Effects of Mode of Delivery on Pelvic Floor Structure: Review Article

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Abstract:

This review is important as comparison of anatomical function and structure of female pelvic floor between women with different delivery modes provides potentially useful information on the risk of developing PFD.

Keywords: PFDs, Vaginal, Cesarean.

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Introduction:

Several studies support that the incidence of PFDs varies with the mode of delivery. MacLennan *et al*. reported pelvic floor dysfunction in 58% of women who had spontaneous vaginal delivery, compared with 43% of those who underwent cesarean section. Increased prevalence of PFDs have been noted in vaginally parous women in the immediate postpartum periods and at several years postpartum (**1).**

In a recent study of parous women, history of a vaginal childbirth was associated with twice the risk of developing bothersome symptoms of stress incontinence compared with women delivered exclusively via cesarean section (**2)**. In contrast to this finding, the follow-up study of the randomized, multicentered Term Breech trial, which compared maternal outcomes 2-years after planned cesarean section with planned vaginal birth for breech presentation at term, showed no differences in the incidence of urinary incontinence between the two delivery groups (17.8% in the planned cesarean section group and 21.8% in the planned vaginal birth group). In addition, there was no difference in the degree of bother caused by urinary incontinence between the two groups (**3).**

Vaginal childbirth that is complicated by anal sphincter trauma has been linked to postpartum fecal incontinence. A history of third- and fourth-degree obstetric lacerations was identified as the only obstetrical risk factor for postpartum fecal incontinence in a systemic review. However, in the absence of anal sphincter trauma, vaginal delivery does not appear to increase the risk of anal incontinence **(4).**

Several studies have linked vaginal childbirth to pelvic organ prolapse (**2**). In one study, history of a single vaginal delivery was associated with a tenfold increased likelihood of developing prolapse (**5).**

Compared with other PFDs, the association between mode of delivery and overactive bladder syndrome is not well established. For example, the likelihood of overactive bladder syndrome does not differ significantly in women who underwent vaginal or cesarean birth 5–10 years ago (**6**).

One of the important components of PFD is UI that severely disrupts patients' quality of life. Dealing with this issue, in a retrospective Norway EPINCONT study, women aged ≤ 65 years were examined to investigate the effects of route of delivery, VD versus CD, on incontinence by looking at the medical birth records. Those who had a history of both modes of delivery were excluded from the study. The women who were nulliparous and delivered by CD only or by VD only were included in this study. The incidences of any type of UI in the nulliparous women, cesarean group, and vaginal group were found to be 10.1%, 15.9%, and 21%, respectively (**6**).

The incidences of stress UI were 4.7%, 6.9%, and 12.2%, respectively; urge UI were 1.6%, 2.2%, and 1.8%, respectively; and mixed type were 3.1%, 5.3%, and 6.1%, respectively. Adjusted odds ratio for any type of incontinence was found to be 1.5 in the cesarean group compared with nulliparous women (95% CI 1.2–1.9). In case of VD, compared with CD, the odds ratio for any incontinence was found to be 1.7 (95% CI 1.3–2.1) and that for severe incontinence was found to be 2.2 (95% CI 1.7–3.2). In summary, the risk for stress UI increased by 2.5-fold in case of VD compared to CD; however, no difference was observed in the risk of UI. This study indicates that CD may not be protective against UI (**7).**

Other obstetrical events & interventions:

Among vaginally parous women, observational studies have identified certain obstetrical factors that may increase the risk of PFDs. These factors include operative vaginal delivery, prolonged second stage of labor, fetal macrosomia and perineal lacerations. These risk factors often occur in clusters, and may impact pelvic floor outcomes synergistically. Urinary incontinence is common in the immediate postpartum period and is more likely to occur in women who had prolonged labor in combination with operative vaginal birth (**6**).

