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# DOES YOUR BONY PELVIC SHAPE DETERMINE YOUR PELVIC SOFT TISSUE DESTINY? RESULTS OF A 3D MRI STUDY.

## Hypothesis / aims of study
**Aim:** To compare quantitative relationships between soft tissue and bony pelvic measures in nulliparous and vaginally parous women. **Null hypothesis:** There is no difference in pelvic bony shape, soft tissue position or levator ani geometry in nulliparas compared to vaginal paras. **Secondary hypothesis:** There is no correlation between pelvic soft tissue geometry and bony pelvic shape in nulliparas or vaginally parous women.

## Study design, materials and methods
Nineteen women from a single gynecology practice underwent pelvic proton density axial MRI for clinical reasons unrelated to pelvic floor disorders.  MR-based 3D reconstructions were made of the pelvic bony and soft tissues, and pre-determined parameters were measured. Nulliparous (N=9) and vaginally parous women (N=10) were compared with respect to bony pelvic width, depth, pubic arch angle, urethral angle, bladder neck position, levator shape, volume, and integrity. Among paras and nulliparas, correlations between bony pelvic width, depth, and pubic arch angle were computed with respect to soft tissue measures. Significant correlations were confirmed by scatterplot analysis. Nonparametric statistical testing was performed with a 0.05 significance level.

## Results
Age, parity, and BMI parameters for the groups are detailed in Table 1. Table 2 presents those parameters with significant differences between the groups. Significant correlations and trends are presented in Tables 3a,b.

**Table 1:** BMI, age, and vaginal parity in nulliparas and paras

| GROUP | | BMI | AGE | VAGDEL |
|---|---|---|---|---|
| nullip N=10 | Mean | 24.58812 | 28.30 | |
| | Median | 22.86776 | 27.00 | |
| | Std. Deviation | 5.318749 | 5.889 | N/A |
| | Minimum | 19.036 | 20 | |
| | Maximum | 36.026 | 39 | |
| parous N=9 | Mean | 25.34915 | 37.67 | 2.11 |
| | Median | 23.93792 | 36.00 | 2.00 |
| | Std. Deviation | 5.562998 | 11.769 | 0.928 |
| | Minimum | 18.452 | 25 | 1 |
| | Maximum | 35.761 | 65 | 3 |

**BMI**:  Body mass index.  **AGE:** Age at  time of MRI.  **VAGDEL:** vaginal parity

**Table 2:** Pelvic 3D parameters having significant differences between nulliparas and paras

| GROUP | | PCL | BNPCL | LHW | LSGL | LSGR |
|---|---|---|---|---|---|---|
| nullip N=10 | Mean | 91.362 | 12.8510 | 32.5640 | 20.0020 | 20.6440 |
| | Median | 95.395 | 11.8450 | 32.7200 | 19.9450 | 21.4200 |
| | Std. Deviation | 8.4813 | 4.92913 | 2.56144 | 2.05441 | 3.27148 |
| | Minimum | 73.0 | 4.94 | 27.31 | 16.79 | 15.22 |
| | Maximum | 99.6 | 20.48 | 36.00 | 23.09 | 24.22 |
| parous N=9 | Mean | 99.399 | 4.5400 | 38.7967 | 30.5111 | 27.5533 |
| | Median | 99.300 | 8.2000 | 36.5300 | 32.3000 | 29.9000 |
| | Std. Deviation | 5.5439 | 10.05470 | 7.06671 | 6.25566 | 6.24648 |
| | Minimum | 89.8 | -12.50 | 29.25 | 21.01 | 18.69 |
| | Maximum | 109.4 | 18.77 | 49.40 | 41.70 | 35.20 |
| p | | .022 | .041 | .022 | .001 | .050 |

**PCL**: pubo-Coccygeal line is anteroposterior distance from symphysis to tip of coccyx.
**BNPCL**: Perpendicular distance from bladder neck to PCL: (positive values lie above PCL, negative values lie below PCL) **LHW**: Maximal transverse distance of the levator hiatus, **LSG**(levator Symphysis Gap): distance from inferior mid pubic symphysis to nearest occurrence of puborectalis muscle on left (LSGL), and right (LSGR).

**Table 3a:** Correlation of age, BMI, and pelvic inlet width with levator measures in the parous group

| GROUP | Parameter | Spearman's rho & 2 tailed significance | LHH | LHW | LSGL | LSGR |
|---|---|---|---|---|---|---|
| Parous N=9 | AGE | Rho | .550 | .667 | .783 | .733 |
| | | p | .125 | **.050** | **.013** | **.025** |
| | BMI | Rho | -.050 | .383 | .667 | .617 |
| | | p | .898 | .308 | **.050** | *.077* |
| | INTERACET | Rho | .683 | .533 | .517 | .500 |
| | | p | **.042** | .139 | .154 | .170 |

**BMI**: Body Mass Index. **INTERACET**: Interacetabular bony pelvic distance. **LHH**: anteroposterior distance from symphysis to levator median raphe. **LSGL, LSGR:** see table 2. No statistically significant correlations were seen in the nulliparous group.

**Table 3b:** Correlation of bony pelvic and soft tissue measures in nulliparas and paras

| GROUP | Bony parameter | Spearman's rho 2 tailed signific. | BNPCL | BNSYM | UREANG | URETHRA | UREVOL |
|---|---|---|---|---|---|---|---|
| Nullip N=10 | INTERSPI | rho | -.188 | -.248 | -.297 | .333 | .867 |
| | | p | .603 | .489 | .405 | .347 | *.001* |
| | INTERACET | rho | .042 | -.345 | -.333 | .467 | .818 |
| | | p | .907 | .328 | .347 | .174 | *.004* |
| Parous N=9 | PCL | Rho | -.929 | .770 | .644 | -.770 | -.510 |
| | | p | *.000* | *.015* | *.061* | *.015* | .160 |
| | INTERTUB | Rho | -.850 | .633 | .400 | -.783 | -.617 |
| | | p | *.004* | *.067* | .286 | *.013* | *.077* |
| | INTERSPI | Rho | -.800 | .633 | .433 | -.750 | -.600 |
| | | p | *.010* | *.067* | .244 | *.020* | .088 |

**PCL:** see table 2. **INTERACET:** see Table 3a. **INTERTUB**: Intertuberous distance. **INTERSPI**: Interspinous distance. **BNPCL:** Table 2. **BNSYM:** distance between bladder neck and pubic symphysis. **UREANG**: angle formed by long axes of urethra and pubic symphysis. **URETHRA**: urethral length. **UREVOL**: urethral volume

### Interpretation of results
Statistically significant differences between parous and nulliparous women were found with respect to pelvic soft tissue geometry and left puborectalis disruptions. Among parous women, increasing bony pelvic width and depth were correlated with a lower bladder neck, and lengthening of the levator hiatus at rest. These correlations were not observed among nulliparas. Our findings need confirmation by larger studies with well characterized participants. However, these pilot results suggest that childbirth-related pelvic soft tissue changes are related to a deeper, wider bony pelvis.

### Concluding message
Bony pelvic geometry may be a risk factor for childbirth related soft tissue damage. Further studies are needed to determine if bony pelvic architecture is altered by the childbirth process.