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Value of perineal Four-dimensional ultrasound imaging technique for follow up of patients undergoing endoscopic hysterectomy for myoma

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► ***Original article***

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ABSTRACT

Background: To investigate the impact of perioperative rapid rehabilitation nursing on pelvic floor function of patients during transvaginal natural cavity endoscopic hysterectomy using perineal Four-dimensional (4D) ultrasound imaging technique. ***Materials and Methods:*** A total of 60 patients undergoing natural cavity endoscopic hysterectomy were evenly divided into control group (CG) and observation group (OG). The CG adopted perioperative nursing mode, and the OG adopted rapid rehabilitation nursing on the basis of the CG. The perineal 4D ultrasound imaging technology was used to evaluate the postoperative pelvic floor function parameters and the incidence of pelvic floor function abnormalities in the two groups. ***Results:*** During anal retraction, the OG exhibited a substantially higher urethral rotation angle and bladder neck mobility compared to the CG ($P < 0.05$). Under resting conditions, the ultrasonic parameters of the two groups did not differ significantly ($P > 0.05$). The OG's ultrasonography parameters were substantially lower than the CG's under the highest Valsalva condition ($P < 0.05$). The incidence of internal urethral orifice infundification did not differ between the two groups ($P > 0.05$). Compared to the OG, the CG had a considerably higher incidence of cystocele ($P < 0.05$). There was a clear difference in pelvic prolapse distance between the two groups ($P < 0.05$). ***Conclusion:*** 4D ultrasound is conducive to accurately identifying the morphological structure and function of the pelvic floor in patients with hysterectomy, and provides guidance for the formulation of the rehabilitation treatment plan for the pelvic floor muscle of the patients.

INTRODUCTION

In gynecological diseases, if the patient has uterine tumors, or other uterine diseases have failed to implement conservative treatment, hysterectomy is usually needed to help the patient's health improve and to preserve their life [1,2]. Currently, transvaginal natural cavity endoscopic hysterectomy is considered as the most effective treatment for female uterine diseases, and the application effect is relatively significant [2]. However, the operation has a stress response, which causes traumatic injury to the tissue neurofascia, changes the pelvic floor structure, leads to changes in the position of the bladder and rectum, and causes symptoms such as vaginal relaxation and urinary incontinence, which has a great impact on the physiological function of patients [3,4]. Therefore, it is very important to give patients scientific, programmed, refined, and individualized nursing measures during the perioperative period of hysterectomy. Rapid rehabilitation nursing is an advanced nursing mode in clinical nursing. By applying this nursing mode, the state of pelvic floor muscle can be optimized to the maximum extent, thus improving the physiological function of patients and improving the prognostic quality of life [5,6]. At present, the clinical evaluation of female anterior pelvic function after surgery is mainly based on ultrasound, which is not only simple to operate, but also has a high resolution for soft tissue [7,8]. With the advancement of dynamic image acquisition technology in three and four dimensions, along with its strong data analysis abilities, pelvic floor ultrasonography has started to be used in clinical practice in recent years [9-11]. The impact of 3D pelvic floor ultrasonography on the diagnosis of postoperative pelvic floor function, however, has not been thoroughly studied. The use of 4D perineal ultrasound can reliably and quantitatively assess pelvic floor muscle contractility and relaxation by measuring the dynamic changes in the size of the levator ani muscle hiatal during pelvic floor contraction and Valsalva maneuver [12,13]. The purpose of this study was to evaluate the effect of 4D perineal ultrasound imaging on the pelvic floor function of patients undergoing transvaginal natural cavity endoscopic hysterectomy. 4D perineal ultrasound can clearly show postoperative pelvic

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floor function, which is conducive to the prevention and treatment of postoperative complications, and provides a new perspective for clinical promotion and reference.

MATERIALS AND METHODS

Clinical data

A total of 60 patients undergoing transvaginal natural cavity endoscopic hysterectomy were selected from the hospital, and were evenly divided into control group (CG) and observation group (OG) according to random parity method, with 30 patients in each group. The CG ranged in age from 40 to 69 years, with an average age of (49.36 ± 5.22) years. Types of disease: 5 cases of adenomyoma, 19 cases of uterine myoma, 6 cases of others. The OG ranged in age from 41 to 66 years, with an average age of (48.04 ± 5.31) years. Types of disease: 5 cases of adenomyoma, 17 cases of uterine myoma, and 8 other cases. Comparable general data showed no statistically significant distinction ($P > 0.05$) between both of the groups.

