Comparison of magnetic resonance defecography with pelvic floor ultrasound and vaginal inspection in the urogynecological diagnosis of pelvic floor dysfunction

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Abstract

Introduction: The aim of the study is to evaluate the use of pelvic floor (PF) ultrasound and vaginal inspection in the quantification of prolapse and to compare findings with magnetic resonance (MR) defecography in a blind study.

Materials and Methods: Data from the dynamic MR imaging (MRI) defecography were compared and evaluated with PF ultrasound and vaginal examinations (VEs) in 45 female patients aged from 52 to 94, between the years 2016 and 2018. With regard to the pelvic organ prolapse (POP), MRI defecography revealed changes in the mid-pubic line. According to Bump et al., the bladder neck descent, degree of the retrosvesical angle, and urethral rotation were measured to identify anterior vaginal wall descent extent. POP quantification (POP-Q) was determined by VE.

Results: With regard to the presence of a Grade II prolapse in the anterior and posterior vaginal walls, the intraclass correlation coefficient (ICC) showed a significant correspondence (ICC = 0.85, 95% confidence interval [CI] 0.67–0.92), (ICC = 0.77, 95% CI 0.63–0.88). With regard to the accordance in the ICC between the VE results (POP-Q) and the dynamic MRI defecography, there was an excellent match in high Grade III and IV in all compartments. In addition to bladder neck funneling, hypermobility of the urethra was identified by ultrasound in seven women (n 7/45, 15.5%).

Conclusion: Despite different reference systems in the quantification of results, both the methods allow for a similarly successful separate assessment of all three compartments. The agreement between methods and interobserver agreement for the clinical diagnosis is good. Based on the results, we would recommend the supplemental dynamic PF ultrasound for part of the noninvasive examination for the diagnosis of POP.

Keywords: Dynamic magnetic resonance defecography, pelvic floor dysfunction, pelvic floor ultrasonography, pelvic organ prolapse quantification
The dynamic pelvic floor ultrasound and vaginal examination provides excellent results for assessing pelvic floor disorders. MRI defecography should be applied to specific questions.

**INTRODUCTION**

Pelvic floor disorders (PFDs) constitute a spectrum of pathologies and account for a variety of clinical presentations and syndromes. PFD symptoms are manifold and include incontinence (fecal and urinary), pelvic pain, sexual dysfunction, constipation, and urogenital prolapse. Breaks in the connective tissue and damage to female anatomical structures of the PF, which stabilize the pelvic organs, cause a descent of the pelvic organs.\(^{[1]}\) Currently, the prevalence of PFD in women over 40 years is between 30% and 50%.\(^{[2]}\) Due to demographic changes, we will be confronted with a further increase in the incidence of genital descensus and/or incontinence in the future.\(^{[3]}\) It is estimated that symptomatic pelvic organ prolapse (POP) cases will have increased by 46% in the USA by 2050.\(^{[4]}\) Due to the anatomical–functional complexity of the female PF, a global assessment showing all three compartments of the pelvis is important for the therapy. This vaginal examination (VE) cannot provide data for all internal organs and structures of the PF (fascia, ligaments, and muscles). Essential for the diagnosis of the descent is a special urogynecological examination, with a classification of severity according to the POP-Q quantification.\(^{[5,6]}\) In recent years, the importance of PF ultrasound has increased over that of other imaging modalities (magnetic resonance [MR] defecography).\(^{[7]}\) Integrated total pelvic ultrasound (endoanal, transvaginal, and transperineal) allows for dynamic multicompartmental PF assessment with the simultaneous assessment of each compartment.\(^{[8-10]}\) The aim of this work was the evaluation of the accordance of dynamic MR defecography and established VE (POP-Q), in combination with PF ultrasound in the quantification of prolapse.

