

# Biomechanical properties of meshes: Implications for a novel surgical technique, the puborectalis sling

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## Background

Pelvic organ prolapse (POP) has been shown to be strongly correlated with excessive levator hiatus distensibility<sup>1</sup>. Reducing the size of the levator hiatus may enhance success rates after POP surgery. A previous pilot study has shown that the levator hiatus area can be significantly reduced by placing a mesh strip around the levator hiatus, known as a puborectalis (PR) sling<sup>2</sup>.

## Aim

To characterise and compare the biomechanical properties of potential mesh for the PR sling surgery:

- Prolene (synthetic mesh)
- Permacol (crosslinked biological graft)
- Biodesign (non-crosslinked biological graft)

## Method

Six samples of each mesh type were subjected to tensile testing on an Instron™ 5800 (Fig.1).

### 1. Cyclic test:

- Preloaded to 1.5 N
- Cycled repetitively to 8 N, 16 N, 32 N and back to 8 N, with 10 cycles at each level

### 2. Creep test:

- Loaded to 30 N at 1 N/s and held for 30 minutes
- Released back to 0 N and held for 60 minutes

### 3. Failure test:

- Stretched to failure at 1 mm/s

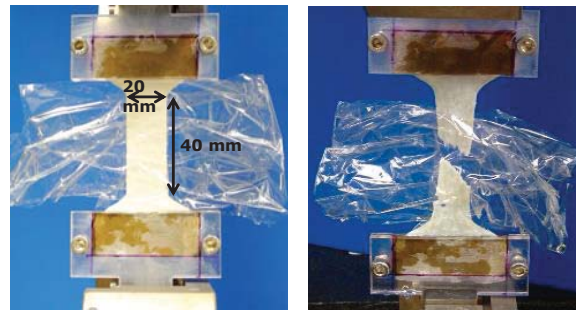
## Reference

Albrich S, Laterza R, Skala C, Naumann G. Impact of mode of delivery on levator morphology: a prospective observational study with 3D ultrasound early in the postpartum period. *Br J Obstet Gynaecol* 2012; 119(1):51-61.

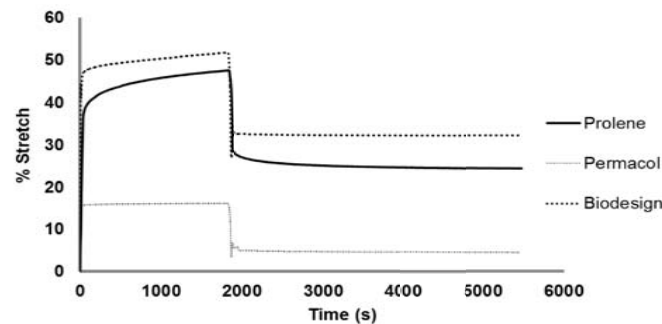
Dietz HP, Shek K, Daly O, Korda A. Can levator avulsion be repaired surgically? A prospective surgical pilot study. *Int Urogynecol J* (2013)

## Results

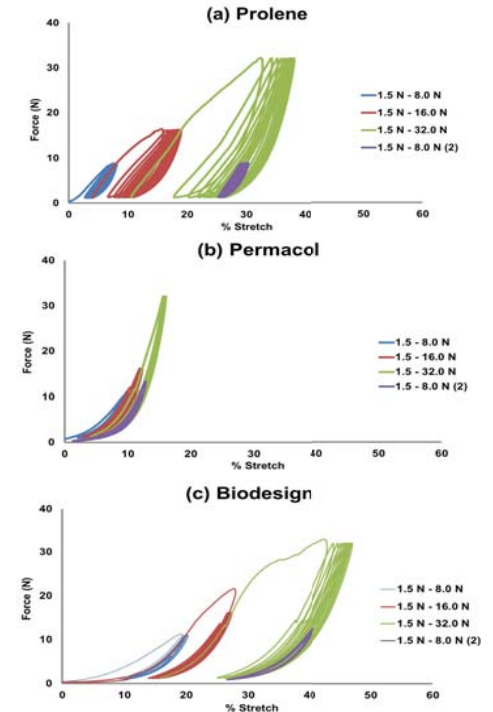
- Permanent elongation was observed in the time-dependent creep responses for all three meshes (Fig. 2).
- The right-shifted hysteresis loops during cyclic tests revealed the visco-plastic behaviour in all three mesh types (Fig. 3).
- Biodesign was the most compliant mesh with the lowest failure force (60 N) and the largest permanent stretch of 52 % in the cyclic test, which was 3.2 and 1.1 times larger than Permacol and Prolene mesh.



**Figure 1.** Permacol mesh mounted on Instron 5800 covered with wet plastic wrap. (A) mesh ready for testing (B) Permacol mesh after failure test.



**Figure 2.** % stretch vs. time for Prolene, Permacol and Biodesign mesh samples



**Figure 3.** Force vs. % stretch for Prolene (a), Permacol (b) and Biodesign (c) mesh samples during cyclic tests

## Summary

- Plastic deformation results in permanent elongation of the mesh, possibly compromising its supporting function.
- In vivo tissue incorporation is likely to further alter the mechanical properties over time and additional testing is necessary before clinical recommendations can be made.