose, in the confidence of thermoplastic immobilization devices for head and neck cancers, and will help strengthen patient trust through clear, science-based communication.

Limitations

Limitations to this study include small sample size, limited number of TLD readings, and limited number of scans. Future studies on surface dose with varying hair conditions should include larger sample sizes and additional readings. Different mask thicknesses could also be used to analyze if the addition of thermoplastic material could potentially increase the bolus effect.

References

1.Research Protocol: Radiation Therapy for Brain Metastases. Accessed November 18, 2025. https://effectivehealthcare.ahrq.gov/sites/default/files/pdf/radiation-therapy-brain-metases-protocol.pdf

2.Gondi V, Bauman G, Bradfield L, et al. Radiation Therapy for Brain Metastases: An ASTRO Clinical Practice Guideline. Pract Radiat Oncol. 2022;12(4):265-282. doi:10.1016/j.prro.2022.02.003

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