Integration of a 3D-Printed bolus in external beam radiotherapy for squamous cell carcinoma: a single institutional study

Andreea-Cosmina Ciobanu[1]
[1] Ovidius Clinical Hospital

Integration of a 3D-Printed bolus in external beam radiotherapy for squamous cell carcinoma: a single institutional study

A.Ciobanu[1,2], V.Sivoglo[2], D.Maican[2], F.Járai-Szabó[1], Z. Bálint[1]

[1] Babes-Bolyai University, Faculty of Physics, Cluj Napoca, Romania
[2] Ovidius Clinical Hospital, Department of Radiotherapy, Constanta, Romania

Purpose
This study aimed to evaluate the clinical implementation of a 3D-Printed bolus in the delivery of external beam radiotherapy (EBRT) for a 65-year-old female patient diagnosed with moderately differentiated squamous cell carcinoma of the right preauricular area. The primary objective was to boost tumour targeting by minimizing air gaps during treatment and achieving a customized fit of the bolus.

Materials/Methods
The patient presented with squamous cell carcinoma characterized by invasion of the auricle and right external auditory canal, along with ulceration and bleeding. A total radiation dose of 50 Gy was prescribed, delivered in 25 fractions. A 3D printed bolus was designed using a CT scan to conform precisely to the contours of the tumour and the surrounding area of interest. This bolus was utilized throughout all 25 treatment sessions to ensure consistent radiation delivery and minimize air gaps that could compromise treatment efficacy.

Results
The treatment was well tolerated, with the patient experiencing minimal side effects to the skin area. The volumetric modulated arc therapy (VMAT) technique, incorporating three partial arcs for beam setup, was employed, which effectively preserved the dosage to the organs at risk (OARs), thereby minimizing potential side effects associated with radiotherapy. Follow-up assessments conducted six months post-treatment revealed remarkable outcomes (Figure 1), with MRI scans indicating a complete response to the radiation therapy and no evidence of residual tumour. Additionally, the patient reported a significant enhancement in her overall quality of life, underscoring the advantages of the personalized approach facilitated by the 3D printed bolus.

Conclusion
The integration of 3D printed bolus technology in radiotherapy demonstrated substantial advantages in conforming to the tumour's anatomy. The results indicate a total response to treatment and marked improvement in patient quality of life, underscoring the potential of personalized treatment strategies in managing complex cancer cases.

References
1. Nuzzi, R., Trossarello, M., Bartoncini, S., Marolo, P., Franco, P., Mantovani, C., & Ricardi, U. (2020). Ocular Complications After Radiation Therapy: An Observational Study. Clinical Ophthalmology, 14, 3153–3166. https://doi.org/10.2147/OPTH.S263291
2. S L Morgan-Fletcher, Prescribing, Recording and Reporting Photon Beam Therapy (Supplement to ICRU Report 50), ICRU Report 62. ICRU, pp. ix+52, 1999 (ICRU Bethesda, MD) $65.00 ISBN 0-

913394-61-0, British Journal of Radiology, Volume 74, Issue 879, 1 March 2001, Page 294, https://doi.org/10.1259/bjr.74.879.740294
3. Brook, I. (2021). Early side effects of radiation treatment for head and neck cancer. Cancer Radiotherapie : Journal de La Societe Francaise de Radiotherapie Oncologique, 25. https://doi.org/10.1016/j.canrad.2021.02.001
4. Wong, G., Lam, E., Bosnic, S., Karam, I., Drost, L., Yee, C., Ariello, K., Chow, E., & Wronski, M. (2020). Quantitative Effect of Bolus on Skin Dose in Postmastectomy Radiation Therapy. Journal of Medical Imaging and Radiation Sciences, 51. https://doi.org/10.1016/j.jmir.2020.06.006