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The Effectiveness of Two- Dimensional (2D) Transperineal Ultrasonography in the Diagnosis and Dynamics of Therapy in Women with Pelvic Floor Disorder

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Abstract

Aim The height of centrum tendineum; depth of the m.bulbocavernosus and m. puborectalis; diastasis of the m.bulbocavernosus, as measured by two- dimensional (2D) transperineal ultrasonography, are markers of the of pelvic floor conditions. In available medical literaturethere is little evidence on the objectification of sonographic parameters in the diagnosis and dynamics of therapy in women with pelvic floor disorder.Therefore, we assessed the effectiveness of 2D transperinealultrasonography in women *before* and *after* minimally invasive perineoplasty.

Methods Prospective uncomparative study of 33 parous women with pelvic floor disorder examined with POP quantification (POP-Q) and 2D transperineal ultrasound before, during and *3 months later*after minimally invasive perineoplasty with surgical thread "Long lift". Statistical analysis was undertaken using Python package SciPy.To check whether the data is normally distributed we used Kolomogorov-Smirnov criteria (scipy.stats.kstest). All background variables (BMI, age, period from first birth and parity) and ultrasound measurements were not normally distributed, hence we used nonparametric statistical criteria. We based on 99 percent confidence level, therefore p-value 0.01 andparameters lower than thatwere considered to be statistically significant.

Results The most significant parameter was the diastasis of m. bulbocavernosus, which decreased 4.6 times in patients *immediately after* surgical treatment (0.2±0.13 cm vs. 0.92±0.18 cm, p <0, 01). Moreover, this effect continued *3 months after perineoplasty*. In addition, transperineal ultrasound scanning showed that the height of centrum tendineum were 1,5 times more amongpatients immediately and *3 months after* surgical treatment (0.62±0.12 cm vs. 0.98±0.1 cm and 0.62±0.12 cm vs. 0.98±0.1 cm, P <0, 01). Other ultrasound parameters - depth of the m.bulbocavernosus, depth of the m. puborectalis- did not have statistically significant changes after perineoplasty.

Conclusion In the course of our research, we have established that2D transperineal ultrasonography could be used not only for diagnosis, but alsofor the dynamicsof therapy in patients with pelvic floor disorder.

Key words: pelvic floor disorder, pelvic organ prolapse, transperineal ultrasound.

Conflict of interest. All authors declare that there is no potential conflict of interest requiring

disclosure in this article.

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Introduction

Pelvic organ prolapse (POP) is a common gynecological condition, affecting 25–41% of middle-aged and elderly women [1, 2].

POP is the hidden epidemic. In the USA it has been conservatively estimated that the prevalence of symptomatic POP will increase by 46% to reach 4.9 million women by 2050. Prolapse of the urinary bladder, bowel and uterus can be associated with a wide range of other pelvic floor symptoms, such as incomplete bladder and bowel emptying, frequent urination, urinary and anal incontinence and sexual dysfunction [3]. Its causes include birth injury, chronic cough, constipation and prior hysterectomy. Women who sustain levatorani muscle (LAM) injury have a higher risk for POP. A detailed evaluation of LAMI is necessary for POP management [4].

The pelvic organs are suspended by the pelvic ligaments and supported by the levatorani muscles. The LAM plays an important role for maintenance of continence and support of the pelvic organs.The median portion of the LAM surrounding urethra, vagina and rectum provides resting tone and contraction, giving a narrow closure of the urogenital hiatus that prevents descent of the pelvic organs.Breaks in the connective tissue and neuromuscular damage, affecting the pelvic floor muscles, cause pelvic organ prolapse [5].

Trauma to the levatorani muscle is a common consequence of vaginal childbirth, affecting between and parousprimiparae. There is an established relationship between levatorani (puborectalis) muscle trauma and female pelvic organ prolapse, which at least partly explains the epidemiological link between vaginal childbirth and prolapse [6].

The incidence of POP is associated with several other factors including age, parity, abdominal circumference and body mass index.