- **Episiotomy & perineal laceration**

Episiotomy is an incision on the female perineum that is performed just prior to crowning of the fetal head to increase the diameter of pelvic outlet, thus expediting delivery of the fetus. It is one of the most common surgical procedures experienced by women. A total of 30–35% of vaginal births include episiotomy in the USA, while 46% of low-risk nulliparous women in the UK experience episiotomy (**8).**

Historically, episiotomy was introduced as a strategy to prevent fetal trauma and maternal perineal injury and its routine use gained popularity as it was endorsed by

prominent obstetricians in the early 1900s. However, research on the relative benefits and harms of routine episiotomy has led to conflicting results. Early advocates of routine episiotomy argued that it protects the mother's perineum, resulting in better postpartum pelvic organ support (**6**). However, high-quality evidence to support the practice of routine episiotomy is lacking. In a systemic review of 28 prospective studies looking at pelvic floor outcomes after episiotomy, no difference was found in symptoms of urinary incontinence between spontaneous laceration and episiotomy groups. In addition, episiotomy was not found to be protective against fecal incontinence, prolapse or decreased pelvic floor muscle strength (**9).**

The use of routine episiotomy also started to gain criticism with the appearance of literature suggesting a possible association between episiotomy and third- and fourth-degree lacerations. **Helwig *et al.* (10**) showed that midline episiotomy doubled the risk of third- and fourth-degree lacerations after controlling for neonatal birth weight and primiparity. **Handa *et al.* (11**) also found an association between episiotomy and fourth-degree laceration.

Anal sphincter laceration is an independent risk factor for fecal incontinence. The prospective multicenter CAPS study showed that compared with women who underwent vaginal childbirth without observed injury to anal sphincter, women who had anal sphincter lacerations during vaginal childbirth were twice as likely to develop postpartum fecal incontinence. In addition, women with a sphincter laceration had greater severity of fecal incontinence. More recently, in a prospective cohort study of women who underwent vaginal childbirth without injury to the anal sphincter, women who sustained an observed injury to the anal sphincter during childbirth are twice as likely to develop postpartum fecal incontinence. More than 90% of the episiotomies in this population were midline **(2)**.

Mediolateral episiotomy has not been found to increase the incidence of prolapse and urinary and fecal incontinence compared with first- and second-degree spontaneous perineal lacerations and intact perineum. There is also evidence suggesting a protective role of mediolateral episiotomy against the development of central-support defects of the anterior vaginal wall. Hence the role of episiotomy as a risk factor versus a protective factor for the development of PFDs remains unknown, as was concluded by a 2005 systematic review (**12**).

- **Prolonged second stage of labor**

The second stage of labor is characterized by progressive descent of the fetal head through the completely dilated cervix. This is achieved by the expulsive forces generated by uterine contractions. During these contractions, intrauterine pressure can be as high as 8 kPa. Maternal pushing can further increase intrauterine pressure to as high as 19 kPa. Ischemic necrosis of the pelvic tissues (including nerves and muscles) and stretch injuries, leading to permanent denervation of the tissues, can occur if this pressure continues for an extended duration (**13**). Thus, a prolonged second stage may increase soft

tissue injury and neuromuscular damage to the pelvic floor. Both of these mechanisms may be central to the pathophysiology of PFDs. This finding is further supported by the suggestion that prolonged pushing for more than 1 h during the second stage of labor is associated with denervation injuries to the pelvis in primiparous women, whereas a passive second stage of labor does not increase the risk for denervation injury (**6**).

- **Fetus-related factors**

Several studies have reported an association between higher birth weights and postpartum urinary incontinence. **Viktrup *et al*. (14)** noted that primiparous women who developed postpartum urinary incontinence had neonates with a greater head circumference; however, these results were not statistically significant. Computer simulations of vaginal delivery also report a positive association between fetal head diameter and stretch on the pubovisceral muscle of the levator ani muscle complex. Larger neonatal size and occiputposterior positions often coexist and synergistically increase the risk of perineal injury (**15).**

- **Maternal age**

Delayed childbearing has been identified as a risk factor for PFDs in several studies. Kuh *et al*. found a strong association between the symptoms of stress urinary incontinence and a maternal age of 30 years or older at first vaginal delivery among British women. **Foldspang *et al*. (16)** found increased risks of urinary incontinence with increasing age at the time of the last childbirth for women aged 30–44 years. **Pregazzi *et al*. (17**) reported an association between urinary frequency and advanced maternal age. The risk of requiring surgery for stress urinary incontinence and pelvic organ prolapse also appears to increase with increasing age at first childbirth, irrespective of the mode of delivery. For example, in one study, 14% of the women 30 years or older at first vaginal birth required surgery for pelvic organ prolapse compared with 6% of women younger than 30 years (**18).**

Relationship between the mode of delivery and OAB:

