A Clinical Systematic Review of Obstetrical Factors Influencing Pelvic Floor Function: Is it Time for a Change in Practice?

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No relevant financial relationships in the past twelve months by presenter or spouse/partner.
The Influence of Obstetrical Factors in the Pathogenesis of Pelvic Floor Disorders: a Clinical Review

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Prevalence of pelvic floor disorders such as POP and SUI is recently increasing. POP has a prevalence of 3-6% based on symptoms and 50% based on vaginal examination. SUI has a prevalence of 12-46%.

• POP and SUI significantly affect quality of life in women in terms of physical morbidity, sexual dysfunction, and overall reduction in psychological well-being.

• Importance of primary prevention and secondary prevention strategies to decrease overall incidence of PFD.
Pelvic Reconstructive Surgery

• Lifetime risk of undergoing surgery to treat POP or SUI is 20%
• Risk of recurrence following surgery was found to be high in large sample size population studies of women, hence, treatment is less than optimal

Vaginal Delivery and PFD

• Vaginal delivery (VD) is the most common cause of pelvic floor disorders, therefore, obstetrical care must be optimized to reduce trauma to the pelvic floor.

• With spontaneous VD, there is a 2.8x ↑ possibility to develop SUI and 5.5x ↑ chance of POP.

• With operative VD, 4.4x ↑ for SUI and 7.5x ↑ for POP.

• Risk for PFD ↑ with increased parity

Cesarean Section in Prevention of PFD

• Only Cesarean section is protective prior to onset of labor or post-labor
• However, factors such as birth weight<3,000g, advanced maternal age (>35 years), BMI≥25 pre-pregnancy and at term, decrease the protective effect.
• Long term studies show a diminished protective effect especially at 2 and 5 years post-partum with increasing symptomatology in later life.
Cesarean Section in Prevention of PFD (Cont.)

Although Cesarean Section confers a relatively high degree of prevention (50%) versus vaginal delivery, it does not totally prevent the incidence of PFD later in life.

Risk Factors for PFD

• In addition to VD; race, family history, maternal age, BMI, UI before or during pregnancy, and estimated fetal birth weight are important determinants of PFD.

• Environmental factors: smoking, caffeine, alcohol, obesity, vitamin D, and estrogen replacement
Levator ani Muscle Avulsion (LMA)

- Tearing of the pubovisceral (pubococcygeus and puborectalis) muscle from its attachment to the pubic bone at delivery with passage of the fetal head (crowning) through the birth canal.
- Implicated in the pathogenesis of POP, SUI, FI
- Risk factors for LMA and SUI: ↑ maternal age with ↑ risk by 10% per year of age, and by 3% per year of childbirth delay, respectively.
- Unilateral or bilateral avulsion (POP)
- Quantified by 3-D US or MRI
- Advanced maternal age also risk factor for OASIS

Gyhagen M, Bullarbo M et al. (2013) BJOG 120:144-151
Levator ani Muscle Avulsion (Cont.)

• Prevalence of levator ani muscle defects is about 20% in primiparous women
• Operative vaginal delivery by forceps presents a higher risk for LMA and PFD at 66% compared to 10.7% following spontaneous delivery. (Direct injury to Levator ani m.)
• Vacuum extraction (VEX) does not increase risk of LMA.

Trutnovsky G, Kamisan Atan I, Martin A, Dietz HP. BJOG 2016;123:1551-1556
Episiotomy

• The role of episiotomy in obstetrical care has been extensively debated during the past 40 years.
• Routine vs. restrictive based on indication and surgeon’s clinical judgement
• Data from 2012 Cochrane review shows that restrictive results in less severe perineal trauma with lower rate of OASIS (28%) compared with routine (75%)

Episiotomy (Cont.)

• Episiotomy performed on indication must consider other factors such as maternal age, parity, birth weight, head circumference, length of second stage of labor, epidural administration, and instrumental delivery (Forceps or VEX) in order to confer protective role of PFD.

• Two large retrospective studies (64,000 and 214,256 women) when taking into consideration above risk factors concluded that episiotomy reduced the incidence of OASI in primiparous women by 23% but increased by 63% in multiparous women.

Episiotomy (Cont.)

• Further data supporting protective effect of episiotomy in primiparous women found a 50% higher risk of OASIS in women with spontaneous perineal tears (without episiotomy) versus incidence of OASIS with episiotomy of only 23%.

