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Original article

Effect of Different Delivery Modes on Pelvic Floor Structure Revealed by Ultrasonography

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ABSTRACT

Background: Pelvic floor dysfunction caused by multiple factors is a complicated process. As life expectancy rises, so does the prevalence of PFD, which includes pelvic organ prolapse (POP), sexual disorders, and lower urinary tract excretory and defecation abnormalities such as overactive bladder, pelvic organ prolapse, and urine and anal incontinence. This study aimed to evaluate the association between type of delivery and pelvic floor structure changes in Zagazig University Hospitals. **Methods:** A cohort study conducted at Zagazig University Hospitals in Obstetrics and Gynecology Ultrasonography unit, utilizing a Mindray Dc-70 ultrasound machine. Patients were separated into two groups (24 vaginal deliveries and 24 cesarean deliveries). All women underwent a thorough history taking, general examination, pelvic examination, and transperineal ultrasonography. **Results:** There were no statistical significance differences between the studied groups in bladder neck rotation. But there was a statistical significance increase in bladder neck descend among NVD group compared to CS group. There was a statistical significance decrease in detrusor muscle thickness among NVD group compared to CS group. There was a statistical significance increase in frequency of pelvic organ prolapse and stress incontinence among NVD group compared to CS group. There was a statistically significant decrease in mean MOS score among NVD group compared to CS group. Also, there was a statistically significant increase in frequency of UPFMC among NVD group compared to CS group. **Conclusion:** it appears that vaginal delivery is associated with more negative effects on pelvic floor structure and function compared to cesarean section delivery.

Keywords: Pelvic floor dysfunction, Vaginal delivery cases, cesarean delivery cases .

INTRODUCTION

Pelvic floor dysfunction that arises due to multifactorial variables is a complex process. The higher the life expectancy, the higher the incidence of PFD. The term "PFD" encompasses a wide range of clinical situations, including sexual disorders and lower urinary tract excretory and defecation conditions such pelvic organ prolapse, hyperactive bladder, and anal and urine incontinence. Women's quality of life is disrupted and the health care system is financially burdened **[1]**.

The duration of the pregnancy, the delivery process and care, and pelvic exercise techniques are the main strategies utilized to reduce PFD. Numerous studies in the literature identify sphincter injury, prolonged second stage of delivery, use of forceps, and traumatic birth as PFD risk factors that can be changed. Foetal head circumference, foetal position, and maternal age are examples of non-modifiable risk variables. There is scant scientific evidence to back up the recommendation of elective cesarean birth as a strategy to avoid the emergence of pelvic floor diseases, even though numerous research show that vaginal birth negatively impacts pelvic floor tissues and functioning. Because PFD is a diverse pathological disease, there may be differences in the consequences of pregnancy, cesarean birth, vaginal delivery, and potential risk factors for PFD**[1].**

A thorough evaluation of PFD is necessary due to the vast range of symptoms and associated disorders, for which a basic clinical assessment is typically insufficient to provide a complete diagnosis **[2].**

The structure and functional anatomy of the female pelvic floor in women who had different delivery methods can be compared to learn potentially important information about the likelihood of having PFD later on. Findings about it will be vital to examine how different delivery techniques affect the anatomy and structure of the female pelvic floor. for developing relevant guidelines that will help patients and healthcare professionals make decisions **[2].** The purpose of this study was to assess the relationship between pelvic floor structural alterations in Zagazig University Hospitals and the type of delivery.

METHODS

A cohort study was conducted in Obstetrics and Gynecology Ultrasonography unit at Zagazig University Hospitals unit from July 2021 to August 2022. included 48 patients with Pelvic floor dysfunction (PFD), divided equally into 2 groups (24 vaginal delivery cases, 24 cesarean delivery cases). The study was authorized by our local ethics commission (IRB # 6932-23-5-2021). The objectives of the study was explained to the women before inclusion in the study. Consent was obtained in writing, informed by each participant. The protocol for the study complied with the Helsinki Declaration (1975), which is the World Medical Association's guideline of ethics for research involving human subjects.

Inclusion Criteria were; Age from 18 to 42 years. Uncomplicated singleton pregnancy and first delivery. The levator ani and Valsalva maneuvers could be performed by women with effectiveness. Presence of stress incontinence or not. Exclusion Criteria**;** Age >42 or < 18 years. BMI >29 or < 18. Past genitourinary surgery history. Patient refusal. Undercurrent pharmacotherapy for over active bladder. Previous lower abdominal surgeries such as Urinary incontinence (UI) surgeries, uterine curettage, and laparoscopic and hysteroscopic treatments.

