

Toward Patient-specific Pessary to Manage Pelvic Organ Prolapse: Design and Simulation

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This study proposed a novel design and personalized approach to developing an intra-vaginal device, also known as a pessary, for the treatment of Pelvic Organ Prolapse (POP). Although POP is likely to have a more diverse dynamic than other health conditions in women, it is currently treated as a "one-size-fits-all" problem in all cases. Pessaries are conservative devices inserted into the vagina to support its internal structure and predominantly come in a ring shape design. After the advent of medical-grade silicone, pessaries have remained largely unchanged for the past 50 years. Failure rates as high as 50% within the first year of use have been attributed to the poor design of these pessaries; with symptoms such as irritation, bleeding, and lacerations felt by most users. To address this problem, a new base shape design was proposed and its deformation was examined using Finite Element Analysis (FEA). Based on the anatomical measurements of each patient, the base design can be adjusted accordingly. To demonstrate the effectiveness of the proposed design, a comparative study was conducted with the most commonly used support pessary, also known as the ring pessary. In order to model the large deformation of the pessaries, the hyperelastic constitutive law (Yeoh model) was fitted to the available stress-strain data of SIL 30 (a silicone urethane resin supplied by Carbon Inc.). The results showed that re-directing the reaction forces of the pessary towards the lateral walls, supported by the pelvic bones, could decrease the overall displacement of the pessaries, and provide effective symptomatic relief thereby, delaying or preventing surgical procedures.