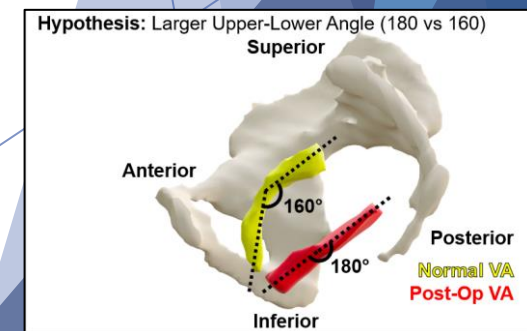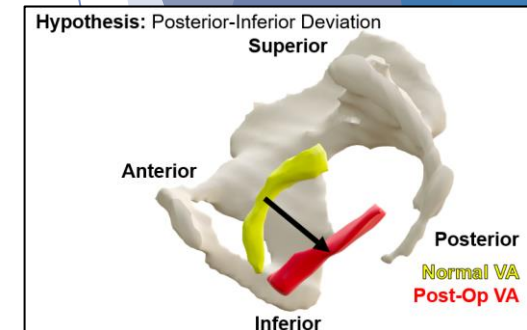# 3D Analysis of the Impact of Pelvic Organ Prolapse Repair Surgery on Vaginal Anatomy

Arijit Dutta[1], Shaniel Bowen[1], Krystyna Rytel[1], Dr. Pamela Moalli[1,2], Dr. Steven Abramowitch[1]

[1]University of Pittsburgh Department of Bioengineering, [2]Magee-Womens Research Institute

- Pelvic Organ Prolapse(POP) is a condition in which pelvic organ(s) protrude out of the body
    - Repair surgeries are present but often fail down the line
- Recurring POP after repair surgery is unknown mechanistically
    - May possibly be caused by failure to restore normal vaginal anatomy
        - Focus on vagina position and angulation of the upper/lower vagina
- Objective: compare the 3D vaginal anatomy in women of three following groups:
    - Women who underwent Native Tissue Repair(NTR)
    - Women who underwent Vaginal Mesh Repair(VM)
    - Women with normal anatomy(no POP)
- Hypothesis: A more posteriorly-inferiorly deviated vagina (smaller upper/lower vaginal angle and y-/z-position, larger upper-lower vaginal angle) is associated with NTR(vs VM), failure(vs success), and postoperative anatomy(vs normal)
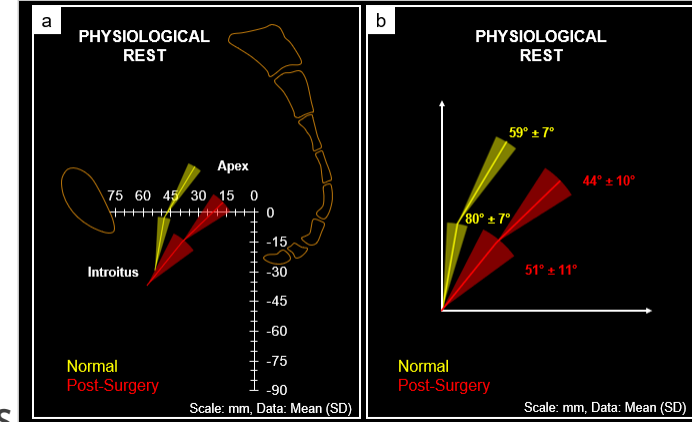
Methods