Since 1996 the International Continence Society (ICS) pelvic organ prolapse quantification (POP-Q) system has been the gold standard for quantification of anatomical prolapse at clinical examination [7]. The staging system derived from POP-Q is based on expert opinion rather than data. Staging of bladder, uterine, small bowel and rectal descent are identical under the quantification system, i.e., a uterus that descends to within 1 cm of the hymen is deemed to be as abnormal as the descent of the anterior or posterior vaginal wall in the same level [8].For that reason, physical examination can lead to underestimate or misdiagnose the site, degree and nature of pelvic organ prolapse in 45–90% of patients as well as toincorrect treatment and recurrence of symptoms in 10–30% of patients after surgery [9-11].Since anatomy does not always correlate with urinary and bowel symptoms, some women need additional diagnostic to make qualified decisionon conservative or surgical treatment.

Transperineal ultrasound is a new alternative for the investigation of functional anatomy of the pelvic floor and cut-offs have been suggested to define clinically relevant descent of the urinary

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bladder, cervix and rectum in relation to the sensation of a vaginal bulge.

The aim of the present study was to explore the effectiveness of 2D transperinealultrasound in diagnosis and dynamic therapy of PFD.

METHODS

This was a prospective uncomparative study undertaken in 33 women who went in a tertiary gynecological unit for symptoms of pelvic floor dysfunctionbetween October 1st 2020 and January. Inclusion criteria were:

1) Patients visited the clinics with symptoms consistent with POP.

2) Patientssought helpbetween October 2020 and January 2021.

3) They received both clinical and ultrasound examinations.

Exclusion criteria were:pregnancy, urinary tract infection, nonparous women. Patients without sonographic data *before* and *after* surgical treatment were excluded.

All patients underwent a clinical interview with POP examination performed based on the Pelvic Organ Prolapse Quantification System of the International Continence Society (ICS POP-Q).

Transperineal ultrasound was performed with the patient supine using a Voluson S6 or IC9-RS (GE Healthcare, Milwaukee, WI, USA) a 4–8-MHz intravaginal transducer that was covered with a condom and was placed on the vagina in the vertical direction.The operator used minimal pressure during the examiner on the pelvic floor.

We used the following parameters as markers of the of pelvic floor conditions (Figure 1):

-centrum tendineum- the minimal distance between the hyperechoic superior border of the m. sphincter ani externus and the superior aspect of the posterior vaginal wall (Pb-perineal body, according POP-Q);

- depth of the m.bulbocavernosus measured at level of the superior part m. sphincter ani externus;

-diastasis of the m.bulbocavernosus inner edges;

- depth of the m.puborectalis was observed as a V-shaped hyperechoic structure surrounding the anorectum.

The normal pelvic floor conditions is characterized height of centrum tendineum more than 1 cm, depth of the m.bulbocavernosusis not less than 1-1,5 cm; lack of m.bulbocavernosus diastasis; depth of the m. puborectalisis more 0,7 cm [12].

Finally, all patients underwent minimally invasive perineoplasty with a surgical thread called "Long Lifting".

Surgical technique. The implantation of "Long lift" thread were carried out through four very

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small and superficial incisions of the skin of the crotch into the subcutaneous tissue and muscle located superficially under the skin.Once the threads were linked, the procedure was ended.The threads applied during the procedure provoke a fibrosis reaction, a collagen production, leadingto the development of the "traction vector", which makes it possible to preserve the effectseven after the absorption of the threads.

Statistical analysis was undertaken using Python package SciPy. To check whether the data is normally distributed we used Kolomogorov-Smirnov criteria (scipy.stats.kstest). All background variables (BMI, age, period from first birth and parity) and ultrasound measurements were not normally distributed, hencewe used nonparametric statistical criteria. To check differences between time series (before, during and after perineoplasty) of ultrasound measurements we applied Mann–Whitney U-test (scipy.stats.mannwhitneyu) women. We based on99 percent confidence level, therefore p-value 0.01 and parameterslower than thatwere considered to be statistically significant. The ethical approval for this study was obtained from the Research Ethics Committee of our institution (13- 502).