One skilled examiner used digital palpation of the vagina to evaluate the puborectalis muscle. Women were told to use as much of their pelvic floor muscles as possible by drawing in and lifting up the urethra, vagina, and rectum as if trying to control gas passage. Since the implantation of the puborectalis muscle on the inferior ramus of the pubic bone was only 2-4 cm proximal to the perineum, the strength of muscle contraction was subjectively measured by digital palpation using the modified Oxford Score (MOS) grading system. This involved inserting the index finger deep into the vagina up to 4 cm and palpating the puborectalis muscle at each side of the vagina during contraction. On a scale of 0 to 5, the MOS was used to measure the strength of the pelvic floor muscles (0 being no contraction, 1 being a tiny contraction known as "flicker"), 2 being a weak contraction, contraction number three being moderate, contraction number four being good, and contraction number five being strong against opposition. A good or forceful contraction was considered to be indicative of a normal pelvic floor function (NpfmC). A weak or missing pelvic floor muscular contraction would indicate inadequate pelvic floor muscle function, or underactivity (UpfmC). If the inferior parts of the puborectalis muscle were separated from the transperineal ultrasonography, the injury was classified as an avulsion injury.

Trans perineal ultrasound:

Using an endocavity probe frequency of 6–12 MHz, transperineal ultrasonography was performed. In a nutshell, the inspection was carried out with the stool evacuated and a modest bladder fullness (50–100ml). When the patients were investigated while in the lithotomy posture, the probe was adjusted to maintain a 45-degree angle between the pubic symphysis axis and the horizontal line that connects the symphysis's lower edge. Images were taken in the maximal Valsalva condition for pubic symphysis, anorectal connection, urethral, vaginal, and neck in the resting state.

Parameter collection:

These parameters were measured under the two previously mentioned states: (1) Bladder neck-Symphyseal Distance (BSD) Figure 1; (2) The angle that separates the proximal urethra from the bladder's posterior wall is known as the posterior vesicourethral angle (β) in Figure 2. (normal value was 90°~120°); (3) Bladder Neck Descent (BND) Figure 3, which is the difference between the neck of the bladder and the lower edge of the pubic symphysis between resting and the largest Valsalva state; (4) Detrusor thickness (DT), three points were measured, and the average value was taken Figure 4; (5) Bladder Neck Rotation Angle, which is the difference between the lower edge of the pubic symphysis to the internal urethral connection and the axis of symphysis pubis at the two states (normal range <20°) (Figure 5).

As a guide, draw a line that runs horizontally across the pubic symphysis's lower border state of pelvic organ prolapse was examined. Should the pelvis exceed the reference line, it was interpreted negatively. Furthermore, if the reference was placed beneath the pelvic organ, it was interpreted as affirmative. Inside and outside the pelvis are represented by negative and positive.

The following were the defined diagnostic criteria for stress incontinence ultrasound: (1) Bladder neck rotation angle ≥ 20°; (2) vertical distance ≥ 2.3cm from the neck of the bladder at the Valsalva state to the pubic symphysis; and (3) bladder urethral angle > 95° at rest. Patients were diagnosed with stress incontinence if they met more than two of the three criteria.

STATISTICAL ANALYSIS:

The statistical analysis was performed with Graph Pad Prism 5.0 and SPSS 19.0. P-values below 0.05 were considered statistically significant when comparing the distribution of stress urine incontinence between the two groups using the $\chi 2$ test.

RESULTS:

Table 1: demonstrated that the mean age differences between the investigated groups were not statistically significant. The bladder neck symphyseal distance (BSD) did not differ statistically significantly across the groups under study, but it did rise statistically in Post vesico-urethral angle (β) among NVD group compared to CS group.

Table 2; showed that there was an increase in frequency of history of stress incontinence in NVD group compared to CS group but without statistical significance.

Table 3; showed there were no statistically significant variations in bladder neck rotation across the groups under study. However, there was an increase in statistical significance in bladder neck descend among NVD group compared to CS group.

Table 4; showed that there was a statistical significance decrease in detrusor muscle thickness among NVD group compared to CS group.

Table 5; showed that there was a statistical significance increase in frequency of pelvic organ prolapse and stress incontinence among NVD group compared to CS group.

Table 6; showed that there was a statistically significant decrease in mean MOS score among NVD group compared to CS group. Also, there was a statistically significant increase in frequency of UPFMC among NVD group compared to CS group.

