Creating Realistic 3D Models as Teaching Aids for Large Colorectal Polyp Assessment

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Aims

- Estimating risk of malignancy within a large, non-pedunculated colorectal polyp (LNPCP) is critical when selecting treatment options, and to avoid adverse outcomes[1].
- LNPCPs account for only 2-5% of polyps, so are infrequently encountered during training.
- Endoscopic photos and videos highlight areas of interest so trainees do not learn skills necessary to interrogate a polyp independently[2].
- Our collaborative project aims to develop a comprehensive library of digital 3D LNPCPs to be used as an interactive online teaching resource and to 3D print a selection of these to create physical training models.

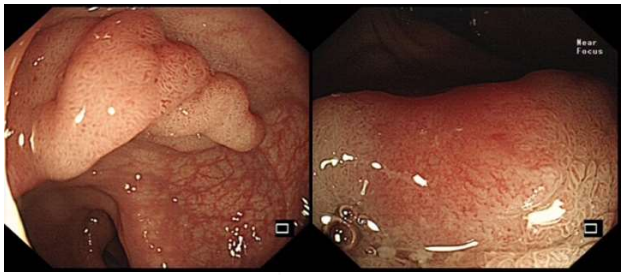


Figure 1: LNPCP with small malignant area, visible only in retroflexion

Methods

- Virtual polyps were created from reference images using digital 3D modelling software, zBrush.
- Pit patterns are reproduced using reaction diffusion software and overlayed on the polyps to create surface textures.
- Digital 3D polyps are presented on an on-line learning platform where they can be manipulated and explored by users. 'Hot-spots' allow annotations and learning material to be accessed via mouse click.
- Selected polyps can be 3D printed in flexible acrylic and finished by hand-painting.
- Evaluation was obtained from 5 experience colonoscopists who rated the models for realism and potential usefulness.

Figure 2: Polyp sculpted in zBrush

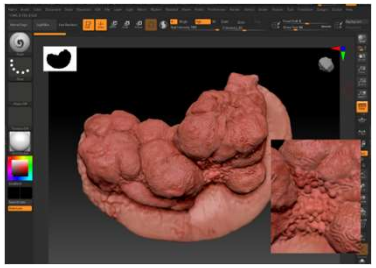


Figure 3: Pit patterns created with Reaction-Diffusion software

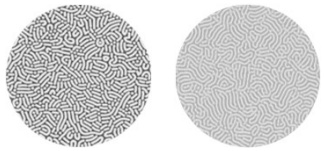


Figure 4: Applying the pit pattern overlay

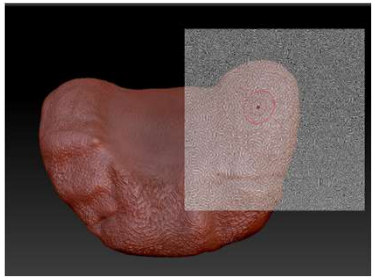


Figure 5. Range of 3D digital polyps presented on Sketchfab, an online repository.

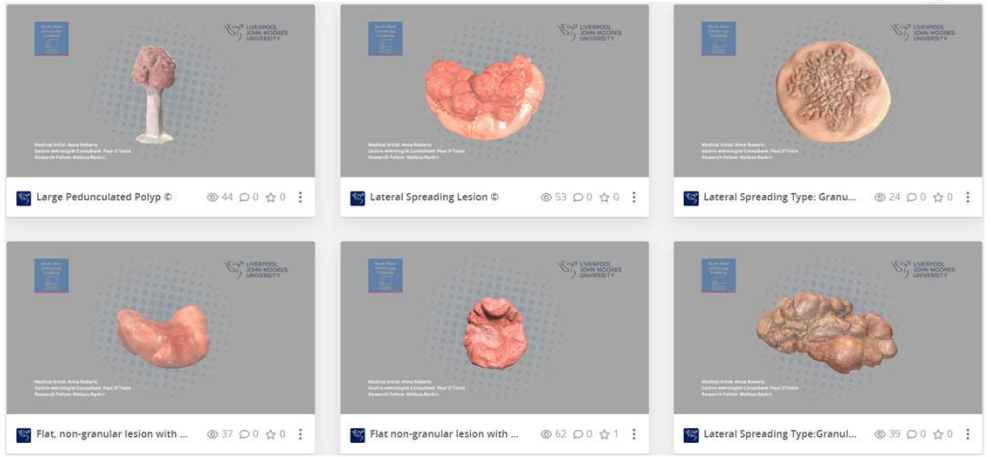
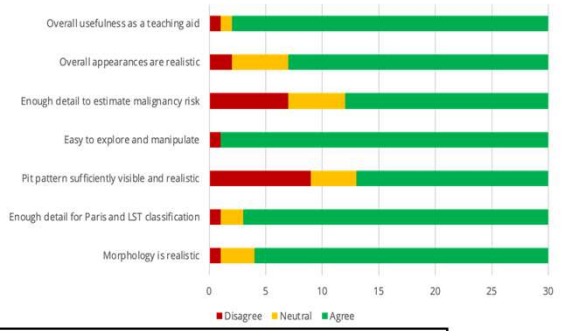


Figure 6: Combined rating scores for all 6 polyps



Results

- Polyps rated highly for morphology and overall realism.
- Assessors found them easy to manipulate and examine.
- Pit patterns were assessed as insufficiently visible and realistic by some.
- Overall, polyps were regarded as realistic and useful as teaching aids.
- Suggestions for improvement included simulating the effects of chromo-endoscopy and narrow band imaging (NBI) to improve estimation of malignancy risk.

Conclusions

- Close collaboration between experienced clinicians and artists with experience in 3D modelling and fabrication can produce artificial polyps of sufficient fidelity to be useful as aids for teaching LNPCP assessment skills.
- Further work is necessary to improve representation of surface features.

References

1. Tate D, Argenziano M, Anderson J et al. Curriculum for training in endoscopic mucosal resection in the colon: European Society of Gastrointestinal Endoscopy (ESGE) Position Statement. Endoscopy 2023; 55: 645–679
2. Ahmad, A. and Saunders, B.P. (2021) 'Photodocumentation in colonoscopy: The need to do better?', Frontline Gastroenterology, 13(4), pp. 337–341. doi:10.1136/flgastro-2021-101903.