Inclusion criteria: (1) Informed and agreed to the study, and signed the informed consent. (2) Normal mental state, good compliance. (3) The hospital Ethics Committee gave its approval to this study (SDLL-12(A)-L). Exclusion criteria: (1) Serious heart, lung, liver, kidney and other dysfunction. 2) There were blood diseases or major heart diseases (3) Pelvic adhesion, severe anemia, mental illness and autoimmune disease patients. (4) Incomplete clinical data, poor compliance.

Nursing methods

The CG adopted perioperative nursing mode. Liver and kidney function, blood routine, coagulation, electrocardiogram, chest film, urine flow dynamics, lower limb vein color ultrasound and heart color ultrasound were performed before surgery to rule out contraindications. Preoperative psychological nursing, perineal nursing, vaginal preparation, dietary guidance and intestinal preparation were performed. During the operation, the vital signs of the patients were closely observed and the doctors were assisted to complete the treatment. Postoperative incision nursing, urination nursing, pain nursing, lower limb venous thrombosis prevention nursing, and discharge guidance were implemented.

1.The OG adopted rapid rehabilitation nursing on the basis of the CG. (1) Preoperative pelvic floor muscle training. Preoperative perineal contraction and relaxation training were mainly used. Patients were instructed to inhale while contracting the anus and exhale while relaxing the anus. 10 sets/min, 20 min each time, four times a day.

2. Intraoperative rapid rehabilitation nursing. Ward nurses understood the patient's operation status and ward nursing contraindications with the operating room nurses. After that, ward nurses and operating room nurses jointly discussed the focus of patient rehabilitation. If the patient had bladder muscle injury during the operation, or the patient had a high incidence of urinary retention after the operation, the bladder muscle rehabilitation exercise could be increased.

3. Life monitoring and rehabilitation nursing after the operation. After the operation, the patient could wake up under general anesthesia with pillows, could lie on his side, the head of the bed could be raised 10-20°, a comfortable sleeping position should be taken to rest, beware of vomiting. Blood oxygen saturation, pulse, blood pressure, and respiratory frequency were measured 30 min/ time. Low-flow oxygen could be taken as directed by your doctor if necessary. The amount of vaginal bleeding was observed and the perineum was kept clean. If the patient had severe pain, the pain was relieved following the doctor's advice. If some patients had postoperative complications, they could be given drug control and symptomatic nursing.

4. Postoperative pelvic floor muscle rehabilitation nursing. 24 h after surgery, patients could be guided to perform pelvic floor muscle exercise, adhere to the principle from simple to difficult. The patient was instructed to empty the bladder and bend the lower limbs on both sides in the supine position to exercise the pelvic floor muscle in the lithotomy position of the bladder. The patient was instructed to contract the anus first and then the vagina at a frequency of 5 s contraction + 5 s relaxation. The above training methods were repeated, 3 times/day, 30 min/ time. Bladder function could also be restored by lithotomy rehabilitation exercise in patients with dysuria. Patients could sit on a stool with their feet crossed, and then gradually raised the hip and reset, 20 sets/ times, 3 times/day. If patients had poor urination and interrupted behavior, they could also exercise through the above bladder function exercise method. This training mainly focused on standing, sitting, and supine positions.

5. Early rehabilitation guidance. After operation, according to the objective conditions of patients, patients should be encouraged to do independent activities and gradually increase the amount of activity, which could prevent venous thrombosis, prevent lung infection, and promote intestinal peristalsis. Two hours after surgery, patients who were awake could drink 5 mL of water, and after 10 minutes of observation without discomfort, drink 20 mL, and then drink 50 mL every 1 h. The sugar-free gum could be chewed to promote anal exhaust. Postoperative diet could be gradually from liquid to semi-liquid, until the general diet. Patients were advised to increase their digestible diet and intake of vegetables and fruits. Chronic cough and constipation could be symptomatic treatment. The patient was

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advised not to squat, weight bearing, cough, and other positions with increased abdominal pressure. Patients generally rested for 3 months after surgery, avoided heavy physical labor for half a year, and paid attention to perineal health. Bathing and sexual activity were forbidden within 90 days after surgery. The patient was asked to return to the hospital 30 d after surgery to review the wound healing, and returned to the hospital regularly according to the doctor's advice. After discharge, the patient was followed up by telephone for 1 year to monitor whether the pelvic floor muscle exercise continued.