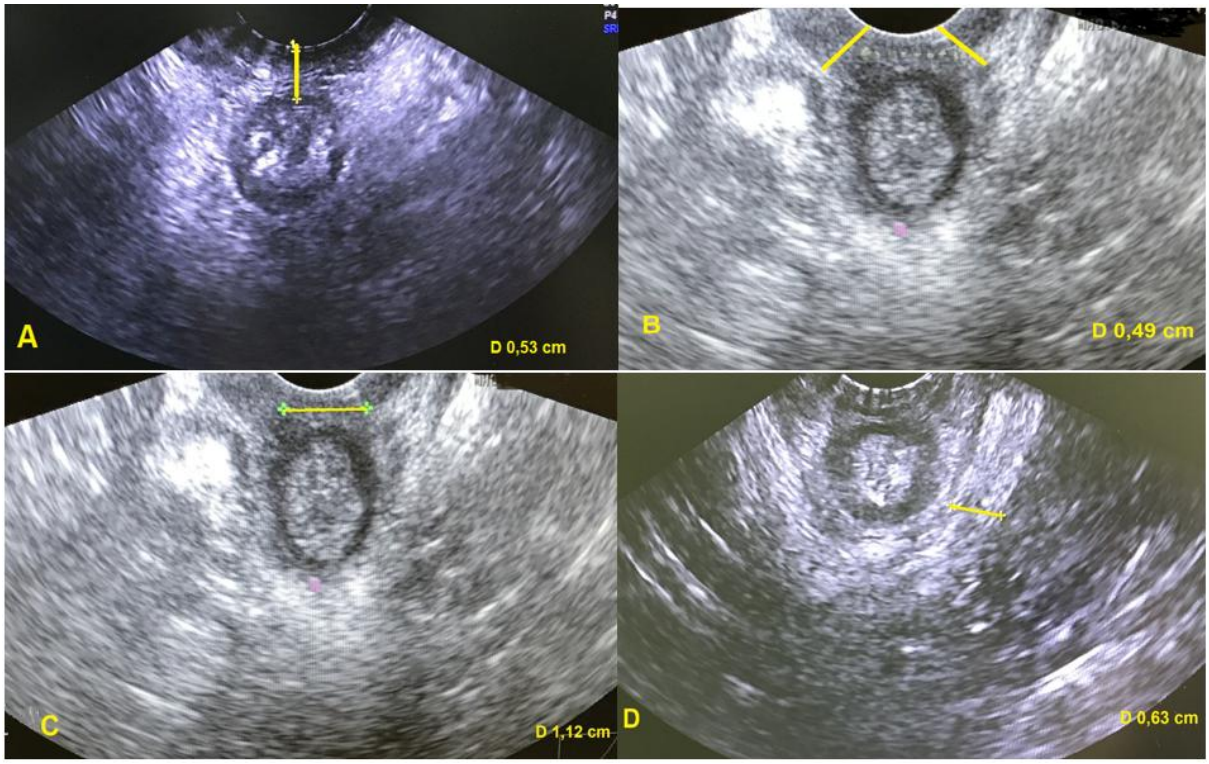

Figure1 Pelvic floor disorder. Transperineal ultrasound scanning showed decrease in the height of the centrum tendineum (A, marked by yellow arrow), the width of m. bulbocavernosus(B,yellow arrow); the diastasis of m. bulbocavernosus and decrease the width of m. puborectalis (D,yellow arrow).

Results

All 33 women were examined with POP-Q (Stage I).
Mean BMI at the time of inclusion was 26.2 kg/m2 (range 20.1-31), mean age was 35.2 years (range 27-43). Period from first birth was 8.3 (range 2350-5550) and mean parity 1.4 (range 1-3). Background variables in the group are lined out in Table 1.

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Mode of delivery was normal vaginal delivery for 13 /33 (39,4%), forceps for 5/33 (15,2%), vacuum for 4/33 (12,1%) and episiotomy for 11/33 (33,3%) of the women.

Characteristic	Value
BMI kg/m2 Mean (SD)	26.1 ± 2.9
Ageyears Mean (SD)	35.2 ± 4.4
Paritynumber Mean (SD)	1.4±0.6
Period from first birth, years Mean (SD)	8.3±3.3
POP- Q stage I n/N (%)	33/33 (100%)
Mode of delivery, n/N (%)	
Normalvaginal	13/33 (39,4 %)
Vacuum	4/33 (12,1 %)
Forceps	5/33 (15,2%)
Episiotomy	1/33 1(33,3%)

TABLE 1 Demographic characteristics of all participants (n = 33).