Table7, figure 6; showed that there was a statistical significance -ve correlation between MOS score and bladder neck rotation among the studied cases.

Table (1): Demographic data of the studied groups:

Variable		**Group I (NVD) (*n*=24)**	**Group II (CS) (n=24)**	**t**	**P**
Age: (years)	*Mean ± Sd* *Range*	29.83±3.38 25-37	30.88±3.3 24-38	1.08	0.29 NS
US findings					
Bladder neck symphyseal distance (BSD): (cm)	*Mean ± Sd* *Range*	2.95±0.4 2.3-3.7	2.83±0.4 1.1-3.2	0.97	0.34 NS
Post vesico-urethral angle (β): (degree)	*Mean ± Sd* *Range*	111.92±19.44 89-145	98.75±20.65 67-140	2.27	0.03*

SD: Standard deviation t: Independent t test NS: Non significant (P>0.05),
*: Significant (P<0.05) **NVD:** Vaginal Delivery Cases, **CS**: Cesarean Delivery Cases

Table (2): History of stress incontinence among the studied groups**:**

Variable		**Group I (NVD) (*n*=24)**		**Group II (CS) (n=24)**		χ^2	**P**
		No	**%**	**No**	**%**		
Stress incontinences:	*-ve* +ve	17 7	70.8 29.2	21 3	87.5 12.5	2.05	0.16 NS

χ^2:Chi square test NS: Non Significant (P>0.05)

Table (3): US findings of bladder neck among the studied groups:

Variable		**Group I (NVD) (*n*=24)**	**Group II (CS) (n=24)**	**MW**	**P**
Bladder neck descend: (cm)	*Mean±Sd* *Median* *Range*	0.38±0.23 0.3 0.1-1.2	0.46±0.27 0.40 0.1-0.9	1.98	0.04*
Bladder neck rotation: (degree)	*Mean±Sd* *Median* *Range*	18.21±6.86 20 7-40	17.83±7.87 18 7-42	0.93	0.36 NS

SD: Standard deviation MW: Mann Whitney test NS: Non significant (P>0.05)
*: Significant (P<0.05)

Table (4): Detrusor muscle thickness among the studied groups:

Variable		Group I (NVD) (*n*=24)	Group II (CS) (n=24)	t	P
Thickness: (cm)	*Mean ±Sd*	0.31±0.06	0.35±0.08	2.45	0.02*
	Range	0.2-0.4	0.2-0.5		

SD: Standard deviation t: Independent t test *: Significant (P<0.05)

Table (5): Pelvic floor morbidity among the studied groups:

Variable		Group I (NVD) (*n*=24)		Group II (CS) (n=24)		χ^2	P
		No	**%**	**No**	**%**		
Pelvic organ prolapse:	*-ve*	16	66.7	22	91.7	4.55	0.03*
	+ve	8	33.3	2	8.3		
Stress incontinences:	*-ve*	15	62.5	21	87.5	4	0.04*
	+ve	9	37.5	3	12.5		

χ^2:Chi square test *: Significant (P<0.05) **: Highly significant (P<0.001)

Table (6): Modified Oxford score among the studied groups:

Variable		Group I (NVD) (*n*=24)		Group II (CS) (n=24)		MW	P
MOS:	*Mean ±Sd*	2.46 ± 1.44		3.63 ± 1.14		2.76	0.006*
	Median	2.5		4			
	Range	0-5		1 - 5			
Variable		No	%	No	%	χ^2	P
Mos class:	*NPFMC (3-5)*	12	50	20	83.3	6	0.01*
	UPFMC (0-2)	12	50	4	16.7		

NPFMC: Normal pelvic floor muscle contraction
UPFMC: Underactive pelvic floor muscle contraction
SD: Standard deviation MW: Mann Whitney test χ^2:Chi square test
*: Significant (p<0.05)

Table (7): Correlation between MOS score and different parameters among the studied groups:

Variable	MOS score (*n*=48)	
	r	P
Age: (years)	-0.20	0.18 NS
Bladder neck symphyseal distance (BSD): (cm)	-0.14	0.33 NS
Post vesico-urethral angle β: (degree)	-0.20	0.18 NS
Bladder neck descend: (cm)	0.06	0.68 NS
Bladder neck rotation: (degree)	-0.62	<0.001**
Detrusor muscle thickness (cm)	0.10	0.49 NS

r: Spearman's correlation coefficient NS: Non significant (p>0.05)
**: Highly significant (P<0.001)

Discussion

In our investigation, the NVD group's β increased statistically significantly more than the CS group's, however there were no statistically significant variations in BSD across the analyzed groups in the resting state.