**PATIENTS AND METHODS**

This study enrolled 45 consecutive female patients from our consultation hour, aged from 52 to 94 (mean 76.72) between 2015 and 2018, complaining of complex and different PFDs. Inclusion criteria were that of women with a combined prolapse (tow compartments) prolapse stage ≥2, according to POP-Q. Exclusion criteria were an isolated descent, Stage 1, and patients with tumors in the rectum or cervix. Each patient was informed of the planned examinations in a preliminary talk and gave their written consent in advance.

**Pelvic floor ultrasound/vaginal examinations**

Each patient received comprehensive diagnostics using PF ultrasound, VE, urodynamic, and diagnostic cystoscopy. These examinations were performed by an experienced urologist with over 3 years of specialist status. In an orienting VE, the severity of the descent was recorded according to the POP-Q classification.\(^{[5,6]}\) Furthermore, the evaluation of all three compartments of the pelvis in three scan planes (sagittal, horizontal, and transversal) was performed with PF ultrasound as a two-dimensional diagnostic method (BK Ultrasound Systems, transducers with 3–5MHz for transperineal and 5–10 MHz for transvaginal and abdominal) at a radiation angle of ≥90\(^{\circ}\). The ultrasound examination was carried out with a bladder filling of approximately 250 ml and in two functional states: at rest and during pressure. The bladder neck descent, degree of the retrovesical angle, and urethral rotation were measured to identify the anterior vaginal wall descent extent. The motion of the bladder neck may comprise a posterior–inferior (rotational) descent with the lower border of the symphysis pubis as the pivot during stress or a sliding (vertical) descent along the urethral axis.\(^{[11,12]}\) As a reproducible anatomical reference structure, the lower symphysis border was chosen.

The posterior urethrovessical angle (angle β) and the position of the internal meatus urethrae internus (MUI), according to Pregazzi et al., were used for the ultrasound quantification of prolapse, and the UI was chosen and recorded\(^{[13]}\) [Figure 1]. The position of the bladder neck was defined as the angle between the bladder neck-symphysis line and the midline of the symphysis pubis. A significant anterior, apical, posterior vaginal wall prolapse was diagnosed on ultrasound if any part of the bladder reached ≥10 mm below the symphysis pubis. In the VE, prolapses in different compartments of the pelvis and the presence of enterocele and paravaginal prolapses were assessed.

For all the women, the severity of the prolapse was determined by the POP-Q classification. When performing
transabdominal US (transducers 5–10 MHz) on patients with paravaginal defects and nulliparous women, we looked at the appearance of the bladder base in the axial view, with the premise that a paravaginal defect would make the bladder base drop on the side of the defect. The loss of paravaginal support (“tenting”) in the axial plane was taken to signify paravaginal defects.

Dynamic magnetic resonance defecography
The dynamic MR defecography (Ingenia 1.5 Tesla MR-System) was performed on a closed device. After filling the rectum with ultrasound gel (200 ml), the small pelvis was examined in a lying position with a T2-weighted sequence in the sagittal, coronal, and transverse planes. MR defecography in the supine position with T2-weighted fast spin-echo sequence in axial sagittal position, MR imaging (MRI) in the midsagittal position, with T2-weighted half-Fourier acquisition single-shot turbo spin-echo sequence at rest, during Valsalva maneuver, true fast imaging with steady-state precession (FISP) imaging during squeezing, and finally defecography images were obtained. To quantify the severity of prolapse in MRI defecography, the midpubic line (MPL) according to Bump et al. as a correlate to the hymenal ring was indicated. This forms the basis for the clinical staging of PF prolapse using the POP-Q system. The distance of the organ vertical to the reference line was measured. To standardize measurement parameters across the evaluation, modalities were defined as follows:

- MPL: The MPL corresponds to a virtual line along the longitudinal axis of the pubis and corresponds to the level of hymen remnants (POP-Q) [Figure 2]
- Hymen: The point at which the MPL intersects with the center of the longitudinal axis of the vagina
- Ba, Bp: The distance of the upper anterior or posterior vaginal wall prolapse from the hymen
- C: The distance of the cervix or vaginal cuff from the hymen.

