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PECTOPEXY TO REPAIR VAGINAL VAULT PROLAPSE: A FINITE ELEMENT APPROACH

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Summary: Vaginal vault prolapse is the descent of the vaginal apex which can occur either in conjunction with uterine prolapse or post-hysterectomy and can coexist with the prolapse of the bladder, urethra, rectum or small bowel [1]. Minimally invasive surgery such as laparoscopic sacrocolpopexy and pectopexy are widely performed using mesh implants to substitute the function of the lax apical ligaments. Especially in obese patients, the sacrocolpopexy mesh implanted between the sacrum and the vaginal stump narrows the pelvis to result defecation disorders, adhesions or trauma of the hypogastric nerves [2]. Laparoscopic pectopexy eases such surgical difficulties and has rapidly proved to be an alternative technique against sacrocolpopexy with good postoperative outcomes [3]. This method uses the lateral parts of the iliopectineal ligament for a bilateral mesh fixation. The mesh implant carefully follows the direction of the round and broad ligaments without crossing or interfering sensitive areas such as the ureter, bowel or hypogastric trunk which offers zero restriction to the organ function by the implant.
The purpose of this study is to compare the effectiveness and functionality of the pectopexy surgical technique against our previous sacrocolpopexy simulation results [4] within the 3D female pelvic floor finite element model constructed from sheet plastination technique to correct vaginal vault prolapse. The Dynamesh-PRS® soft and the Dynamesh-PRP® soft from FEG Textiltechnik mbH, Aachen, Germany, Gynecare Prolift® and Ultrapro® from Ethicon Inc. Johnson & Johnson are tested for both surgical techniques. Numerical simulations are conducted at rest after surgery and during Valsalva maneuver with weakened tissues modeled by reduced tissue stiffness. Assuming the pelvic tissues to be isotropic, hyperelastic and incompressible materials, a three term Mooney Rivlin type strain energy function is used to model the mechanical behavior of tissues. Furthermore, the mechanical composition of the fascia tissue composed of smooth muscles, elastin-collagen and adipose tissue is considered using multiscale mechanics adopting their respective volume fraction. The positions of the organs are calculated with respect to the pubococcygeal line for female pelvic floor at rest after repair and during Valsalva maneuver using the all meshes.