This agrees with **Wang et al [2]** who used ultrasonography to look into how various delivery methods affected what makes up the pelvic floor. They showed that, in the resting state, there was no statistically significant difference in the BSD, DT, and β of the childless and fertile women. There was a statistically significant difference in β between women who delivered babies vaginally and those who delivered babies by cesarean section when they were at rest. Certain hidden injuries can happen when a woman is pregnant or giving delivery.

On the other hand, **Wang et al [3]** who used transperineal four-dimensional ultrasonography to evaluate how different delivery techniques affect women's pelvic floor function 6–8 weeks postpartum. Compared to the selective caesarean section group, the vaginal group had considerably larger pelvic diaphragm hiatus characteristics under the maximum Valsalva action ($P < 0.05$). Additionally, the differences in parameters between the two groups' resting patient populations were not statistically insignificant ($P > 0.05$).

In our investigation, bladder neck rotation did not vary statistically noticeably across the groups under investigation. However, when comparing the NVD group to the CS group, there was a statistically significant increase in bladder neck descent.

This is in accordance with **Wang et al [2]** who reported that, the rotation angles of the bladder neck, β, and BND varied significantly between the combination of caesarean sections and vaginal births during the Valsalva maneuver.

This also agrees with **Wang et al [3]** who reported that, the pelvic diaphragm hiatus parameters were significantly greater in the vaginal group compared to the selective caesarean section group ($P < 0.05$) The pelvic diaphragm hiatus values in patients at rest differed between the two groups under the greatest Valsalva action, and these changes were not statistically insignificant ($P > 0.05$).

Furthermore **Mohamed [4],** they sought to determine how pregnant women's Transperineal measurement of the postpartum posterior urethrovesical angle (PUVA) ultrasonography (US), was affected by their mode of birth and pregnancy. According to their findings, during six weeks following delivery and the third postpartum month, women from the continent had statistically significant increases in the valsalva maneuver and posterior urethrovesical angle at rest. However, six months after giving birth, the posterior urethrovesical angle values in expectant mothers fell to nearly normal levels. Even though women who received VD had higher values than women who underwent CS after six months after birth, the posterior urethrovesical angle after delivery was within the customary permissible range in both groups. The hiatal region grew considerably on VM in the VD group, and 4% of the women even showed a ballooning in the 3D sonography. Following vacuum extraction delivery (VE), a levator ani muscle (LAM) avulsion occurred in 4% of women.

On the other hand, **Stroeder et al [5],** we sought in order to ascertain pelvic floor disorders (PFDs) and their effects on women's quality of life (QoL) and the changes in the pelvic floor architecture that lead to PFDs in primigravidae during and after pregnancy. When comparing the Valsalva maneuver (VM) three months after birth to the third trimester 2D sonography, bladder neck mobility (BNM) increased considerably across all delivery groups.

Another prospective study found that three months after delivery, the urethrovesical angle and urethral mobility both considerably increased **[6]**.

In our study, there was a statistical significance decrease in detrusor muscle thickness among NVD group compared to CS group.

This is in accordance with **Kociszewski et al [7]** who compared detrusor muscle thickness Among females who had babies vaginally (VD) as opposed to those who delivered babies via caesarean section (CS). The study found that detrusor muscle thickness was significantly lower in the VD group compared to the CS group. The authors suggested that this may be due to the traumatic stretching significant harm to the muscles of the pelvic floor that can occur during vaginal delivery.

This is also in line with **Chen et al [8]** who found that detrusor muscle thickness was significantly lower in the Both instrumental and spontaneous vaginal delivery (SVD) are possible (IVD) groups compared to the elective cesarean section (ECS) group. The authors suggested that this may be due to the mechanical trauma that can occur during vaginal delivery.

Blomquist et al found that weakened PFM was linked to the cumulative incidence of POP, SUI, and overactive bladder in an analysis of 1143 participants following vaginal birth**[9]**.

Our study showed that the NVD group had a higher frequency of history of stress incontinence (Group I) compared to CS group (Group II); in (Group I), 7 (29.2%) had stress incontinence and in (Group II), 3 (12.5%) had stress incontinence but without statistical significance.

However, when it comes to The two groups' levels of stress differed statistically significantly incontinence, transperineal ultrasonography prolapse of pelvic organs, and both, with a higher prevalence of these conditions observed in NVD group compared to CS group. For stress incontinence, in Group I, 9 cases (37.5%) tested positive (+ve). In Group II, 3 cases (12.5%) tested positive.