Abbreviations: BMI, body mass index, POP- Q, pelvic organ prolapse quantification system.

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We carried out a comparative analysis of sonographic parameters *before*(A), *immediately afterperineoplasty*(B) and *3 months after surgical treatment*(C) (Table 2).

Based on the sonography data the most significant parameter was the diastasis of m. bulbocavernosus, which decreased 4.6 times in patients *immediately after surgical treatment*(0.2±0.13 cm vs. 0.92±0.18 cm, p <0, 01). Moreover, this effect continued *3 months afterperineoplasty* (Figure 4).

In addition, transperineal ultrasound scanning showed that the height of centrum tendineum were 1,5 times more in patients immediately and *3 months after*surgical treatment (0.62±0.12 cm vs. 0.98±0.1 cm and 0.62±0.12 cm vs. 0.98±0.1 cm, P <0, 01). (Figure 3).

Other ultrasound parameters – depth of the m.bulbocavernosus, depth of the m. puborectalis– did not have statistically significant changes after perineoplasty(Figure 2;5).

	Depth of the m.puborectalis		Heightof centrumtendineum		Depth of the m.bulbocavernosus		Diastasis of the m.bulbocavernosus	
	Mean (SD)	p	Mean (SD)	p	Mean (SD)	p	Mean (SD)	p
A	0.59±0.09	>0.05	0.62±0.12	<0.01	0.83±0.18	>0.05	0.92±0.18	<0.01
B	0.58±0.09		0.98±0.1		0.82±0.16		0.2±0.13	
A	0.59±0.09	>0.05	0.62±0.12	<0.01	0.83±0.18	>0.05	0.92±0.18	<0.01
C	0.6±0.09		0.98±0.1		0.84±0.15		0.21±0.21	
B	0.58±0.09	>0.05	0.98±0.1	>0.05	0.82±0.16	>0.05	0.2±0.13	>0.05
C	0.6±0.09		0.98±0.1		0.84±0.15		0.21±0.21	

Table2

Time series: A - measurements before perineoplasty, B - immediately after perineoplasty, C - 3 months after perineoplasty

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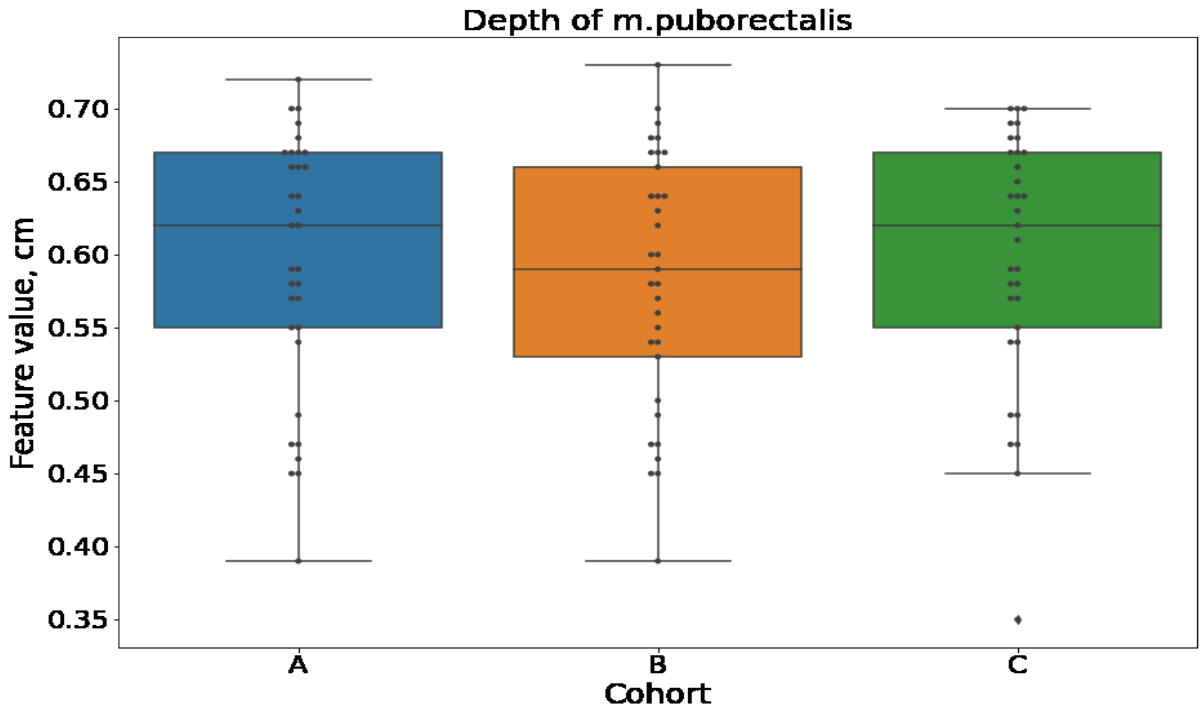