• Type of episiotomy: lateral, mediolateral, or midline? Optimal angle?

Episiotomy (Cont.)

- Mediolateral episiotomy is most protective against OASIS and PFD (lowest risk)
- Medial and lateral episiotomy carry highest risk of OASIS
- RCOG recommends performance of episiotomy at angle of 60° to the midline
- Relation found between parity, extent of perineal stretching, and degree of tearing: lower parity associated with a higher degree of tearing (inverse correlation)

Epidural Anesthesia (EA)

• EA has muscle relaxing effects on the perineum which confers a net protective effect against levator ani m. trauma and OASI.

• EA tends to prolong the second stage of labor by suppressing uterine contractility → relaxation of uterine smooth m. tone → slowing of cervical dilatation → diminishing pain sensation → pelvic floor less susceptible to injury from fetal head passage.

• Large retrospective cohort studies support these findings. (adjusted OR 0.84)

Duration of the Second Stage of Labor

• A longer second stage of labor is associated with a higher risk of OASIS, however, not for spontaneous deliveries.
• \( \Rightarrow 6\% \) increase in OASIS risk per 15 min. in second stage of labor before instrumental delivery.
• No difference was found in a randomized trial between early and delayed pushing in the second stage.

Duration of the Second Stage of Labor (Cont.)

• Duration of second stage of labor is positively correlated with the risk of levator m. avulsion, however, the link to PFD is still inconclusive.

• A higher incidence of operative vaginal deliveries precludes a prolonged second stage, thus, potentially contributing to the risk of levator trauma.

Biomechanical Studies

- Biomechanical studies by DeLancey and Mascarenhas in the past 10 years have demonstrated importance of pressure changes incurred during vaginal delivery with fetal passage through birth canal on integrity of pelvic floor musculature (uterine contractility and fetal head compression.)

- Maximal pressures on the pelvic floor during the second stage of labor are higher than the intravaginal pressures for coughing and straining.

Pressures on Pelvic Floor and Fetal Head Compression

• During second stage, uterine contractions increase intrauterine pressure near the fetal head from 2.6 to 8.5 kPa; with bearing down IUP increases to 19kPa. → expulsive forces on fetal head of 16N at rest, 54N during contraction, and 120 N on pushing.

• Levator ani m. can stretch to 3.5 times its original length without rupturing-dependent on pressures induced by fetal head.

Mechanism of Pelvic Muscle Floor Injury

- Area of overstretching of muscle is part most likely to sustain injury- levator ani m. is divided into iliococcygeus, pubococcygeus, and puborectalis m. with max. stretch ratios of 2.73, 2.50, and 2.28 resp. (3.5 all)

- In non-pregnant species, max. stretch ratio of 1.5

- Hormonal effects of pregnancy on tissue composition, sarcomere number and length has been shown in rats, yet still remains inconclusive in humans.

Mechanism of Pelvic Muscle Floor Injury (Cont.)

• Tissue stretch ratios are proportional to fetal head size ⇒ important role of fetal head circumference (HC) in determining extent of muscular stretch and hence, degree of tearing. i.e. stretch induced injury

• Max stretch value was found at end of second stage of labor with fetal crowning.

• Other numerical simulation studies found that more than 10% of muscular fibers are damaged with extension of the fetal head in OA positions and vertex presentation.

Simulated Effect of Fetal Head Descent on Levator ani m.(2\textsuperscript{nd} Stage of Labor)

Ashton-Miller JA. and DeLancey JO. (2009)
Numerical Simulation Model of Fetal Head Descent

Fig. 3 Levels used to evaluate the stretch and their initial lengths

<table>
<thead>
<tr>
<th>Level</th>
<th>Initial length</th>
<th>Length at 60 mm descent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>18.1 cm</td>
<td>22.1 cm</td>
</tr>
<tr>
<td>Level 2</td>
<td>19.2 cm</td>
<td>23.9 cm</td>
</tr>
<tr>
<td>Level 3</td>
<td>20.6 cm</td>
<td>25.1 cm</td>
</tr>
<tr>
<td>Level 4</td>
<td>22.1 cm</td>
<td>25.8 cm</td>
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<tr>
<td>Level 5</td>
<td>13.6 cm</td>
<td>16.2 cm</td>
</tr>
<tr>
<td>Level 6</td>
<td>13.9 cm</td>
<td>15.7 cm</td>
</tr>
<tr>
<td>Level 7</td>
<td>14.5 cm</td>
<td>15.8 cm</td>
</tr>
</tbody>
</table>

Fetal Head Descent and Pelvic Floor Muscle Stretch Values

Primary and Secondary Prevention

• Given the direct link between VD and PFD in later life, few preventive measures to date have been proposed to decrease its incidence.