6. Routine clinical rehabilitation nursing. If the patient had severe pain, the patient could be instructed to take a semi-decumbent position and followed the doctor's advice for analgesic pump drug infusion. Or patients with perineal edema could be treated with 50% magnesium sulfate wet hot compress and physiotherapy. Bladder function training instruction was implemented before removal of urinary tube. During the day, the catheter was closed and opened once for 2-4 h to guide the patient to hold urine and exercise the bladder muscle. The catheter could be open when the bladder was full, and could remain open overnight. The catheter was removed after 48 hours of exercise. After the patient urinated on his own, the residual urine was measured by four-dimensional color ultrasound, and the recovery of bladder function was observed.

Inspection method

GEVoluson E10 color Doppler ultrasound diagnostic instrument and its matching cathode-type probe were used for pelvic floor ultrasound examination in both groups at 30 d after surgery. Before the examination, the patients were informed of precautions and instructed to empty their urine and urine as much as possible. The coupler was applied on the vaginal probe and disposable condom was put on. The patient was instructed to take the vesicolithiasis position, keep the hip joint in the state of abductive flexion, and adjust the appropriate direction after close to the labia minora on the lower margin of the pubic union. The angle between the lower margin of the pubic symphysis and the central axis of the pubic symphysis is ensured to be 45°, and the posterior angle of the vesicourethra was accurately measured, the angle of urethral tilt, the distance from the external cervical opening to the pubic symphysis, and the distance from the bladder neck to the pubic symphysis under resting and maximum Valsalva conditions. A 4-dimensional exploration was performed with a RAB4-8L volumetric probe (6~12 MHz). The probe was placed close to the labia majora with a swing angle of 85° and a maximum scanning angle of 195°. The median sagittal section consisting of anorectal angle, symphysis pubis, and urethra was observed with the horizontal line of the posterior lower margin of symphysis pubis as a reference mark. Four-dimensional images under resting and maximum Valsalva conditions were collected, image data was transmitted to ultrasonic imaging workstation, and processed with the 4D View off-machine software. Urethral rotation angle (difference between urethral tilt angle at rest and maximum Valsalva conditions) and bladder neck movement (difference between bladder neck position at rest and maximum Valsalva conditions) were measured during anal retraction. At the same time, the distance from the external cervix to the symphysis pubis, the distance from the bladder neck to the symphysis pubis, the posterior angle of the vesicourethra (the angle formed between the posterior wall of the proximal urethra and the bladder triangle), the angle of urethral tilt and the angle of the levator muscle were measured under resting and maximum Valsalva conditions.

Observation indicators

1. The difference of urethral rotation angle and bladder neck movement between the two groups was compared.
2. The differences between the two groups were compared under the resting and maximum Val-salva conditions in the distance from the external cervix to the symphysis pubis, the distance from the bladder neck to the symphysis pubis, the posterior angle of the vesicourethra, the angle of urethral tilt, and the angle of the levator muscle.
3. The pelvic floor function scores of the two groups were compared. The pelvic floor function score was compared according to the self-designed scale, including gynecological examination, POPQ score, manual examination muscle strength examination, tension examination, urodynamic examination. On a percentage basis, the function deteriorated as the score increases.
4. The distance of pelvic prolapse between the two groups was compared, including the distance of anterior pelvic bulge and the angle of urethral transfer.
5. The incidence of pelvic dysfunction before surgery was compared between the two groups. (a) The bladder located at or below the reference line of the pubic bone of the bladder neck was cystocele. (b) The degree of cystocele in the maximum Valsalva state was divided into the following types according to Green: Type I: UA ≥ 140°, URA < 45°; Type II: UA ≥ 140°, URA ≥ 45°; Type III: UA < 140°, URA ≥ 45°.

Statistical analysis

The data were analyzed by SPSS21.0, the measurement data were expressed as x±s, and the comparison results were tested by t. The counting data were expressed as percentage, and the results of comparison between groups were tested by chi-square test. If $P < 0.05$, the difference was statistically significant.