Figure 2

Dynamics of changes of the m. puborectalis's depth before (A), immediately after perineoplasty (B), 3 months after perineoplasty (C). Data are shown for all participants (n = 33).

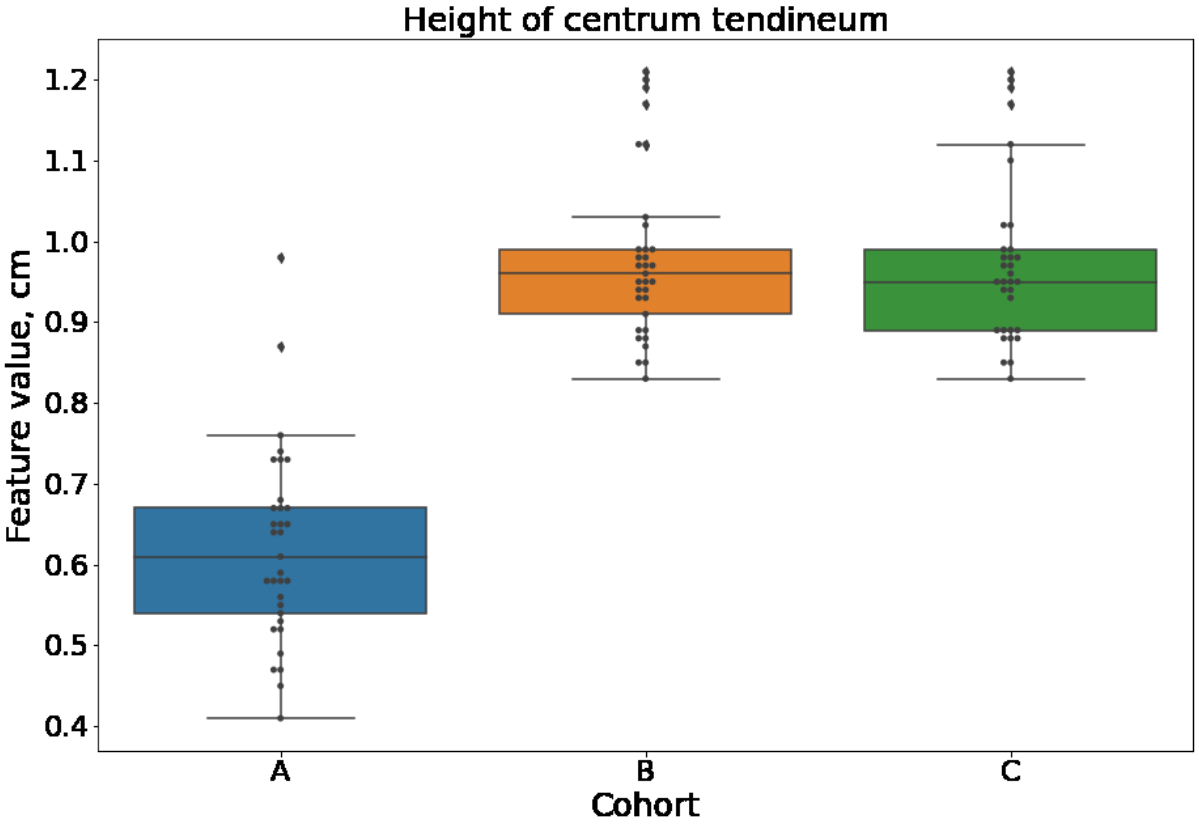

Figure 3

Dynamics of changes of the centrum tendineus's height before (A), immediately after perineoplasty (B), 3 months after perineoplasty (C).

