A 3D-Printed Eyelid Model for Oculoplastic Training

Ali Istanaksai[1], Mohsan Malik[2]

Background

•Surgical simulations that mimic human tissue have the potential to revolutionize training in oculoplastic surgery

•Current simulation techniques, such as suture pads and cadaveric tissue, have limitations in replicating necessary tissue planes for eyelid surgery

•Advancements in 3D printing offer an opportunity to create realistic tissue models for enhanced surgical training

•This study evaluates the validity of a novel 3D printed eye lid tissue model, aiming to determine its potential as a cost-effective and widely accessible alternative to cadaveric tissue

Methods

•A simplified eye model was created with four tissue planes: skin, orbicularis muscle, tarsus, and conjunctiva

•Polymeric material was modified to achieve different elasticity levels, simulating varying degrees of resistance for each tissue

•The simplified eye model was 3D printed in a modified shape

•Face, content validity, and utility of the material were evaluated using a 16-item Likert-scale questionnaire

•The study included a total of nine participants, consisting of five consultants and four oculoplastic fellows

•The participants performed lid margin repair tasks to assess the model's validity and usefulness in training

Results

Overall, face validation i.e. “look of the tissue model” scored median 4.00, IQR: 1.00 and content validation i.e. “feel of the tissue model” mean 3.38, IQR: 1.00, this was largely due to tarsus layer, which was given the lowest rating (mean 3.05, IQR: 2.00) attributed to the lack of stiffness compared to human tarsus.

Experts thought the proposed model was useful for eyelid suturing and wedge resection (mean 4.66, IQR 1.00 & mean 4.00, IQR 0, respectively). It was preferred over the standard tissue pad (median 5.00, IQR: 1.00) for ease of identifying layers.

Experts were equivocal regarding which they preferred over the 3D-printed model and cadaveric tissue. There was a slight preference for human cadaveric tissue and this was likely felt to be slight preferential to animal cadaveric tissue.

On the whole, fellows were more impressed with the visual appearance and physical feel of the model than consultants, however the cohorts had similar views on their teaching potential and general utility.

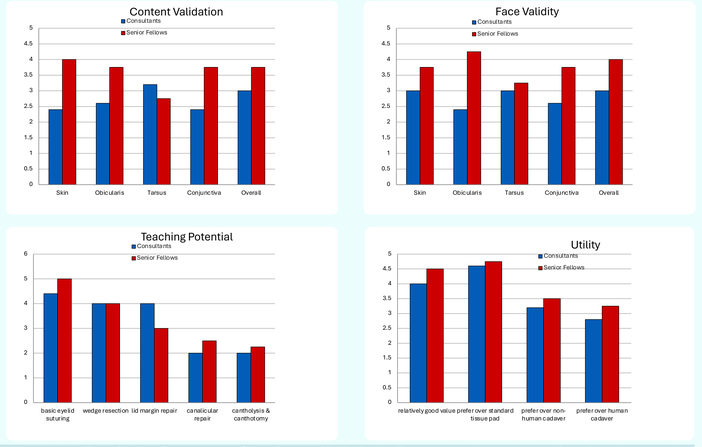


Figure 1-4: Bar charts showing Likert responses of Consultants and Oculoplastic Fellows to a 16-point questionnaire (1-5 where 5 is very positive)

Discussion

•Our study validates the proposed 3D printed eyelid tissue model for oculoplastic surgery training

•High face validation and adequate content validation were achieved

•This model offers a cost-effective and widely available alternative to cadaveric tissue, having a significantly lower cost

•Having layers that felt distinct of each other was a desired characteristic that the 3D printed model struggled to replicate

•Iterative collaboration between surgeons and tissue engineers can enhance models' fidelity - rapid turnover of models are possible with 3D printing technology

•Resource usage can be more efficient through use of improved training materials

Conclusion

•The 3D printed eyelid tissue model has potential as a low-cost, widely accessible alternative

•By reducing reliance on cadaveric tissue, this model contributes to ethical and fiscal considerations in surgical education

•Further collaboration with the supplier has the potential for further refinement of the model and a more faithful representation

•The model's improved fidelity over traditional suture pad materials enhances the training experience for surgeons

Correspondence to ali.istanaksai@kcl.ac.uk