Methods: MRI Vaginal Segmentation

Methods: Vaginal Axis Calculation Process

Methods: Vaginal Angle Calculations

Methods: Vaginal Angle Definitions

- Three groups of women
  - 34 treated for POP via NTR
  - 28 treated for POP via VM
    - Both surgical groups underwent dynamic MRI 30-42 months postoperatively at rest, strain, and post-strain
    - Surgical groups were further separated into surgical outcome (Success vs Failure)
      - Failure was determined by prolapse past the hymen during strain
  - 5 nulliparous with normal anatomy used as control
    - At rest MRIs were used for these women
- 3D vagina models were made, using 3D Slicer, from the MRIs of the test subjects
- The models were used to calculate vaginal angles and anatomical position in respect to a 3D pelvic coordinate system using Mathematica
- Comparisons were made of the vaginal angles (sagittal, coronal) and anatomic position(at rest, recovery) by the following
  - Type of Surgery
  - Surgical Outcome
  - Postoperative vs Normal anatomy
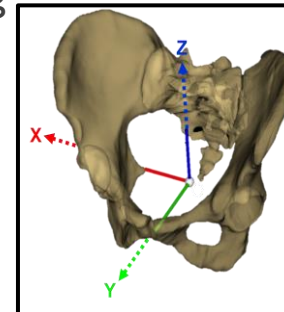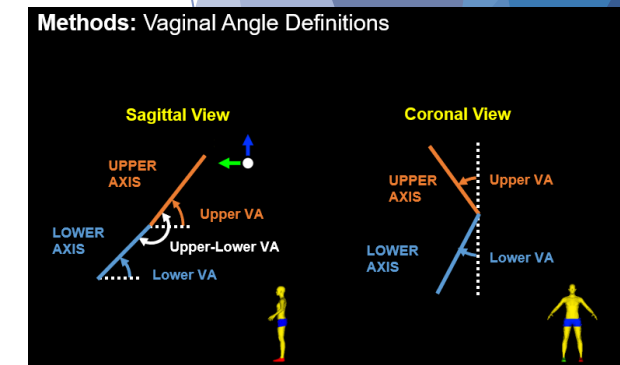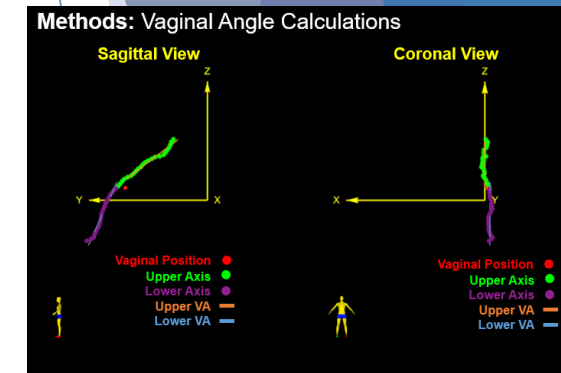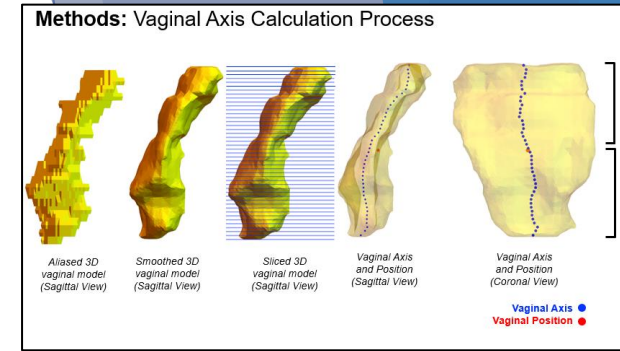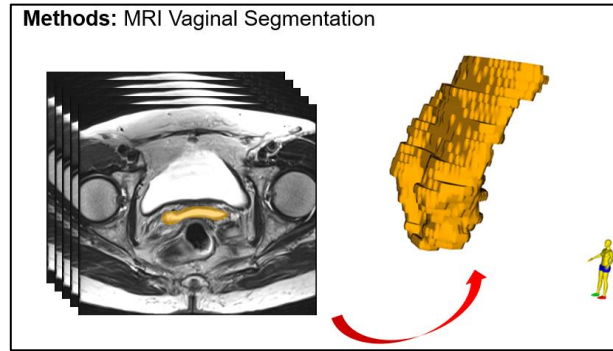
3D Pelvic Coordinate System

Results and Conclusion

Vaginal Angle Results

▶ 18/34 NTR and 10/28 repairs were MRI failures

▶ No significant differences were observed comparing surgical groups or outcomes

 ▶ P value of 0.05 used in the Wilcoxon Rank Sum Test

▶ Postoperative patient's vs Normal Patients

 ▶ Vagina more posteriorly positioned (y=40 mm vs 49 mm, P=0.001)

 ▶ Vagina more inferiorly positioned (z=-14mm vs -2 mm, P=0.001)

 ▶ Smaller sagittal upper(44° vs 60°, P=.001) and lower vaginal angle(52° vs 83°, P<.0001)

 ▶ Larger sagittal upper-lower vaginal angle(172° vs 159°, P=.025)

▶ Pelvic Organ Prolapse repair surgery fails to restore the pelvic anatomy back to normal

 ▶ The postoperative surgery group(more than half of which were successful) had anatomical structures significantly different from normal

 ▶ Successes and Failures were not statistically significantly different from each other

▶ Better repair methods are needed in order to have better surgical outcomes

 ▶ Must ensure anatomy is closer to normal positions