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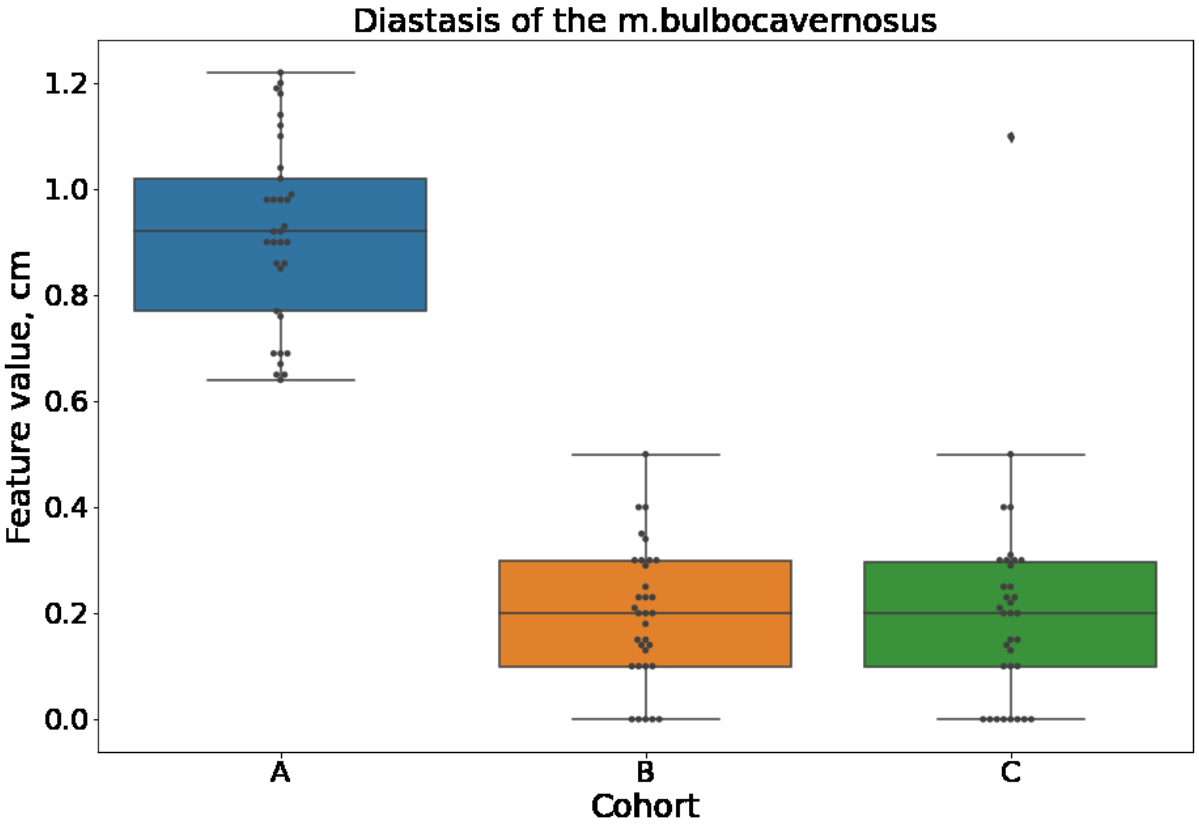

Figure 4

Dynamics of changes of the m. bulbocavernosus's diastasis before (A), immediately after perineoplasty (B), 3 months after perineoplasty (C). Data are shown for all participants (n = 33).