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RESULTS

Comparison of urethral rotation angle and bladder neck movement between two groups

During anal retraction, the urethral rotation angle in the OG was significantly higher than that in the CG ($P < 0.05$), and the bladder neck mobility in the OG was also greater than that in the CG ($P < 0.05$), as shown in figure 1.

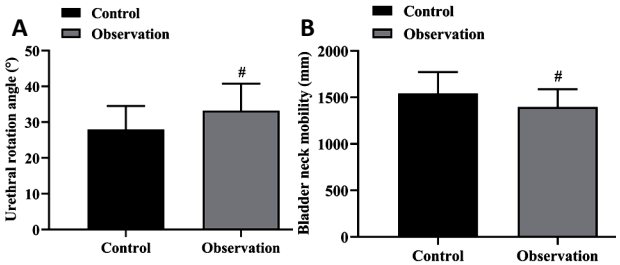

Figure 1. Comparison of urethral rotation angle and bladder neck movement between the two groups. **(A)** the urethral rotation angle in the OG and CG groups during anal retraction. **(B)** The bladder neck mobility in the OG and CG groups during anal retraction. #p < 0.05, compared with the control group.

Comparison of ultrasound parameters under resting conditions between the two groups

Under resting conditions, there were no significant differences in the distance from external cervix to symphysis pubis, the distance from bladder neck to symphysis pubis, the posterior angle of vesicourethra, the angle of urethral tilt and the angle of the levator muscle between the two groups ($P > 0.05$, figure 2).

Comparison of ultrasonic parameters in two groups under maximum Valsalva conditions

Under maximum Valsalva condition, the distance from external cervix to symphysis pubis and the distance from bladder neck to symphysis pubis in the OG were significantly greater than those in the CG, and the posterior angle of vesicourethra, the angle of urethral tilt and the angle of the levator muscle in the OG were significantly lower than those in CG ($P < 0.01$, figure 3).

Incidence of pelvic dysfunction before operation between the two groups

There was no significant difference in the incidence of infundification of internal urethral orifice between the two groups ($P > 0.05$). The incidence of cystocele in the CG was significantly higher than that in the OG ($P < 0.05$, table 1). Among them, there was a statistically significant difference in the incidence of Green type II and type III cystocele ($P < 0.05$), as shown in table 2.

Comparison of pelvic prolapse distance between two groups

The distance of anterior pelvic bulging in the OG was longer than that in the CG, and the angle of urethral metastasis in the OG was greater than that in CG ($P < 0.05$, figure 4).

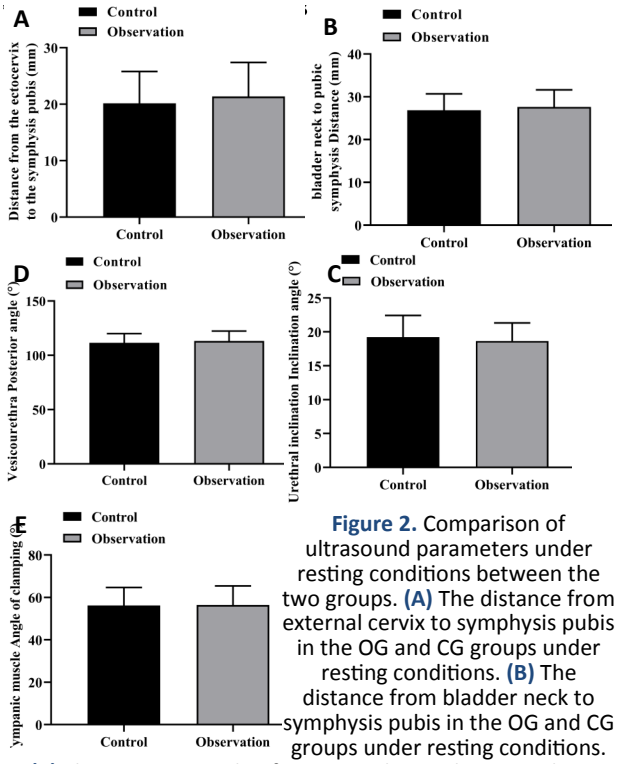

Figure 2. Comparison of ultrasound parameters under resting conditions between the two groups. **(A)** The distance from external cervix to symphysis pubis in the OG and CG groups under resting conditions. **(B)** The distance from bladder neck to symphysis pubis in the OG and CG groups under resting conditions. **(C)** The posterior angle of vesicourethra in the OG and CG groups under resting conditions. **(D)** The angle of urethral tilt in the OG and CG groups under resting conditions. **(E)** The angle of the levator muscle in the OG and CG groups under resting conditions. #p < 0.05, compared with the control group.