The reference lines of measurement for the prolapse of the anterior vaginal wall, cervix or cuff, and posterior vaginal wall were recorded in centimeters by calculating the difference between the coordinates of maximal prolapse and the hymen. The collected reference lines, according to Bump et al., were then allocated, whether the extent of the pathologic finding was slightly (I°) – total (IV°). Finally, the results of the examination were evaluated by an experienced radiologist with more than 3 years of specialist status.

By means of MR defecography and VE with PF ultrasound, two independently blinded examiners assessed the change or lowering of the pelvic organs.

Statistical data evaluation
A regression analysis was performed on the lowering below the MPL of the posterior angle (β). For the comparison of metric variables, interobserver variability was used, with a calculation of the intraclass correlation coefficient (ICC) and the 95% confidence interval (95% CI) using IBM SPSS® Statistics 18, (USA).

RESULTS
The mean age of the study population of the 45 women was 74 (52–94) years, at the time of examination. The body mass index for women was between 19 and 41 kg/m² (median: 34.8 kg/m²). On average, the patients had 2.23 normal vaginal deliveries with a minimum of 0 and a maximum of 6. For cesarean sections, the average number of deliveries was 2.56 per woman. Twenty-four of 45 women (53%) had only one vaginal delivery and 13 (28%) had a cesarean section. Eight (17) had vaginal deliveries and a cesarean section. With regard to the previous operations in the pelvis, 26 women (57.7%) had previously undergone a hysterectomy. In terms of bladder dysfunction, 8 women (17.7%) had mixed urinary incontinence, thirty (66.6%) had urge incontinence, thirty (66.6%) had urge incontinence, and 27 (60%) had nocturia at least once. None of the women had fecal incontinence. In contrast to bladder dysfunction, 23 of the 45 patients (51.1%) reported a urinary retention. Of the 19 women (42.2%) who complained about defecatory dysfunction and constipation, 17 of the 19 women (89%) had to be treated regularly with laxatives. Thirty-three women (73.3%) reported a foreign-body sensation in the vagina and 26 (57.7%) reported pain in the abdomen. During the clinical evaluation, 38 patients (84.4%) had received a cystometric. In 18 of 45 (47%), the study showed detrusor overactivity. The results of the clinical evaluation are shown in Table 1.

Anterior compartment
The VE revealed Stage II anterior vaginal wall prolapse in 29 of 45 patients (64.4%), Stage III anterior vaginal wall

Figure 2: Quantification of the degree prolapse of pelvic organs according to Bump RC, et al. Am J Obstet Gynecol 1996;175:10-7. *Midpubic line = MPL, corresponds to the plane of residues of hymen (pelvic organ prolapse quantification)
prolapse in 7 of 35 patients (15.5%), and Stage IV in 7 of 35 patients (15.5%). For further verification of the clinical findings, PF ultrasound was performed, with evidence of rotational cystocele in 27 of 45 patients (60%), and a vertical cystocele in 16 of 45 patients (35.5%). In the evaluation of the sonographic image data, two patients had to be excluded from the analysis. This was because the symphysis was outside the image area and because of poor image quality. Hypermobility of the urethra with funnelling of the bladder neck was noted in 7 of the 45 patients (15.5%). Bilateral lateral defect with PF tear at the arcus tendineus fascia pelvis was diagnosed by PF ultrasound in 2 of 45 patients (4.4%).

In conventional ultrasound, the posterior urethrovesical angle (angle $\beta$) at rest averaged 128.8° $\pm$16.5°, with a maximum of 135° and a minimum of 125°. During pressing, the posterior urethrovesical angle (angle $\beta$) averaged 139.5° $\pm$16.9°. The maximum value was 152° and the lowest value was 114°. At rest, the location of the meatus urethrae internus (MUI) averaged 2.54 cm, with a maximum of 3.1 cm and a minimum of 1.9 cm. The negative descent of the bladder below the symphysis pubis was −5.8 mm (mean, +12 mm; standard deviation [SD], 10 mm).