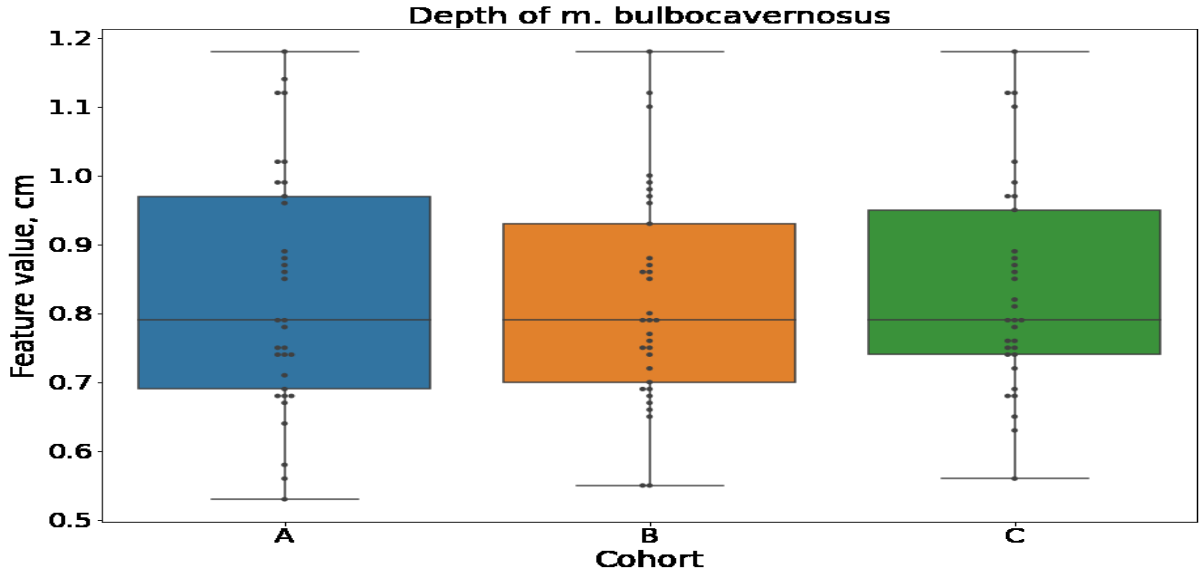

Figure 5

Dynamics of changes of the m. bulbocavernosus's depth before (A), immediately after perineoplasty (B), 3 months after perineoplasty (C).Data are shown for all participants (n = 33).

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Discussion

There are a variety of surgical management strategies to help surgeons repair POP. Surgical treatment for POP includes native tissue repair, augmentation with mesh and minimally invasive surgeries (MIS). Currently, MIS techniques for POP repair are increasing in popularity and continuing to evolve.

The classical surgical technique used during pelvic floor repair interventions is very similar to traditional anterior or posterior colporrhaphy performed in urogynecological settings to correct vaginal prolapse or pelvic floor defects. Colporrhaphy is often associated with perineoplasty, which involves the removal of a triangle-shaped portion of skin tissue from the perineum above the anus to tighten the vaginal introitus and reconstruct the perineal body.

The different techniques proposed for pelvic floor repair have been studied in small trials assessing surgical outcomes, patient satisfaction and postoperative complications.

Pardo et al. [13] treated subjective wide vagina and sexual dysfunction with traditional colporrhaphy in 53 patients. 74 %of the patients were satisfied with the results. Adamo and Corvi reported that lateral colporrhaphy can improve sexual sensitivity in patients with a wide vagina [14].

Minimally invasive approaches have high efficacy for POP repair.Some authors recently proposed a functional vaginal rejuvenation with elastic silicone threads in 180 women with a feeling of wide vagina [15]. This novel surgical technique requires the insertion of silicone threads under the vaginal submucosa, following two incisions at 3 and 9 o'clock for the inlet and outlet of the threads. In this kind of intervention, it is crucial to avoid injuring the urethra (anterior to vagina) and the rectum (posterior to vagina). Overall, the authors reported that after 12 months, the Female Sexual Function Index (FSFI) total score was significantly improved. Moreover, 92.8% of the women were satisfied with outcomes with regard to feeling of correction of vaginal width. The most common complications reported were implant exposure (5% of women), capsule contracture (3.9%) and infection (1.7%).

In available medical literature there is no data on the objectification of sonographic parameters in the diagnosis and dynamics of therapy in women with pelvic floor disorder.

In our study we assess the effectiveness of two- dimensional (2D) transperineal ultrasonography in the diagnosis and dynamics of therapy in women *before* and *after* implantation surgical thread "Long lift". Minimally invasive perineoplasty with surgical thread "Long lift" avoids significant traumatic normal tissue injury.The lifting effect on the tissues of the perineum is facilitated by small cogs on the thread.