Compared with other PFDs, the association between the mode of delivery and overactive bladder (OAB) syndrome is not well established. For example, the likelihood of OAB syndrome does not differ significantly in women who underwent VD or CD 5–10 years ago (**2).** In another study, it has been emphasized that pregnancy state itself is a risk factor for OAB, and not the mode of delivery. In this study, OAB symptoms were more likely to be seen among multiparous women compared to primiparous women, who were again more likely to have the symptoms compared to nulliparous ones. Although these symptoms are more frequently seen in the VD group than in the CD group, it did not reach statistical significance (**19).**

Mechanism of obstetrical injury:

Preservation of the function of pelvic viscera depends upon the interaction between the anatomical as well as neurological integrity of the organs and their support systems. For example, the maintenance of urinary continence depends on the anatomical and functional

competence of the urethral sphincter and integrity of the urethral coaptation mechanism, as well as structurally and neurologically intact urethral support system (levator muscles and endopelvic fascia, among others). Loss of any of these components can lead to incontinence. The trauma to the pelvic floor during childbirth that predisposes women to develop PFDs appears to be multifactorial, as shown in Figure 9 **(6).**

For example, vaginal childbirth has been associated with an increase in urethral mobility, decreased leak point pressures and injury to pelvic floor muscles. Mechanical injury to the pelvic floor support system, denervation, ischemia and reperfusion injury and defective soft tissue remodeling are some of the underlying mechanisms of injury for development of PFDs **(20**).

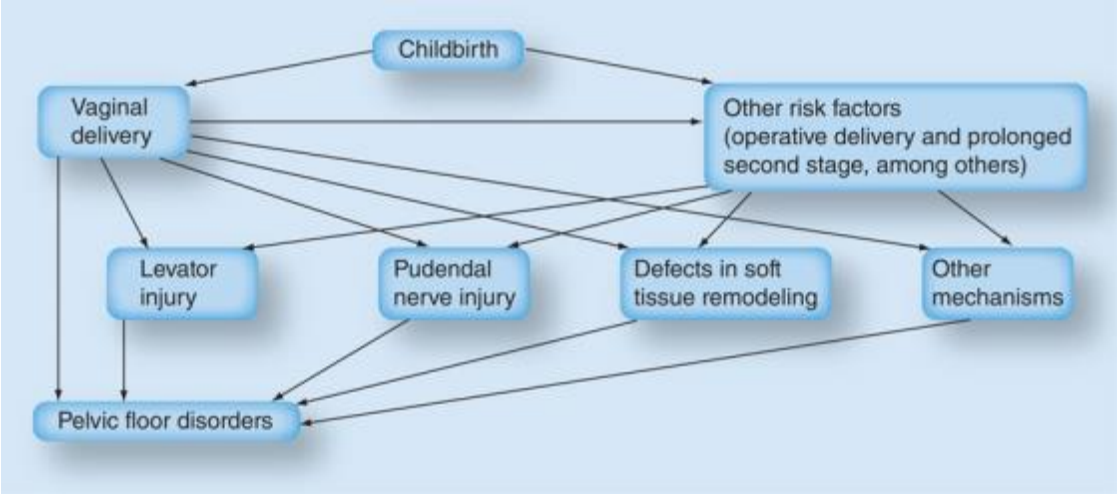

Fig. 9: Multifactorial nature of obstetrical trauma leading to pelvic floor disorders **(6)**

Mechanical injury to the pelvic floor:

Mechanical support to the pelvis is provided by the muscles of the pelvic diaphragm, endopelvic fascia and its lateral condensations (arcus tendentious fascia pelvis and pelvic ligaments), and their bony attachments. The levator ani muscle complex, which consists of the pubococcygeus, puborectalis and iliococcygeus muscles, is the largest muscle of the pelvic floor and a critical component of the pelvic floor support system. This muscle complex forms a U-shaped sling around the urethra, distal vagina and rectum, thus providing support to these structures. The normal baseline activity of the levator ani muscle keeps the urogenital hiatus closed against the opening action of intra-abdominal pressure. A maximum voluntary contraction of the levator ani muscles further increases the vaginal closure force by 46%, leading to further compression of the rectum, distal vagina and urethra behind the pubic bone (**21).**

Damage to levator ani muscles may lead to the widening of the urogenital hiatus and downward descent of the pelvic organs. Several MRI and ultrasound studies have shown increased odds of levator ani muscle injury in women with pelvic organ prolapse.

Increased prevalence of levator ani muscle injury has also been shown in women with stress urinary incontinence (**22).**

Vaginal childbirth has been identified as a risk factor for levator injury. Overstretching and damage to the levator muscle, particularly to the pubococcygeal muscle, which is the shortest and most medial component of levator ani complex, has been linked to vaginal delivery. Operative vaginal delivery further increases the risk of levator ani injury (**23**).

