Purpose: Currently surgeons are trained on cadaver eyes which are costly and logistically difficult to obtain. Synthetic ophthalmic teaching models provide an alternate surgical training modality. In this prospective study, we will assess corneal suturing performance on novel 3D-printed ophthalmic models in subjects with varied experience using custom software.

Methods: Subjects (n=37) with varied experience performed corneal suturing sessions (8 interrupted sutures) on a novel 3D-printed ophthalmic model made of polyacrylate (BIONIKO, Miami, FL, USA). Subjects were divided into two groups by surgical experience, beginner or expert, and further divided into two subgroups: the experimental subgroup performed six supervised training sessions over a three weeks and the control subgroup performed two. Software was developed in LabVIEW to assess symmetry, spacing, and radiality of the sutures in each group. Spacing was defined as the arc length along the host/donor junction between each suture. Symmetry was defined as the difference between the inner and outer suture lengths with respect to the host/donor junction. Radiality was defined as the angle between the suture and the line perpendicular to the intersection of the suture and the host/donor junction.

Results: Boundary and feature characterization of the corneal sutures were easily assessed using the custom software. A statistically significant improvement in radiality and spacing between the first and the last corneal suturing session was found in the experimental beginner group (12.56° vs 9.29°, p=0.048 and 0.53mm vs 0.40mm, p=0.013, respectively). No significant improvement was found in the control beginner group. In the experimental expert group, significant improvement was found in radiality (9.41° vs 6.35°, p=0.029).

Conclusions: This study demonstrated that practice on these models yielded a significant improvement in corneal suturing skills within three weeks, especially in the beginner experimental group. Custom photogrammetry-based software enabled an accurate, and reproducible assessment of corneal surgical performance on the 3D-printed eye models (BIONIKO, Miami, FL, USA). These models represent an alternative resource to teach ophthalmic surgical techniques.

(left to right) (a) 3D-printed eye model with eight interrupted sutures, (b) radiality, (c) spacing, (d) symmetry as measured in the custom software