Assessing the utility of 3D printed models of Müllerian tract anomalies for clinical education

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BACKGROUND

Congenital Müllerian anomalies are often rare and complex(1). Understanding these anomalies is critical to ensure timely diagnosis and optimal surgery.

The obstructed hemivagina and ipsilaterial renal agenesis and didelphys uterus (OHVIRA) anomaly is an uncommon but clinically significant Müllerian anomaly. Girls with this anomaly typically present around menarche, often with increasing pelvic pain. Unfortunately the diagnosis is not uncommonly missed, and can result in the patient being put through unnecessary procedures.

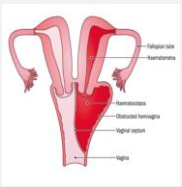


Figure 1: schematic of OHVIRA anomaly

Medical imaging facilitates pre-operative planning, but traditionally provides only 2-dimensional representations, which limits conceptualisation of complex anatomy. This problem may be overcome with three dimensional (3D) models, which can also assist with patient communication and understanding. 3D-printing has been successfully utilised in a number of other disciplines, including vascular, neurological and cardiac surgery. Experience of 3D printing in gynaecology has thus far been limited.

AIMS & OBJECTIVES

- To create an accurate 3D models of the OVIRA anomaly
- To demonstrate the utility of the model for increasing trainees' understanding of the condition, and confidence approaching the surgical treatment
- To investigate the perceived benefit of using these models to aid patient communication and understanding

METHODS

Magnetic Resonance Images (MRI) of patients with OVIRA anomalies were collected. A high resolution scan was de-identified and processed to create a 3D software model, which was then printed. The model was printed in two sections, and a clear material was selected, to allow internal structures to be visualized. Red paint was used to illustrate the haematocolpos in the blocked right side.

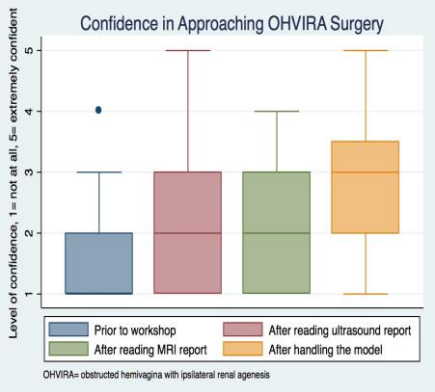
3D printer (orange)

Doctors attending a paediatric and adolescent gynaecology workshop were taken through an OHVIRA case. The history was presented, followed by the ultrasound and MRI reports, then the 3D models. Of 90 attendees, 82 completed a sliding scale, 5 point questionnaire assessing the utility of the models.

RESULTS and DISCUSSION

There was a small but meaningful increase in doctors' confidence approaching surgical correction of the anomaly after handling the model (0.82 +/- 0.16, p<0.000). However, a number of attendees stated that while the model improved their understanding of the condition (see figure 4), they still did not feel confident approaching the surgery. The surgical technique was not discussed in the workshop, if it had been, this number would likely have been higher.

Figure 3:

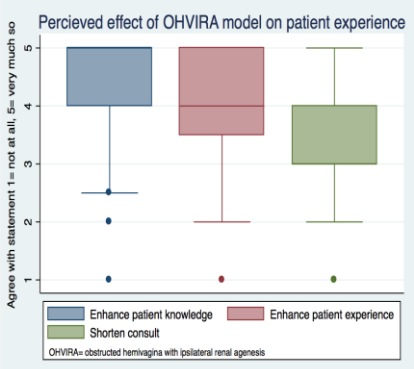


The results indicated that the addition of an MRI was not useful in increasing doctors' confidence regarding treatment, in fact there was a small decrease (-0.19 +/- 0.11, p<0.08), though there was only weak evidence that this wasn't just due to chance. This should prompt discussion about best practice resource allocation with the work up of these cases.

Note- 3 surgeons that rated their confidence as 5/5 with approaching the surgery of this anomaly at the start of the workshop were excluded, given this could not be improved on.

Figure 4:

Participants' response to the question 'the 3D model enhanced your understanding of the anomaly'					
	1	2	3	4	5
Level of agreement, 1= not at all, 5= very much so	9%	14%	25%	29%	23%



The majority of attendees found that the models enhanced their understanding at least to some degree. There was a strongly positive response to the perceived benefit of using these models in consultations to enhance patient communication and improve the patient experience.

Common feedback of how the model could be improved was to use colour to delineate different structures, such as the cervix.

CONCLUSIONS

- The 3D printed OHVIRA models were well received- improving doctors' understanding of the condition, and to a lesser extent, their confidence in approaching the surgical treatment.
- The majority of doctors surveyed agreed that the models would greatly enhance the patient experience and their knowledge of the condition.
- It was more challenging and time consuming to produce Müllerian anomaly models from MRI than in other anatomical areas. Thus while these 3D printed models may be useful in training, medical education and patient communication, their utility in individual case preparation may be limited.
- Consideration should be given to the legitimacy of ordering MRIs in these patients, as in this group, it did not improve doctors' confidence in approaching their treatment.

REFERENCES

1. Troiano RN, McCarthy SM. Müllerian Duct Anomalies: Imaging and Clinical Issues. Radiology. 2004;233(1):19-34.

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