Similarly, in the study done by **Lukacz et al [10],** The validated Epidemiology of Prolapse and Incontinence Questionnaire was used to determine the prevalence of pelvic organ prolapse, stress urinary incontinence, overactive bladder, and anal incontinence in a random sample of women aged 25–84. The results showed that there is an independent correlation between the risk of pelvic floor disorders and vaginal birth, and that caesarean delivery had a protective effect against the development of pelvic floor difficulties when compared to vaginal delivery.

This also in agreement with **Hantoushzadeh et al [11]** who sought to ascertain the frequency of minor urine incontinence under stress (SUI) in relation to pre-pregnancy SUI and mode of delivery one year after delivery. Regarding the route of delivery, they found that there was a notable variation in the patients' incidence of SUI with and without a history of SUI prior to pregnancy at 40 days, 3 months, and 6 months postpartum ($P < 0.05$, all groups).

In accordance, **Wei et al [12]** aimed to examine any possible contributing factors for female stress-related SUI. The prevalence of SUI and pre-pregnancy urine incontinence were closely associated ($P<0.001$). This indicates that women who had pre-pregnancy urinary incontinence history are more prone to develop stress-related urine incontinence.

Wang et al stated that vaginal delivery may undermine the structure supporting the pelvic organs, harm the The muscles and fascia of the pelvic floor change the pelvic floor's movement, and alter the position of the bladder neck. Urinary incontinence caused by stress is largely caused by these alterations. A cesarean delivery can successfully stop the pelvic floor tissue from rupturing or dilatation, protecting the parturient's early pelvic floor function and preventing urinary tract injury **[3]**.

According to **Zhao et al [13]** we sought to ascertain how various delivery methods and associated obstetric variables affected Chinese primipara babies' postpartum pelvic floor muscle's short-term strength. They found that the group that had a cesarean delivery had stronger pelvic floor muscles (PFMs) than the group that had a vaginal delivery ($p < 0.05$).

Unlubilgin et al [14] demonstrated a substantial correlation between the development of prolapse and UI and the rise in the posterior urethrovesical angle.

The pelvic floor muscles degenerate during delivery due to the fetal head's mechanical compression and expansion, which results in shorter muscle fibers and reduced contractility**[15].** This process also results in damage to the pelvic floor nerves, which exacerbates the denervation phenomena of the pelvic floor muscle **[16]**.

Furthermore, there are obstetric factors that can exacerbate the urethral striated muscle and pelvic floor becoming denervated, including an increase in the number of childbirths, an excessively protracted very large head circumference and weight, second stage of labour of the fetus, perineal incisions, etc. The pelvic floor's contraction force remained unchanged in contrast to vaginal delivery, yet there were additionally less noticeable alterations in the location of the bladder and vaginal necks **[2]**.

Stretching the vagina during the parturient's vaginal delivery can cause nerve lacerations, birth canal stretch, perineal lacerations, and injuries to the muscles of the pelvic floor **[17]** .

Following birth, the parturient's Her uterus won't be forced by her front and lower limbs, her pelvic floor will quit supporting her, and her hormone levels will gradually return to normal. Additionally, the cervical ring will revert to its initial condition **[18]**. 42 days following delivery is when a Regular assessment of pelvic floor function ought to be carried out. and 42 days following postpartum lochia, pelvic floor reconditioning therapy can begin. In order to prevent future The best course of action for pelvic floor dysfunction, including uterine prolapse and urine incontinence, is pelvic floor muscle rehabilitation within three months of giving birth. Furthermore, Evaluations are necessary for elderly persons and menopausal women who exhibit pelvic floor problems, such as sneeze leakage. Treatment for laughing leaks and chronic pelvic discomfort can be obtained at any time through pelvic floor rehabilitation The better the outcome, the earlier the treatment is started **[3].**

According to **Stroeder et al.,** 31% of PFD cases—42.9% of which had already occurred during pregnancy—were described as having UI, making it the most common type of PFD. No incidences of high-grade pelvic organ changes during pregnancy or after delivery were reported in our group, indicating a low prevalence of POP.

In our investigation, the mean MOS score for The NVD group's was noticeably less than the CS group's. Furthermore, there was a statistically significant increase in the frequency of UPFMC in the NVD group compared to the CS group **[5]**.

