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Introduction & Objectives: Surgical planning for robotic-assisted partial nephrectomy (RAPN) is widely performed using 2-dimensional (2D) CT images. It is unclear to what extent 2D images fully simulate surgical anatomy and case complexity. To overcome these limitations, software has been developed to reconstruct 3D models using available CT images. We present the results of a feasibility study, to explore the potential role and practicality of 3D models in the context of surgical utility for preoperative and intraoperative use, as well as improving patient involvement.

Materials & Methods: We prospectively enrolled 22 non-consecutive patients due to undergo a RAPN at our high-volume kidney cancer centre. Institutional Review Board approval was obtained. Patient demographics and tumour characteristics including R.E.N.A.L. nephrometry score were collected. Surgical outcome measures included console time, warm ischaemia time (WIT), estimated blood loss (EBL), length of stay (LOS), complications and histological margin status. The value of the 3D model to the surgeon and patient was assessed using a survey.

Results: The median age was 58.5 years (interquartile range [IQR] 51.5-64.8) and median BMI 28 (IQR 27-31) with 15 male and 7 female patients. Overall, 12 (55%) were cT1a and 10 (45%) cT1b tumours. Based on the R.E.N.A.L. score, 12 (55%) were of intermediate complexity, whilst 6 (27%) and 4 (18%) were of low and high complexity, respectively. Median (IQR) console time was 135 (IQR 91.3-153.3) min and WIT 15.5 (IQR 13.8-22.3) min. Median (IQR) EBL was 125 (IQR 50-237.5) mls. Two patients (R.E.N.A.L. score 11A and 10P) underwent a conversion to radical nephrectomy due to a risk of a positive margin during resection. Median (IQR) LOS was 2 (IQR 2-3) days. No complications were noted and all patients had negative surgical margins. In 17/22 cases, surgeons scored 5, on a 5-point Likert Scale (LKS), that the 3D model was useful overall for pre-operative planning, with clarification of vascular anatomy in 22/22 and assessing feasibility of selective clamping in 13/22. Intra-operatively, it facilitated with renal hilum dissection in 21/22, identifying feeding arteries for clamping in 20/22, assessing feasibility of tumour enucleation vs partial nephrectomy in 14/22, clarification of tumour margins in 12/22 and assisting with excision and suture planning in 9/22. The patients reported a better understanding of their procedure using the 3D model, with a median LKS score of 5.

Conclusions: This study shows the potential benefit of 3D technology in surgical planning with positive uptake from the surgeons and patients. It appears to assist with improved perception of vascular anatomy and resection approach. The images were also found to be beneficial to patients in disease understanding aiding surgical counselling. A randomised controlled trial is needed to further evaluate the technology.