

THE EFFECTIVENESS OF A THREE-DIMENSIONAL MODEL OF A PAEDIATRIC ABDOMINAL NEUROBLASTOMA IN VIRTUAL REALITY FOR SURGICAL PLANNING AND JUNIOR DOCTOR EDUCATION

Background and Aims:

Surgical excision of abdominal neuroblastomas (NB) presents considerable anatomical complexities, particularly when multiple image-defined risk factors (IDRFs) are present.

This research introduces a prototype 3D NB model integrated into a Virtual Reality (VR) application, tailored for junior doctor education and surgical planning.

Methods:

- A 3D Model was digitally reconstructed from a patient's dataset (including computed tomography (CT) and magnetic resonance (MR) images) and visualized in VR through an Oculus Quest 2.
- Interactions in VR allow for CT dataset overlay, toggling individual structures visibility, 360-degree navigation, providing information and the ability to annotate.
- User testing at the Royal Hospital for Children, Glasgow, involved 20 medical professionals of varying levels of training, exploring three aspects through mixed methods research : (1) A counterbalanced design contrasting two-dimensional (2D) versus VR identification of anatomical structures (Mann-Whitney U test and Wilcoxon-signed rank analysis), (2) Usability testing via the System Usability Scale (SUS), and (3) Presence assessment via the ITC-Sense of Presence Inventory (ITC-SOPI) questionnaire.

Results:

Fewer errors in anatomical identification were present in VR compared to 2D ($p < 0.05$), with a higher mean error value if 2D was used prior to 3D (1.2 vs 0.5).

SUS ranked highly (79.75), and all presence constructs were positively scored: Spatial (Mean 3.75 ± 0.55 SD), Engagement (Mean 4.08 ± 0.4 SD), Ecological Validity (Mean 3.72 ± 0.83 SD), and Negative Effects (Mean 1.77 ± 0.78 SD).

Conclusion:

This 3D neuroblastoma model in VR demonstrated improved anatomical recognition,

as a user-friendly tool to enhance both surgical planning and medical education. This provides a foundation for future research and development within the context of comparable rare tumour masses.