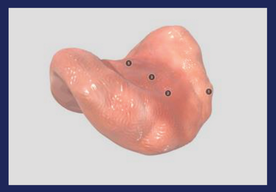
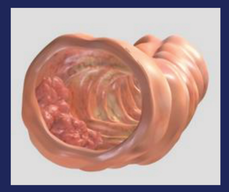

DEVELOPMENT OF 3D TRAINING MODELS FOR THE IDENTIFICATION AND CLASSIFICATION OF COLORECTAL POLYPS

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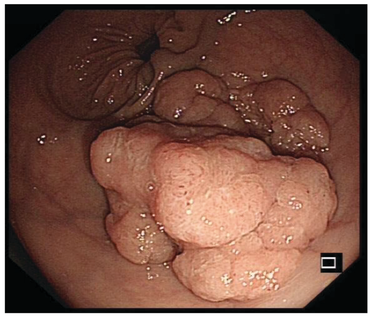
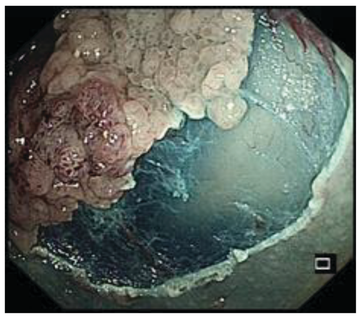
Abstract

Colorectal cancers develop from pre-malignant polyps that can be removed during colonoscopy. Detection, assessment, and removal of polyps has a major role in bowel cancer prevention. Accurate classification is based on general morphology, and surface pit and capillary patterns. It is difficult to teach assessment skills because static polyp images are often of poor quality and cannot show all areas of interest. A variety of colorectal polyps with highly detailed surface textures that correlate to specific pathological features were 3D modelled in ZBrush software, published on Sketchfab as an online interactive resource, and 3D printed in durable and flexible resins to act as training and educational aids.

Context

Failure to detect pre-malignant polyps during a colonoscopy increases the subsequent risk of cancer. Challenges exist for learners to recognise important pathological features and estimate risk of cancer but Patel et al., (2017) found that within polypectomy training, 48.2% of trainees received only 10 minutes of training with large polyps before entering clinical practice.

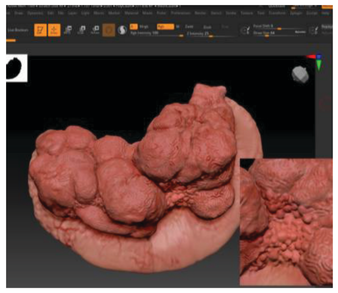
Digital and physical 3D models have learning affordances. They promote critical thinking, clinical assessment and psychomotor abilities (Ardila et al., 2023); facilitate online collaboration (Mikami et al., 2022) and haptic learning (Garcia et al., 2018), and increase student satisfaction and knowledge accuracy (Ye et al., 2020).

Objectives

- To produce an interactive on-line training resource using annotated 3D models that promote self-navigation and support learning.
- To create a set of tactile 3D printed, realistic polyp models for use in the classroom.

Methods

Using ZBrush, a range of sessile, spreading and pedunculated 3D polyp models were sculpted from a 'Dynamesh Sphere' using the 'Move topological' 'Standard' and 'Form Soft' brushes, to create the intended morphology and surface textures.

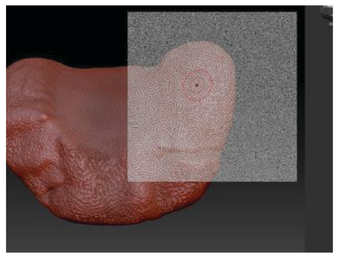
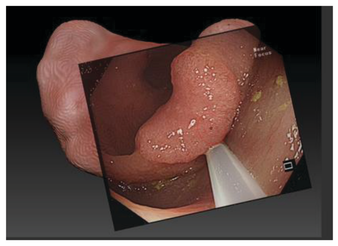


The online AI Reaction Diffusion Playground was used to create a range of textures similar to surface pit pattering of polyps.

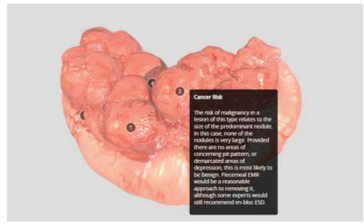
Using the 'spotlight' tool in ZBrush the Reaction Diffusion 'pit pattern' textures were projected onto the polyp models, to create specific detailed surface textures.

Clinical images of polyps were also projected to ensure realistic colour and appearance.

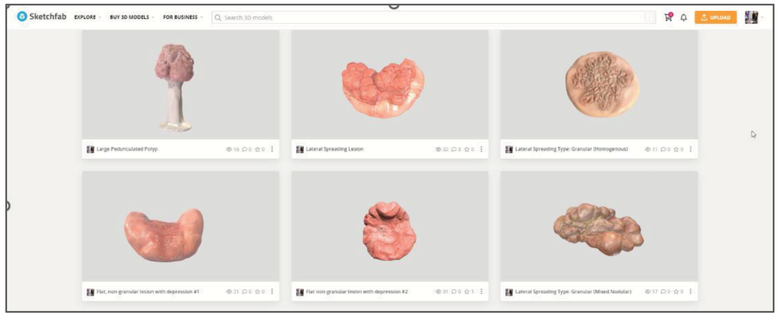
The finished models with texture maps were exported as .OBJ files for online publication.

Ten 3D models were uploaded to Sketchfab.com; the largest online immersive platform for hosting 3D content. Text annotations were added to each model.



Results



Scan the QR code (left) to view the models online. Scan the QR code (right) to view the models in augmented reality.

The polyp models were scaled up and 3D printed in durable and flexible resins to act as classroom teaching aids that assist with haptic learning.

Next Steps

- Obtain clinical feedback from healthcare professionals.
- Embed the digital models into interactive endoscopy training and learning resources on LJMU LMS.
- Create moulds from the 3D prints and use bioplastics to make models that mimic the texture and feel of a physical polyp.