The results of the ultrasound examinations are shown in Tables 2 and 3.

The second observer diagnosed a Stage II anterior vaginal wall prolapse in 26 of the 45 women (57.7%) in MR defecography, anterior vaginal wall prolapse Stage III in 9 (20%), and 8 (17.7%) at Grade IV.

With regard to the presence of a Stage II anterior vaginal wall prolapse, there was a significant correlation between dynamic MRI defecography and the VE results (International Continence Society [ICS] POP-Q) in the ICC (ICC = 0.85, 95% CI 0.67–0.92) [Table 4]. A significant agreement was found for anterior vaginal wall prolapse Stage III and IV (ICC = 0.90, 95% CI 0.79–0.95), respectively (ICC = 0.91, 95% CI 0.82–0.95) [Table 4].

**Apical compartment**

The total vaginal length averaged 8.7 cm (median: 9.1 cm), with a minimum of 6 cm and a maximum of 11 cm. At the time of examination, 26/45 (57.7%) women were hysterectomized. In the evaluation of the apical compartment by VE, the first examiner found an apical prolapse Stage I in 4 out 19 patients (8.8%), apical prolapse Stage III in 6 (31.5%), and Stage IV in 4 (21.05%). There was no descent in 26.3% ($n = 5$) of the cases.

### Table 1: Characteristics of included studies investigating diagnostic accuracy of elements of patient history or physical evaluation of patients with descent ($n=45$) No. Pts. (%)

| Clinical evaluation of patients with descent ($n=45$) | No. Pts. (%) |
|----------------------------------------------------|--------------|
| Median age (minimum-maximum)                        | 74 (52-94)   |
| BMI (kg/m$^2$), median (minimum-maximum)            | 34.8 (19-41) |
| Vaginal deliveries (median)                         | 2.23         |
| Cesarean section (median)                           | 2.56         |
| Hysterectomy, n (%)                                 | 26/45 (57.77) |
| Voiding dysfunction, n (%)                          | 23/45 (51.1) |
| Anorectal dysfunction, n (%)                        | 19/45 (51.1) |
| Mixed urinary incontinence, n (%)                   | 8/45 (17.7)  |
| Urge incontinence, n (%)                            | 30/45 (66.6) |
| Nocturia, n (%)                                     | 30/45 (60)   |
| Urinary retention, n (%)                            | 23/45 (51.1) |
| Detrusor overactivity, n (%)                        | 18/45 (40)   |
| Regular use of laxatives, n (%)                     | 17/45 (37.7) |

BMI1: Body mass index

### Table 2: Parameter of the pelvic floor ultrasound: Posterior urethrovesical angle and meatus urethrae internus

| Reference line | MUI (cm) | $\beta$ angle (°) | MUI (cm) | $\beta$ angle (°) |
|----------------|----------|-------------------|----------|-------------------|
| Minimum        | 1.9      | 135               | -2.35    | 152               |
| Maximum        | 3.1      | 125               | 2.2      | 114               |
| Average        | 2.54     | 128.8$\pm$16.5    | 0.85     | 139.5$\pm$16.9    |
| Median         | 2.62     | 0.96              |          |                   |

MUI: Meatus urethrae internus

### Table 3: Cutoffs for POP by PF ultrasound assessment and by the ICS POP-Q and correlation between quantification (ICS POP-Q/ultrasound quantification of anterior vaginal wall prolapse of uterine or vault descent and of posterior vaginal wall prolapse)

| Pelvic organ | Pelvic floor ultrasound | Clinical stage ICS-POP-Q | $r$ |
|--------------|-------------------------|-------------------------|-----|
| Cystocele    | -5.8 mm (mean, +12 mm; SD 10 mm) | Bladder−11 mm=Ba−0.56 | 0.77 |
|              | +10 mm (mean+30 mm; SD 13 mm) | Uterus 13 mm=C-5, 2 cm | 0.81 |
| Rectocele    | -15 mm (mean=10 mm; SD 15 mm) | Rectum−18 mm=BP-0.73 | 0.68 |