Increase in the incidence of levator ani muscle injury has been listed as one of the potential explanations for the observed association between older age at first birth and higher incidence of PFDs. Dietz and Simpson performed 3D ultrasounds on vaginally parous women who presented with symptoms of PFDs. Women with evidence of levator muscle trauma on 3D ultrasounds were older than women without evidence of levator trauma (mean age: 25.5 vs 23.5 years) (**24).**

Effect of the mode of delivery on FI:

Despite the high prevalence and distressing nature of fecal incontinence (FI), the mechanism by which childbirth influences this condition is not fully understood. Laceration of the external anal sphincter during VD is the main risk factor for incontinence of flatus or feces. The coexistence of an unrecognized injury to the internal anal sphincter may explain why up to one-half of parturients subsequently experience FI even after repair of a recognized sphincter laceration. Vacuum extraction also increases the risk of FI. The association of VD with FI has been documented (**7).**

Ryhammer et al (25) reported that the odds of flatus incontinence were 6.6-fold higher (95% CI 2.4–18.3) after the third VD, compared with the first or second VD. **Pollack et al (26)** prospectively followed 309 nulliparous women for 5 years after VD and found that, compared with the women who had only one VD, those who had >1 subsequent childbirths were at a significantly increased risk of anal incontinence (odds ratio 2.4; 95% CI 1.1–5.6). In this study, most of the subsequent childbirths (95%) were VDs. Several studies, including a recent review article, have examined outcomes that were associated with CD versus VD for the primary prevention of FI. With the exception of a few studies, most do not provide evidence for CD as a preventive strategy. Moreover, the impact of delivery type on FI appears to decline with age. Thirty years after delivery, comparable prevalence rates of flatus incontinence and FI were found among women whose index delivery was complicated by anal sphincter disruption or those who had VD with episiotomy or CD (**27).**

Relationship between PFD and sexual dysfunction:

Another condition associated with PFD is sexual dysfunction. This situation, similar to UI, may be due to the factors associated with the development of PFD, or it may also be caused by surgical procedures performed to correct PFD. The incidence of sexual dysfunction in women with UI is reported to vary between 26% and 47%. A total of 11–77% of women with UI experience urinary leakage during coitus. Comparing women who have both POP and UI with those who have only UI, sexual dysfunction was found to be more common in the first group with both morbidity (**28).**

In the study performed by **Sen et al (29)**, advanced age, POP, and mode of delivery were found to be risk factors for sexual dysfunction.

POP and UI surgeries have a big role in the reconstruction of local anatomy and in reducing or eliminating the symptoms. However, this situation may not provide optimal sexual function. The reason for sexual dysfunction following vaginal surgery may be classified as organic and/or psychosocial (**30**). The prevalence of sexual dysfunction in women who gave birth has been increasing. The main question related to this issue is the following: Does cesarean operation prevent sexual dysfunction? **Klein et al (31)** examined the rate of dissatisfaction during sexual intercourse at 3 months postpartum in a prospective study involving 135 women who underwent CD and 864 women who had VD. Higher dissatisfaction rate was found in the VD group, showing statistical significance (70% vs. 54%, $p < 0.05$). However, dyspareunia rates were found to be identical in both groups (31% vs. 31%). By contrast, in another study, although sexual dysfunction is seen less in short-term follow in CD group, in the long term, it did not change perineal pain, sexual dysfunction, and sex dissatisfaction rates. It is concluded that CD does not prevent sexual dysfunction (**32).**

Pelvic floor exercises during and after pregnancy:

As with all diseases, strategies to prevent the formation of PFD have gained importance in recent years. Pelvic floor exercise program is one of these strategies, and it is extremely important that women participate actively in this process. These exercises should be recommended to all women in the 1st trimester (**33).** In a prospective randomized study, when the UI of the patients was evaluated with International Consultation on Incontinence Questionnaire—Urinary Incontinence Short Form, to perform these exercises up to at least 22 weeks regardless of the previous status, reduces significantly by increasing the ability to contract in primiparous pregnant women. A decrease in risk of FI as well as UI supports the importance of pelvic floor exercises during pregnancy to prevent PFD, **(34).**

Lifestyle changes during pregnancy have been recommended to prevent constipation and obesity that may negatively affect PFD (**7).**

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