Kera Treatment: Treating Advanced Cases of Keratoconus

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Late-stage keratoconus is a progressive corneal disease causing severe visual loss. Conventional treatments, like corneal rings, often fail in advanced cases due to insufficient tensile strength to counteract the disease's progression. This research addresses this limitation through a dual-approach methodology aimed at both corneal stabilization and structural correction. Corneal ring implants were developed through the incorporation of 0.5% nanocrystalline cellulose into polymethyl methacrylate (PMMA), resulting in a significant tensile strength improvement from 86MPa to 93 MPa in material testing. Also bioactive nanocoating was produced to augment corneal thickness and roughness. To ensure successful fabrication the ring was characterized via TEM, SEM, XRD, FTIR, Tensile strength Test and was tested in Cellular Study with three different concentrations of Ascorbic acid and TGF-beta Type I. Experimentation demonstrated varying increases in Type I and III collagen across samples where Two-way ANOVA revealed highly significant effects of treatment condition ($p<0.001$), time ($p<0.001$), and their interaction ($p<0.001$) on collagen fold change, with Sample A (100 μm) demonstrating the greatest increase (4-fold) after 72 H,(6-fold) after 6 days of treatment. The synergy of enhanced mechanical properties and bioactive nanocoating properly addresses the underlying problems related to advanced keratoconus, offering a strong, regenerative, and biocompatible alternative to conventional corneal transplantation. The comprehensive approach shows great promise for preventing tissue rejection and operating complications, hence improving patient outcomes.

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