As shown in Table 1, the significant increase of height of centrum tendineum and decrease diastasis of the m.bulbocavernosus can be interpreted as animprovement of the pelvic floor conditions.

Conclusion

2D transperineal ultrasonography is the least invasive, cheapest, simplest and most commonly available method for pelvic floor imaging. We propose that the diastasis of m. bulbocavernosus and height of centrum tendineum could be reliable sonographic markers in dynamics of therapy in women with PFD.

References

1. Nygaard I, Barder M. Prevalence of symptomatic pelvic floor disorders in US women. JAMA. 2008;300(11):1311–6.

2. Hendrix S, Clark A, Nygaard I, Aragaki A, Barnabei V, McTiernan A. Pelvic organ prolapse in the Women's Health Initiative: gravity and gravidity. Am J Obstet Gynecol. 2002;186(6):1160–6.

3. Ingrid Volløyhaug,RodrigoGuzmánRojas,SivMørkved, KjellÅsmundSalvesen.Comparison of transperineal ultrasound with POP-Q for assessing symptoms of prolapse. IntUrogynecol J.2018.https://doi.org/10.1007/s00192-018-3722-3

4. Lai W, Wen L, Li Y, Huang X, Qing Z. Concordance of tomographic ultrasound and multiplanar ultrasound in detecting levatorani muscle injury in patients with pelvic organ prolapse. PLoS ONE.2018.13(7): e0199864. https://doi.org/10.1371/journal.pone.0199864

5. Volløyhaug I, Mørkved S, Salvesen KÅ. Association between pelvic floor muscle trauma and pelvic organ prolapse 20 years after delivery. International Urogynecology Journal. 2016 Jan;27(1):39-45. DOI: 10.1007/s00192-015-2784-8.

6. V. H. Eisenberg, V. Chantarasorn, K. L. Shek, H. P. Dietz. Does levatorani injury affect cystocele type? Ultrasound ObstetGynecol 2010; 36: 618–623. DOI: 10.1002/uog.7712

7. Bump R, Mattiasson A, Bo K, Brubaker L, DeLancey J, Klarskov P, Shull B, Smith A. The standardization of terminology of female pelvic organ prolapses and pelvic floor dysfunction. Am J ObstetGynecol 1996; 175: 10–1

8. Dietz HP, Mann K. What is clinically relevant prolapse? An attempt at defining cutoffs for the clinical assessment of pelvic organ descent. IntUrogynecol J 2014; 25: 451–455.

9. Maglinte DD, Kelvin FM, Fitzgerald K, Hale DS, Benson JT. Association of compartment defects in pelvic floor dysfunction. AJR Am J Roentgenol. 1999 Feb;172(2):439-444.

10. Kelvin FM, Hale DS, Maglinte DD, Patten BJ, Benson JT. Female pelvic organ prolapse: diagnostic contribution of dynamic cystoproctography and comparison with physical examination. AJR Am J Roentgenol. 1999 Jul;173(1):31-37.

11. Nygaard I, Barber MD, Burgio KL, Kenton K, Meikle S, Schaffer J, Spino C, Whitehead WE, Wu J, Brody DJ; Pelvic Floor Disorders Network. Prevalence of symptomatic pelvic floor disorders in US women. JAMA, 2008; 300(11): p.1311-1316.

12. Chechneva M.A., Buyanova S.N., Popov A.A. Ultrasound diagnosis of genital prolapse and urinary incontinence in women. M.: "MEDpress-inform." 2016.; P 20.

13. Pardo JS, Sola VD, Ricci PA, et al. Colpoperineoplasty in women with a sensation of a wide vagina. ActaObstetGynecolScand 2006; 85:1125–7.

14. Adamo C, Corvi M. Cosmetic mucosal vaginal tightening (lateral colporrhaphy): improving sexual sensitivity in women with a sensation of wide vagina. PlastReconstrSurg 2009;123: 212e–3e

15. . Park TH, Park HJ, Whang KW. Functional vaginal rejuvenation with elastic silicone threads: a 4-year experience with 180 patients. J PlastSurg Hand Surg. 2015;49(1):36–39.

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