• Cesarean Section as primary method of prevention has inherent operative risks (blood loss, adhesion formation, etc.) and does not insure complete prevention as previously stated.
Primary Prevention

• UR-CHOICE scoring system as screening method prior to delivery to identify women at high risk for PFD.

• Acronym stands for Race, Childbearing age, Height(mat.) Overweight (mat.) Inheritance (family history) Children (number desired, EFBW.)

• Pelvic Floor Muscle Training (PFMT) prior to delivery by trained sport instructors (10 min.per day for 22 weeks) vs. midwife.

Primary Prevention (Cont.)

• Two Cochrane RCT in women with intensive antenatal PFMT compared to no PFMT or usual antenatal care yielded approx. 30% decrease (rr .71, 95% CI .54-.95) in reports of Urinary Incontinence(UI) up to 6 months post-partum.

• Epi-No® birth trainer (balloon designed to stretch vagina and perineum in late pregnancy) no evidence of protective effect found from RCT

• Warm compresses, intraoital massage, standing birth position, ↓2\textsuperscript{nd} stage duration all confer a protective effect against PFD but data is limited.

Assisted Delivery

• Modified Ritgen’s maneuver during delivery of the head (slow and controlled) decreased the incidence of OASIS by 50 % as proven in seven non-RCT trials (two from Norway)

Secondary Prevention

• Can be defined as procedures that detect and treat preclinical pathological changes to halt or slow the progression of disease to more symptomatic conditions.

• PFMT is effective in treating SUI, MUI, and POP in the general female population

• No preventive studies exist on PFMT in UI in general population of premenopausal women

• Women who regularly exercise are less likely to experience UI, however, higher levels of physical activity as seen in elite athletes is associated with UI.

Secondary Prevention (Cont.)

• Studies (RCT) examining the long term effects of PFMT in the post-partum period are sparse.
• Levator ani muscle status post-partum is an important factor in considering prevention of UI, POP, and FI by Pelvic Floor Muscle Training (PFMT).
Comorbidities and PFD

• Obesity, Diabetes, COPD, and Constipation present varying risk factors for development of SUI, POP, and FI.

• Many epidemiological studies show obesity to be a risk factor for UI with ↑incidence of SUI, UUI, POP, and FI associated with ↑BMI. (shorter time span over weight gain⇒↑risk of UI)

• Weight loss either through bariatric surgery or non-surgical methods leads to improvement of UI, OAB, and FI symptoms.

Gyhagen M, Bullarbo M, et al. (2013) BJOG 120:144-151
Comorbidities and PFD(Cont.)

• No correlation found between early intensive treatment of DM I and prevalence of UI in later life. Effect of early treatment on later development of POP is also unknown.

• Prospective cohort study of middle and older age women with COPD found increased reports of UI progression.

• Constipation results in sustained intra-abdominal pressures that can affect the integrity of pelvic supporting structures→ straining increases risk of SUI and urinary urgency, but not POP.

Kruger J. (2014) IUGA Annual Meeting Abstract Video, 17.11.15
Other Comorbidities

• Smoking, Vitamin D, and Estrogen Replacement
• Data from large epidemiological studies revealed a strong association among UI, AI, and smoking; but no beneficial effect with cessation. Link with POP is inconsistent.
• National Health and Nutrition Examination Survey revealed that low levels of vit.D <30 ng/ml were associated with a higher prevalence of UI, but not AI.

Comorbidities (Cont.)

- Estrogen Replacement: small link found between ERT (oral or transdermal) with the development of UI. Reversible upon discontinuation.
- Dietary intake of phytoestrogens has no effect on urinary symptoms.

Conclusions

• At present there exists limited methods for prevention of Pelvic Floor Disorders.

• Reliance on Cesarean Section as a primary means of prevention would only increase the CD rate and expose numerous low risk pregnancies to unnecessary surgical risks especially in the case of repeated Cesarean Sections.

• Future research efforts must be directed towards preventing PFD at the time of delivery through biomechanical modeling, birth simulation, and translational clinical instrumentation.