Gao et al found that ladies who had given birth naturally had significantly lower Modified Oxford scores in contrast to females who had had caesarean sections. The authors hypothesised that the pelvic floor muscles could be to blame for this that may sustain harm during a vaginal delivery **[19]**.

Wei et al found revealed the incidence of pelvic organ prolapse was considerably higher among women who had given birth vaginally and a lower levator hiatus area in contrast to females who had had caesarean sections. The authors suggested that this may be because to the pelvic floor's expansion and deterioration muscles that can occur during vaginal delivery **[12]**.

Our study is limited by the relatively small sample size and in a specific population (patients of Zagazig University Hospitals, hence it's possible that the findings cannot be applied to different groups or environments. Additionally, the study did not account for other factors that may influence pelvic floor structure and function, such as being overweight or obese, straining to pass gas or stool for an extended period of time, hard lifting, persistent coughing due to health issues or smoking, and pre-existing pelvic floor abnormalities.

Conclusion:

We find that, Vaginal birth appears to be linked to more negative outcomes than caesarean section delivery effects on pelvic floor structure and function. These findings highlight the need of considering how delivery mode may impact pelvic floor health and the need for women who have given birth vaginally to treat pelvic floor problems with the proper care.

Declaration of interest

The authors report no conflicts of interest. The authors along are responsible for the content and writing of the paper.