POP-P: Pelvic organ prolapse quantification, SD: Standard deviation, Ba: Most distal position of the remaining upper anterior vaginal wall, Bp: Most distal position of the remaining upper posterior vaginal wall, C: Most distal edge of cervix, ICS: International Continence Society: A negative value signifies a position below the posterior inferior margin of the symphysis pubis on ultrasound or above the hymen on ICS POP-Q assessment.

In the PF ultrasound, a partial-to-maximum total prolapse of the uterus was documented in 12 (63.1%) patients. The negative descent of uterine below the symphysis pubis was +10 mm (mean, +30 mm; SD, 13 mm) [Table 3]. We also found vaginal vault prolapse in one patient (3.8%) in VE and in PF ultrasound after hysterectomy.

The second examiner did not record any prolapse uterine in MR defecography in 26.3% of the cases ($n = 5$). A Stage I apical prolapse was found in two patients (10.5%) and a Stage II prolapse was also found in two patients (10.5%). A significant Stage III apical prolapse was diagnosed in 5 patients (26.31%) and Stage IV in 4 patients (21.05%).
With regard to the accordance in the ICC between the VE results and the dynamic MRI defecography, there was a significant accordance in the severity Stage I (ICC = 0.77, 95% CI 0.63–0.88). In high-grade apical prolapse Stages III and IV, there was a high level of accordance (ICC = 0.87, 95% CI 0.75–0.93 and ICC = 1) between the two methods [Table 4].

**Correlation between international continence society pelvic organ prolapse quantification and pelvic floor ultrasound of prolapse**

We found a good correlation between the ICS POP-Q system and ultrasound quantification of prolapse. The position of the anterior compartment under Valsalva maneuver correlated well ($r = 0.77$) with negative descent of the bladder below the symphysis pubis $-11$ mm. Apical descent correlated excellent ($r = 0.81$) with the negative descent of the uterus below the symphysis pubis $+10$ mm. The posterior compartment correlation was slight to good ($r = 0.68$), with a negative descent of rectal ampulla below the symphysis pubis $-15$ mm [Table 4].

**DISCUSSION**

Due to the multifactorial etiology of PF dysfunction combined with disorders of the pelvic organs, the dynamic imaging of each pelvic organ is crucial. Many trials report different reliable reference lines for assessing a reduction in MR defecography; however, there are no comparative studies that directly compare VE and PF ultrasound with MR defecography (using the MPL line) to evaluate all three compartments.

A study published by Fauconnier et al. with 47 patients with PFD shows poor accordance in dynamic MRI when compared to VE.\[17\]

The variability in the study’s results may be due to the different reference lines used in the comparison of MR defecography with VE: While Cortes et al. showed a low correlation between clinical and MRI findings in the assessment of a prolapse in 51 patients (agreement in 21 cases, 41.1%),\[18\] Lakeman et al. arrive at a contrasting result in their prospective analysis of 30 patients.\[19\] Arian et al.\[20\] demonstrated a moderate-to-good level of agreement (49%–80%) between MRI and POP-Q examination using the pubococygeal line and H-line as reference lines for the detection of bladder neck and urethral prolapse.

In terms of posterior vaginal wall descent, ICC showed a significant correspondence between VE and dynamic MR defecography in severity Stage II (ICC = 0.788, 95% CI 0.60–0.89). Regarding a Stage III posterior vaginal wall prolapse, there was a high level of accordance between both the observers (ICC = 0.92, 95% CI 0.85–0.96) [Table 4].

Despite the different frames of reference, we found good inter-observer correlation in our analysis of the evaluation of POP-Q in VE and MRI defecography. In women with mild POP ≤ II, the correlation of dynamic MRI was comparable to the total VE, while this correlation was highly significant in women with at least stages III and IV. The correlation between MRI defecography and POP-Q is shown in Table 4, with correlation coefficients between both the examiners.