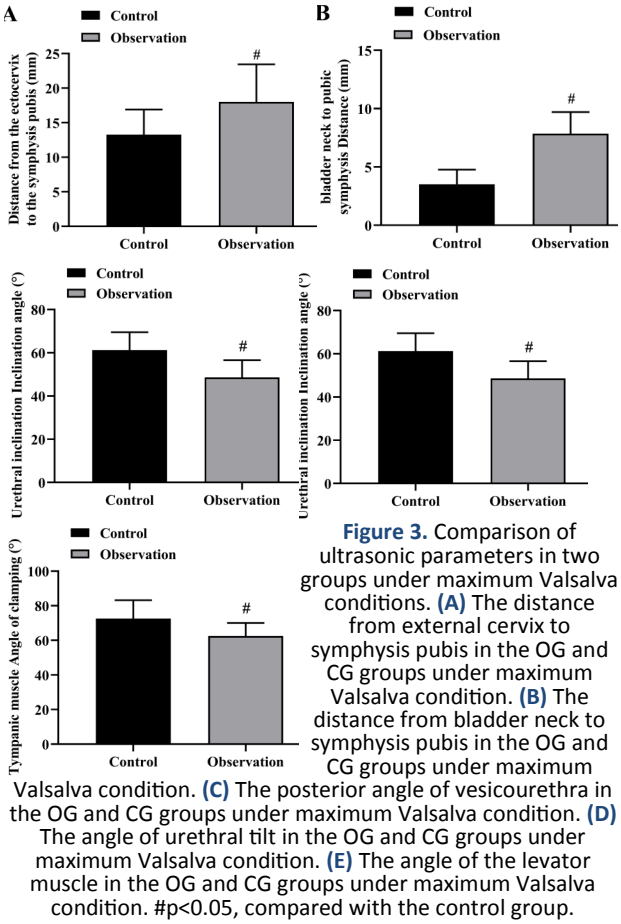

Figure 3. Comparison of ultrasonic parameters in two groups under maximum Valsalva conditions. **(A)** The distance from external cervix to symphysis pubis in the OG and CG groups under maximum Valsalva condition. **(B)** The distance from bladder neck to symphysis pubis in the OG and CG groups under maximum Valsalva condition. **(C)** The posterior angle of vesicourethra in the OG and CG groups under maximum Valsalva condition. **(D)** The angle of urethral tilt in the OG and CG groups under maximum Valsalva condition. **(E)** The angle of the levator muscle in the OG and CG groups under maximum Valsalva condition. #p<0.05, compared with the control group.

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Table 1. Incidence of pelvic dysfunction before operation in both groups.

Groups	Cases	Infundibulation of urethra	Cystocele	Pelvic dysfunction rate (%)
Observation group	60	5 (8.33)	8 (13.33)	21.66
Control group	60	7 (11.67)	47 (78.33)	90.00
X^2		3.031	40.078	41.738
P		0.243	<0.001	<0.001

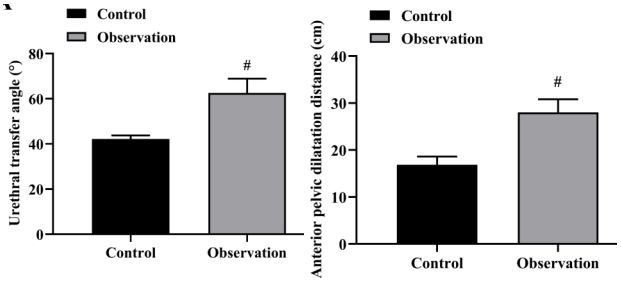

Figure 4. Comparison of pelvic prolapse distance between two groups. **(A)** The distance of anterior pelvic bulging in the OG and CG groups. **(B)** The angle of urethral metastasis in the OG and CG groups. #p < 0.05, compared with the control group.