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Supplementary

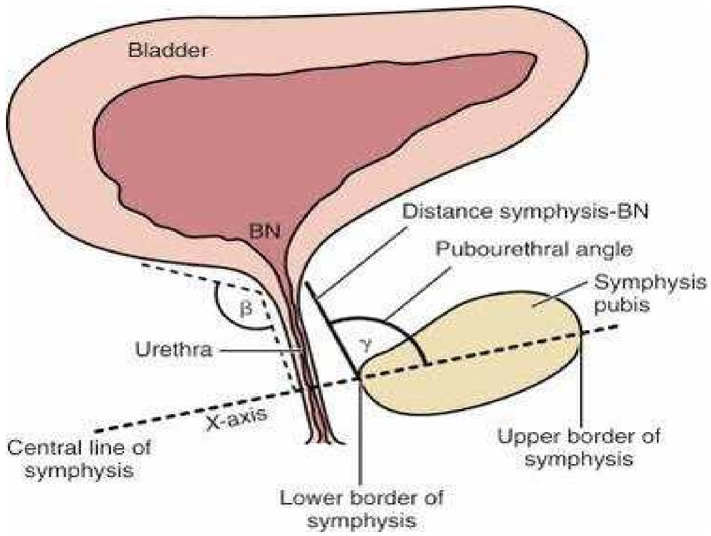

Figure 1S1: Bladder neck symphyseal distance

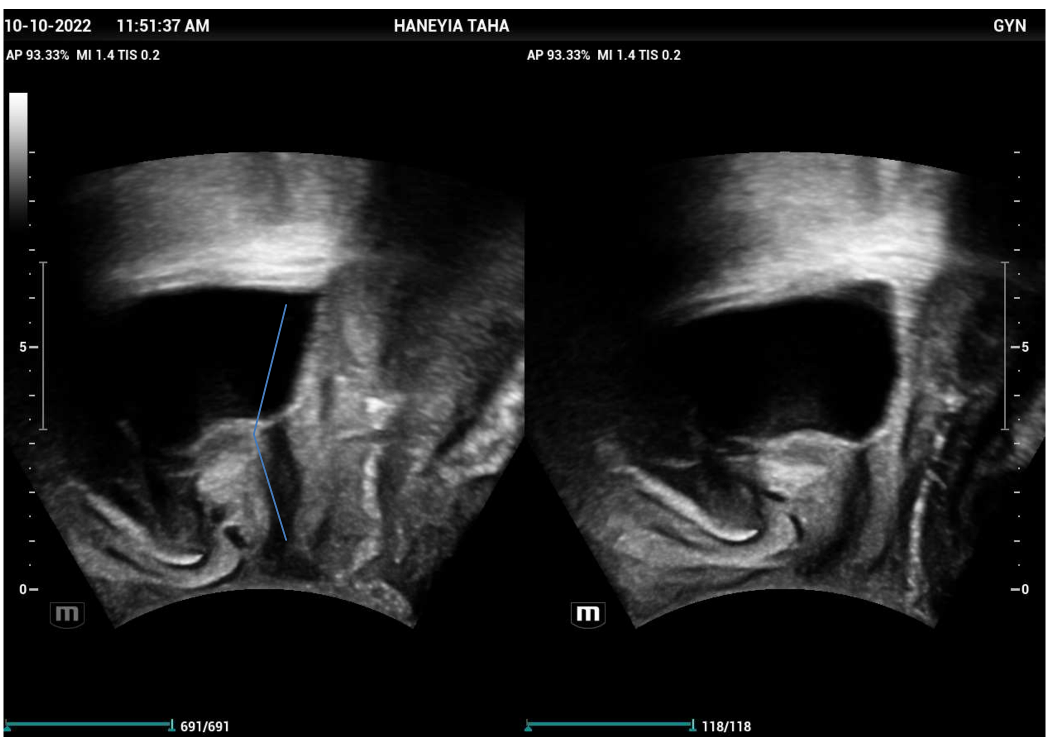

Figure 2 S2: Posterior vesicourethral angle

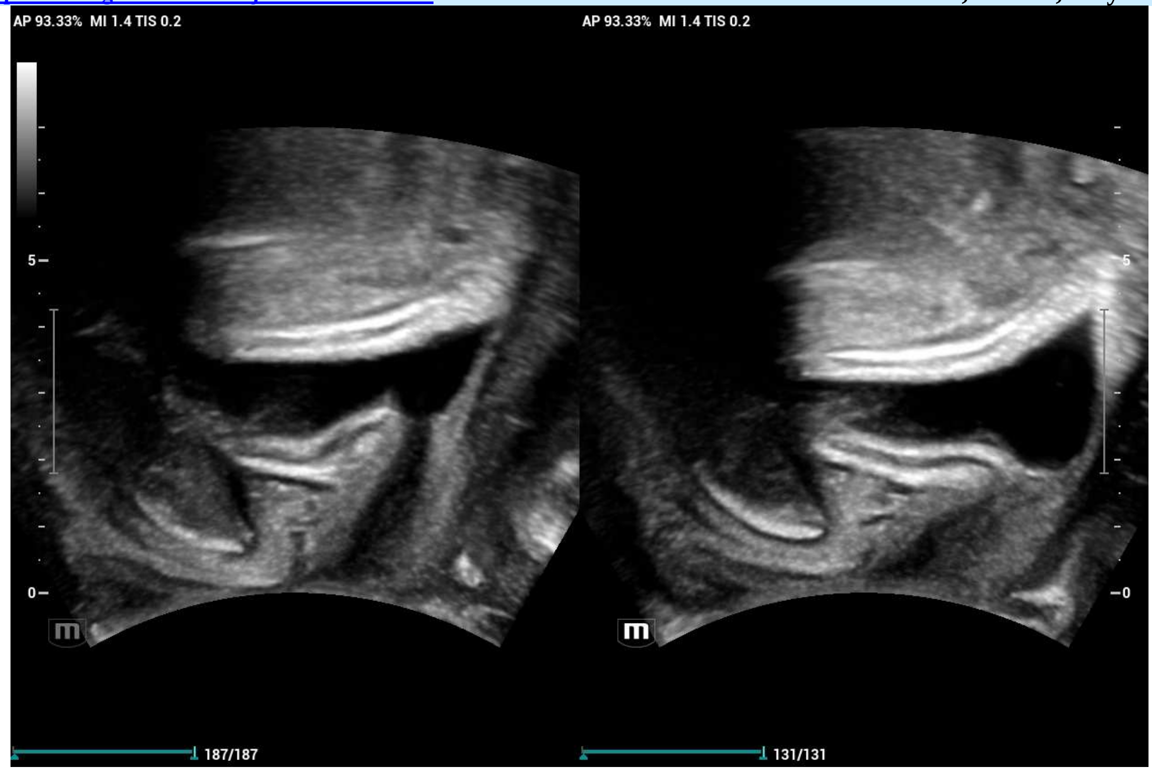

Figure 3S3: Bladder Neck Descent

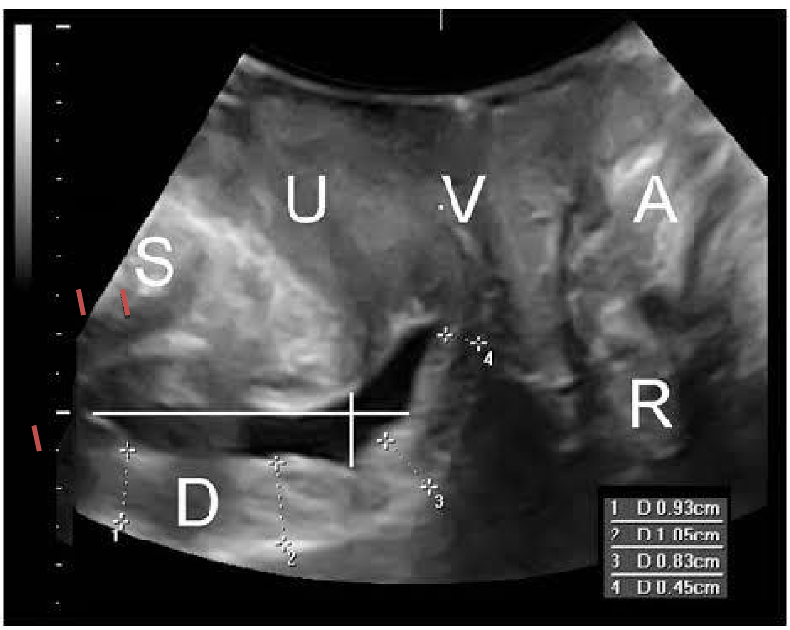