Although there is still no generally accepted standardization for PF ultrasound, with regard to the lowering severity, the layering of the reference lines, the course of the examination and the evaluation, and the supplementary PF ultrasound in our analysis have shown an excellent representation of all the three compartments, especially in the evaluation of the posterior compartment (enterocele), which is not present in the VE. The PF ultrasound showed that the results of the examination of the pelvic organs

### Table 4: Intraclass correlation coefficient of all three compartments in vaginal inspection/pelvic floor ultrasound with magnetic resonance defecography

| Pelvic organ prolapse | ICC | 95% CI |
|-----------------------|-----|--------|
| Anterior compartment   | 0.85| 0.67-0.92 |
| Anterior wall descent II° | 0.90 | 0.79-0.95 |
| Anterior wall prolapse IV° | 0.91 | 0.82-0.95 |
| Posterior compartment  | 0.78| 0.60-0.89 |
| Posterior wall descent II° | 0.92 | 0.85-0.96 |
| Posterior wall prolapse III° | 0.77 | 0.63-0.88 |
| Apical compartment     | 0.87| 0.75-0.93 |
| Apical wall descent II° | 1   |        |
| Apical wall prolapse III° | 0.92 | 0.85-0.96 |
| Apical wall prolapse IV° | 1   |        |

1 = 100% accordance
as well as the size of the posterior urethrovesical angle, showing the hypermobility of the urethra and the funneling of the bladder neck, are reproducible.

Our analysis shows that the accompanying PF ultrasound for VE also offers the possibility of dynamic imaging for all three compartments. PF ultrasound complements VE findings in determining the nature and severity of the condition and in identifying different underlying anatomical abnormalities that are impossible to distinguish clinically, as they result in similar changes to surface anatomy. In addition, it is increasingly clear that the assessment of levator ani morphology and functional anatomy should form an integral part of the POP assessment, preferably by imaging. This method is noninvasive and by far the easiest, cheapest, and most widely available technique for PF imaging at present. ultrasound has several important advantages over other imaging modalities, including the absence of ionizing radiation, relative ease of use, minimal discomfort, cost-effectiveness, relatively short time required, and wide availability.

Limitations

Before offering conclusions, we would like to draw the reader's attention to the study's limitations. One such limitation of the present work was the relatively small study collective (n = 45) and another was the study design at a center with only one examiner per method, both of which have prevented us from drawing any definitive conclusions. It should be noted, however, that the size of the study group in the comparative studies was not any higher.