DISCUTION

Obstetrics and gynecology is the key surgical department of the hospital. The application of good nursing measures can not only ensure the smooth operation, but also promote the postoperative recovery of patients, which plays a very important role in easing the relationship between doctors and patients. Currently, hysterectomy is an important method commonly used in obstetrics and gynecology to treat diseases such as endometrial hyperplasia and uterine fibroids. Due to the remarkable therapeutic effect, hysterectomy is widely used. However, due to the influence of surgical stress, mental pressure and other factors, the surgical effect and postoperative recovery may be affected [14,15]. Research data have revealed that the complication rate of hysterectomy is about 20% [16]. Therefore, in addition to active surgical treatment, it is of great importance to give patients scientific, high-quality and careful nursing measures in the perioperative period.

4D ultrasound adds a time axis on the basis of 3D ultrasound, further improving the dynamic, stereoscopics and graphic properties of images, helping medical staff to more accurately observe the subject's bladder movement, bladder prolapse, hiatus dilation, urethral funnel and other abnormalities. This diagnosis method will not cause any form of damage to the subject's body, which is easy to be accepted by the client and has a wider application range [11,17,18]. 4D ultrasound can accurately display the patient's quiesce and tension BSD, and then the medical staff can guide the patient to breathe correctly, observe the bladder neck movement, urethral bladder rotation angle, and urethral bladder back angle under different conditions, and present the pathological conditions in the form of video through the timeline and upload them to the computer system. The diagnostic physician can accurately evaluate the client's anterior pelvic function by combining multiple test results [19]. In recent years, our hospital has applied the four-dimensional ultrasound technology and achieved good results. Therefore, this study used 4D ultrasound technology to explore the effect of rapid rehabilitation nursing on pelvic floor function in patients after hysterectomy

The results of this study showed that during anal retraction, the urethral rotation Angle and bladder neck movement in the OG were significantly higher than those in the CG. The reason for these may be that hysterectomy is a traumatic operation, which can cause traumatic damage to the nerve fascia surrounding the abdominal cavity of patients, and change the structure of the pelvic floor, resulting in changes in the position of the bladder and rectum, vaginal relaxation, urinary incontinence and other symptoms, which have a greater impact on the physiological function of patients. In addition, under the maximum Valsalva condition, the distance from the external cervix to the symphysis pubis and the distance from the bladder neck to the symphysis pubis in the OG were significantly greater than those in the CG, and the posterior angle of the vesicourethra, the angle of urethral tilt and the angle of the levator muscle in the OG were significantly lower than those in the CG, suggesting that when patients were placed in the supine position with knees bent under the Valsalva condition, The comparison of pelvic floor parameters of patients recovered by different nursing methods showed significant statistical difference, which indirectly reflected that 4D ultrasound was beneficial to accurately identify pelvic floor morphology, structure and function. Under 4D ultrasound imaging, it was found that the pelvic floor related indexes of patients in the CG and the OG were not completely the same, and there were some differences, which could provide guidance for the formulation of pelvic floor muscle rehabilitation treatment plan for patients after hysterectomy.

Rapid rehabilitation nursing can help patients master the skills and key points of pelvic floor muscle function exercise by carrying out the pelvic floor muscle function exercise program and providing guidance before surgery, while the implementation of pelvic floor muscle function exercise after surgery can help patients improve the state of pelvic floor function, optimize pelvic floor function and promote patients' rehabilitation [7,20]. At the same time, electrical stimulation therapy is carried out in the physiotherapy intervention stage, through different frequency bands of current stimulation can strengthen the physiological ability of the pelvic

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muscle group and enhance the muscle support tension of the pelvic organ, which is of great value for improving the physiological function of the pelvic muscle group of patients, and thus accelerate the postoperative rehabilitation process of patients. Therefore, it is of great clinical significance to strengthen the functional rehabilitation of pelvic floor muscle after operation.

CONCLUSION

4D ultrasound is conducive to accurately identifying the morphological structure and function of the pelvic floor in patients with hysterectomy, and provides guidance for the formulation of the rehabilitation treatment plan for the pelvic floor muscle of the patients.

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Ethical consideration: All patients signed a documented, voluntarily informed consent form. All methods were carried out in compliance with the Helsinki Declaration criteria, and this study was authorized by our institution's Ethics Committee (SDLL-12(A)-L).

Author contribution: Z-H. H. conceived and designed the experiments. J. Z. contributed significantly to the experiments and arranging data. L.H. and J.Z. performed data analyses. Z-H. H. wrote the draft manuscript. Z-H. H. and J.Z. revised the manuscript. All authors read and approved the final manuscript.

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