IMPROVED HEALING AFTER CORNEAL TRANSPLANTATION BY OPTIMIZATION OF PATIENT POSITIONING

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Corneal transplantation is the only solution which avoids loss of vision, when endothelial cells are dramatically lost. The surgery involves injecting gas into the anterior chamber of the eye, to create a bubble that pushes onto the donor cornea (graft), achieving sutureless adherence to the host cornea. During the postoperative period, patient positioning affects the bubble. To improve healing, we study the shape of the gas-bubble interface throughout the postoperative period, by numerically solving the equations of fluid motion using OpenFOAM, in particular the Volume-of-Fluids method. Patient-specific anterior chambers (ACs) of variable anterior chamber depths (ACD) are considered, for either phakic (with natural lens) and pseudophakic (with artificial lens) eyes. For each AC, gas-graft coverage is computed for different gas fill and patient positioning. The results show[1] that the influence of positioning is negligible, regardless of gas filling, as long as the ACD is small. However, when the ACD value increases, patient positioning becomes important, especially for pseudophakic ACs. The difference between best and worst patient positioning over time, for each AC, is negligible for small ACD but significant for larger ACD, especially for pseudophakic eyes, where guidelines for optimal positioning become essential. Finally, mapping of the bubble position highlights the importance of patient positioning for an even gas-graft coverage.

References

[1] V. Garcia Bennett, M. Alberti, M. Quadrio, and J. O. Pralits, "Optimization of patient positioning for improved healing after corneal transplantation," *Journal of Biomechanics*, vol. 150, p. 111510, 2023. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0021929023000799

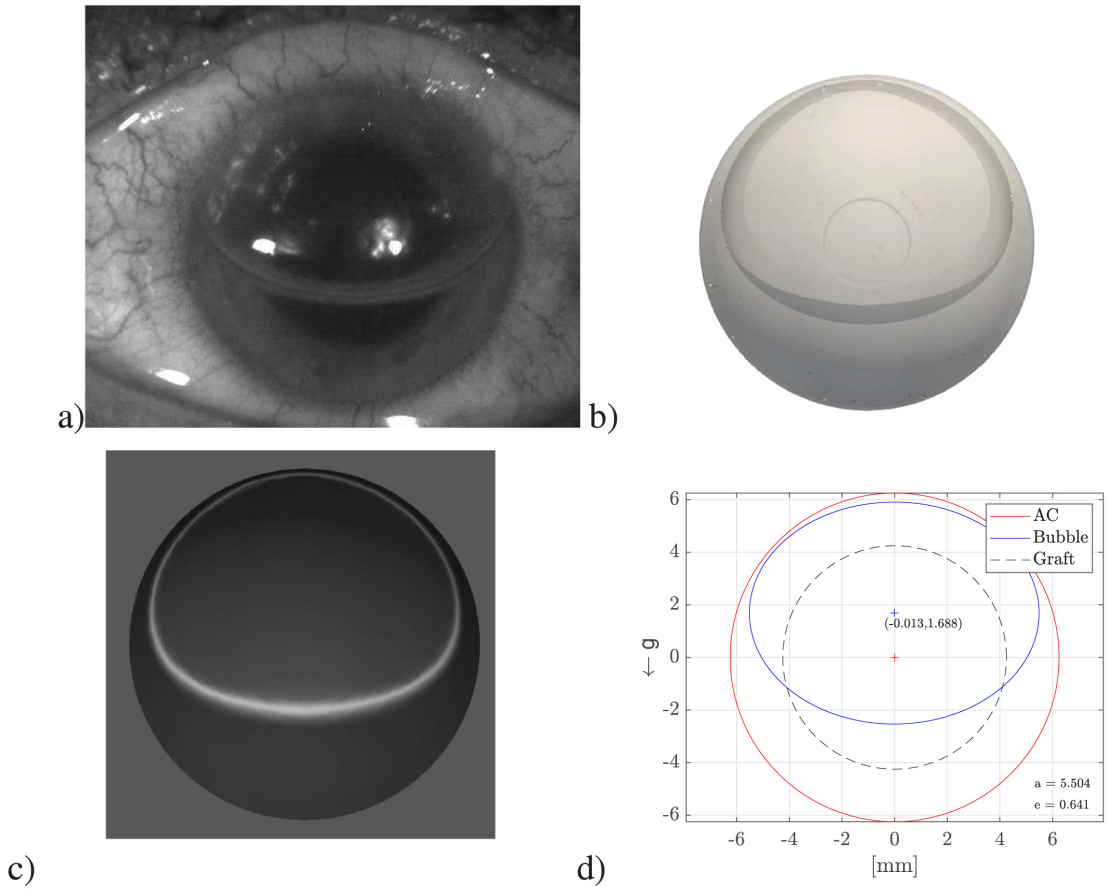

Figure 1: Fig. 3. Example of the ellipse detection method applied to a phakic patient with an ACD 3.68 mm, a gas filling ratio of and gaze angle. (a) Near infra-red image of a patient's eye after DMEK, (b) Numerical recreation of the patient's AC and its equilibrium state, (c) Gray-scale screenshot for ellipse detection, (d) Characteristic dimensions of the projection of the bubble on the cornea.