Purpose: Dosimetric characteristics of new P-32 ophthalmic applicator as substitute for Sr/Y-90 irradiation were evaluated. The integrity and safety were confirmed. The feasibility for 32P ophthalmic applicators was evaluated.

Method and Materials: According to optimal design of P-32 ophthalmic applicator, Monte Carlo simulations were performed to calculate dosimetric characteristics: reference dose rate, central axis depth doses, transaxial dose profiles. The reference dose rate at the surface of an ophthalmic applicator is measured by using an extrapolation ionization chamber (EC) and radiochromic film (RCF). Depth dose distributions and dose profiles were measured using RCF. The source non-uniformity was calculated. The source leakage was examined for the safety. The effective shielding of the applicator was verified.

Results: The reference dose rates of EC, RCF was 4.13 ± 0.21 cGy/s and 3.84 ± 0.25 cGy/s, respectively. The axial depth dose rate was reduced into approximately 1/10 as 32P betas penetrate every 2 mm depth. Measured data sets in depths of 1 mm to 3 mm agreed with Monte Carlo data. The dose profiles were not uniform due to non-uniform activity distribution. At the surface (depth=0.1 mm), source non-uniformities were 27.8%, 11.3% for film, MCNP, respectively. The exposure rate of the handle grip toward a clinician was 1.4 mR/hour (background: 0.1 mR/hour).

Conclusion: The 32P applicator with a 20 mCi (740 MBq) activity can deliver the therapeutic doses to the surface of the conjunctiva within 6 min, while sparing the lens better than 90Sr/Y applicators. The integrity and safety of an new P-32 applicator was confirmed. However, prior to the clinical application of every new applicator, safety, dose uniformity, and absorbed dose rate at the reference point should be carefully evaluated by the method developed in this study.