CONCLUSION

Despite two different reference systems, both the lines (mid-pubic and POP-Q) show similarly good reliability values in terms of their reproducibility. Supplementary dynamic PF ultrasound allows the assessment of complex PFD. In addition, it is a simple procedure that enables a precise and sensitive assessment of findings with less invasiveness, lack of radiation exposure, and easy reproducibility. This method, therefore, should be used in the diagnosis of PFD. The role of PF ultrasound in the dynamic imaging of all pelvic organs should be examined in a large multicenter study with more patient numbers to arrive at a final outcome with more definitive conclusions.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. DeLancey JO. The anatomy of the pelvic floor. Curr Opin Obstet Gynecol 1994;6:313-6.
2. Lawrence JM, Lukacz ES, Nager CW, Hsu JW, Luber KM. Prevalence and co-occurrence of pelvic floor disorders in community-dwelling women. Obstet Gynecol 2008;111:678-85.
3. Nygaard I, Barber MD, Burgio KL, Kenton K, Meikle S, Schaffer J, et al. Prevalence of symptomatic pelvic floor disorders in US women. JAMA 2008;300:1311-6.
4. Wu JM, Hendley AF, Fulton RG, Myers ER. Forecasting the prevalence of pelvic floor disorders in U.S. Women: 2010 to 2050. Obstet Gynecol 2009;114:1278-83.
5. Persu C, Chapple CR, Cauvin V, Gutuc S, Geavlete P. Pelvic Organ Prolapse Quantification System (POP-Q) – A new era in pelvic prolapse staging. J Med Life 2011;4:75-81.
6. Pizzoferrato AČ, Nyangoh Timoh K, Fritel X, Zareski E, Bader G, Faouconnier A. Dynamic Magnetic Resonance Imaging and pelvic floor disorders: How and when? Eur J Obstet Gynecol Reprod Biol 2014;181:259-66.
7. Koelbl H, Bernaschek G, Deutinger J. Assessment of female urinary incontinence by introital sonography. J Clin Ultrasound 1990;18:570-4.
8. Santoro GA, Wieczorek AP, Dietz HP, Mellgren A, Sultan AH, Shohrhei SA, et al. State of the art: An integrated approach to pelvic floor ultrasonography. Ultrasound Obstet Gynecol 2011;37:381-96.
9. Wieczorek AP, Stanikiewicz A, Santoro GA, Woźniak MM, Bogusiewicz M, Rechercher T. Pelvic floor disorders: Role of new ultrasonographic techniques. World J Urol 2011;29:615-23.
10. Bump RC, Mattiasson A, Bo K, Brubaker LP, DeLancey JO, Klarskov P, et al. The standardization of terminology of female pelvic organ prolapse and pelvic floor dysfunction. Am J Obstet Gynecol 2002;181:2124-55.
11. Pregazzi R, Sartore A, Bortoli P, Grimaldi E, Troiano L, Guaschino S. Pelvic ultrasonic imaging of pelvic organ prolapse for pelvic floor defaecatory dysfunction: A pictorial review. Br J Radiol 2015;88:20150494.
12. Petri E, Koelbl H, Schaer G. What is the place of ultrasound in urogynecology? A written panel. Int Urogynecol J Pelvic Floor Dysfunct 1999;10:262-73.
13. Santoro GA, Wieczorek AP, Dietz HP, Mellgren A, Sultan AH, Shohrhei SA, et al. State of the art: An integrated approach to pelvic floor ultrasonography. Ultrasound Obstet Gynecol 2011;37:381-96.
14. Ostrzenski A, Osborne NG. Ultrasonography as a screening tool for paravaginal defects in women with stress incontinence: A pilot study. Int Urogynecol J Pelvic Floor Dysfunct 1998;9:195-9.
15. Bump RC, Mattiasson A, Bø K, Brubaker LP, DeLancey JO, Klarskov P, et al. The standardization of terminology of female pelvic organ prolapse and pelvic floor dysfunction. Am J Obstet Gynecol 1996;175:10-7.
16. Comiter CV, Vasavada SP, Barbacan ZL, Gousse AE, Raz S. Grading pelvic prolapse and pelvic floor relaxation using dynamic magnetic resonance imaging. Urology 1999;54:454-7.
17. Faouconnier A, Zareski E, Abichedid J, Bader G, Falissard B, Fritel X. Dynamic magnetic resonance imaging for grading pelvic organ prolapse according to the International Continence Society classification: Which line should be used? Neurourol Urodyn 2008;27:191-7.
18. Cortes E, Reid WM, Singh K, Berger L. Clinical examination and dynamic magnetic resonance imaging in vaginal vault prolapse. Obstet Gynecol 2004;103:41-6.
19. Lakeman MM, Zijlstra FM, Peringa J, Nederveen AJ, Stoker J, Roovers JP. Dynamic magnetic resonance imaging to quantify pelvic organ prolapse: Reliability of assessment and correlation with clinical findings and pelvic floor symptoms. Int Urogynecol J 2012;23:1547-54.
20. Arian A, Zinat G, Deldar P, Esfekhani T, Gity M. Agreement of manual exam (POP-Q) with pelvic MRI in assessment of anterior pelvic organ prolapse. J Radiol 2017;14:38542.