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Development of personalised 3D printed abdominal aortic aneurysm models with use of different materials for clinical education and training in interventional radiology

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SHORT COMMUNICATION

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ABSTRACT

Background

3D printing is increasingly used in medical applications with studies proving its clinical value in surgical planning and simulation of complex surgical procedures. Use of patient-specific or personalised 3D printed models could serve as a useful tool in clinical education and training by practicing interventional procedures on the realistic physical models.

Aims

This study aimed to develop 3D printed personalised abdominal aortic aneurysm (AAA) models using different materials for the purpose of simulating interventional radiology procedure when performing endovascular aneurysm repair.

Methods

Anonymized Computed Tomography (CT) images of a sample case with an intrarenal AAA were selected to generate 3D volume data comprising AAA and arterial branches covering from celiac axis to common iliac arteries. The 3D segmented AAA model was printed with six different materials including resin, high impact polystyrene (HIPS), polyethylene terephthalate glycol (PETG), polylactic acid (PLA), polymethacrylate (PMMA), and thermoplastic polyurethane (TPU). The 3D printed models were scanned on a 192-slice CT scanner with and without use of contrast medium. Model accuracy in terms of AAA length and maximal transverse diameter was measured on original CT images and compared with that from these 3D printed models.

Results

The AAA models were successfully printed with these six different materials. 3D printed AAA models accurately replicated aortic aneurysm dimensions with mean differences less than 0.5 mm between measurements from original CT images and 3D printed models.

Conclusion

This study shows the feasibility of printing personalised AAA models with different materials with high accuracy of replicating aortic aneurysm. The 3D printed personalised models will be used to train interventional radiology trainees to develop their practical skills on performing endovascular aneurysm repair procedures.

Key Words

3D printing, Abdominal aortic aneurysm, Endovascular aneurysm repair, Accuracy, Model, Simulation

Introduction

Abdominal Aortic Aneurysm (AAA) is a common vascular disease that affects elderly patients. Conventional treatment of AAA by open surgery is associated with potential risks of intraoperative and post-operative complications, especially higher in patients with cardiovascular disease. Currently, minimally invasive Endo