Understanding the Impact of Mesh Tension on Vaginal Function and Structural Integrity

Katrina M. Knight,[1,2] Sophya Breedlove,[1] Gabrielle E. King,[2] Pamela A. Moalli[1-3]

[1]Department of Bioengineering, University of Pittsburgh, Pittsburgh, PA; [2]Magee-Womens Research Institute, Pittsburgh, PA; [3]Department of Obstetrics, Gynecology, and Reproductive Sciences, University of Pittsburgh, Pittsburgh, PA

MAGEE-WOMENS RESEARCH INSTITUTE

PITT | SWANSON ENGINEERING
BIOENGINEERING

Building Interdisciplinary Research Careers in Women's Health

BACKGROUND

- Synthetic meshes are commonly used in surgical repairs of pelvic organ prolapse (POP)
- Surgeons apply tension to mesh during surgical repairs of POP
- Tensioning mesh causes the pores to collapse and the mesh to wrinkle (i.e., mesh deformation) (Barone et al 2015 and 2016)
- Mesh deformation leads to vaginal degeneration and mesh complications (e.g., exposure of mesh fibers through the vaginal epithelium) (Knight et al 2022)
- The independent impact of mesh tension (in the absence of deformation) on the underlying vagina is not clear
- **Objective:** to determine the impact of mesh tension on vaginal contractile function and structural properties
- **Hypothesis:** increased tension will lead to compromised vaginal contractile function and structural integrity

METHODS

- Nonhuman primates, Rhesus macaques, aged 8 to 15 years old (IACUC 16088646)
- Mesh was implanted onto the vagina via sacrocolpopexy (Figure 1)
  - No Tension (n=9)
  - Low Tension (1 N, ~0.4 lbs, n=8)
  - High Tension (10 N, ~2.2 lbs, n=8)
- Sham (no mesh implanted) served as controls (n=9)
- After 12 weeks, vagina (Sham) and mesh-vagina complexes excised *en bloc*

This work was supported by the following grants: NIH R01 HD083383; NIH K12 AR084218; NIH T32 EB034216.

METHODS

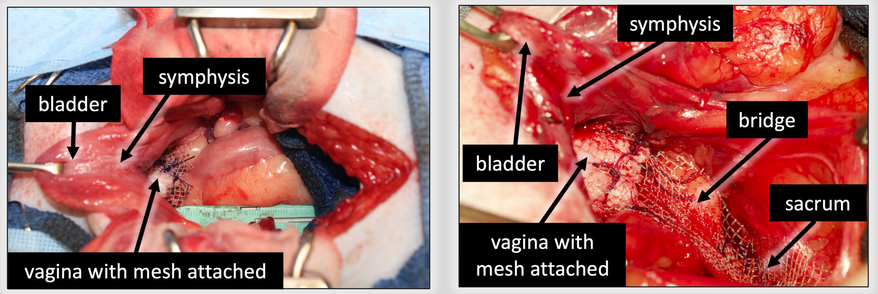

Figure 1: *In vivo* surgical images demonstrating mesh implanted (not deformed) onto the vagina in the absence of tension (left) and on low or high tension (right).

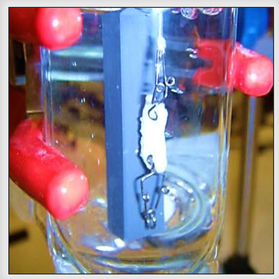

Figure 2: A vaginal contractility assay was performed in which the vagina (Sham) and mesh-vagina complex strips were exposed to 120 mM KCl to cause the vagina (and indirectly the smooth muscle) to contract.

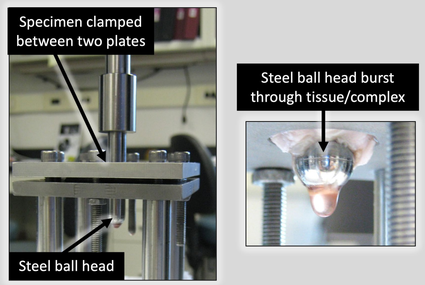

Figure 3: Ball-burst testing was used to assess vaginal structural properties (stiffness, load and elongation at failure, energy absorbed), a proxy for the structural integrity of the vagina.

CONCLUSION

- Increasing mesh tension had minimal impact on the contractile function and structural integrity of the vagina
  - Difference between low and high tension may be too small to observe differences
  - Inherent biological differences between primates within a group may have impacted the results
- Increased sample size and future studies assessing histologic and biochemical endpoints are needed to further investigate study findings

RESULTS

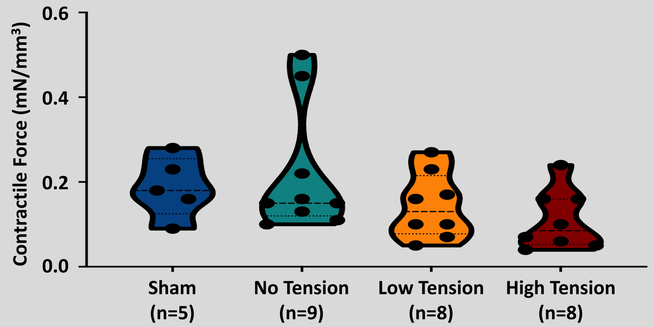

Figure 4: A trend towards a decrease in contractility was observed with increasing tension; however, vaginal contractility was not significantly different between the groups (p=0.174).

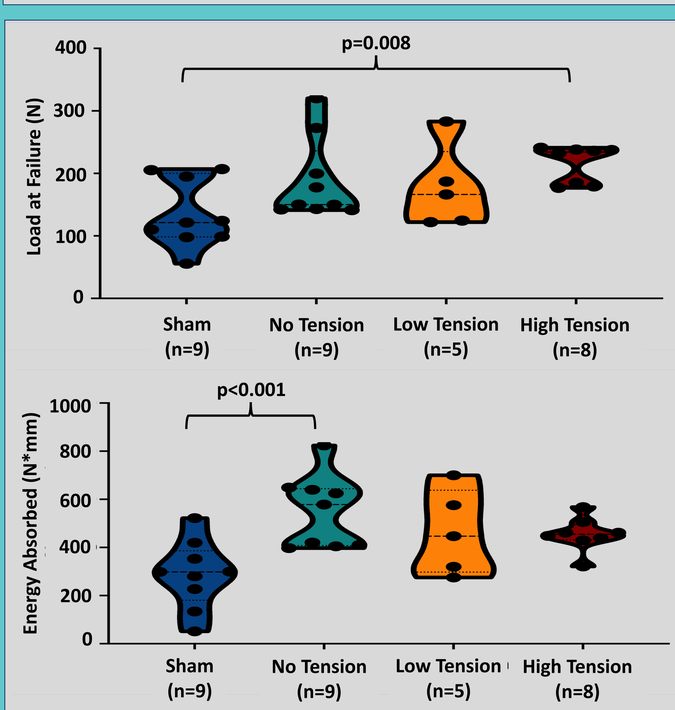

Figure 5: Compared to Sham, the load at failure was 60% higher for High Tension (p=0.008) while the energy absorbed was 91% higher for No Tension (p<0.001). All other structural properties (i.e., stiffness and elongation at failure) were not significantly different (p's>0.05).