Figure 4 S4: Detrusor thickness (DT), of which three points were measured and the average value was taken

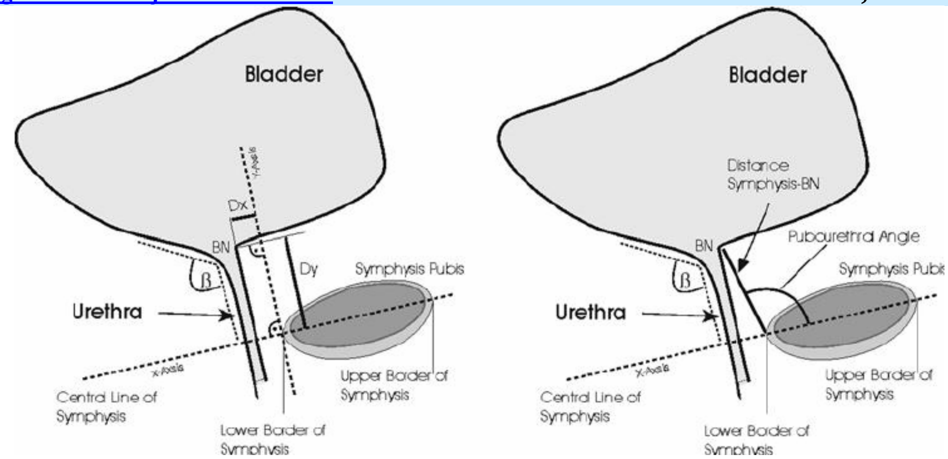

Figure 5 S5: Bladder neck rotation

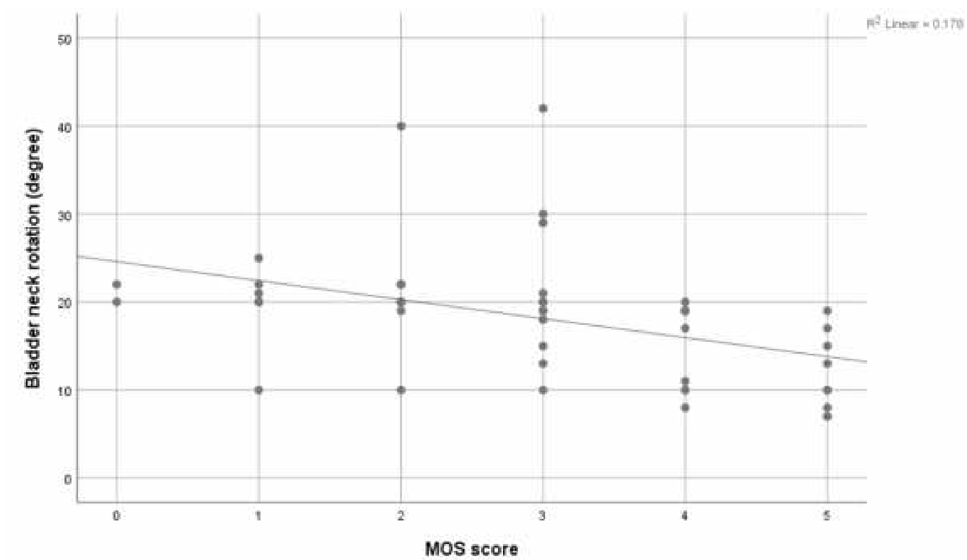

Figure (6) S6: Correlation between MOS score and different parameters among the studied groups.

Citation:

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