

Commentary

Beyond POP-Q: A Hypothesis-Generating Anatomical-Support Phenotyping Framework for Female Pelvic Floor Disorders

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Female pelvic floor disorders are commonly classified according to the predominant symptom or the compartment involved in prolapse; however, stress urinary incontinence, pelvic organ prolapse, and vaginal laxity frequently coexist in the same patient. The POP-Q system provides a standardized anatomical description of prolapse, but by itself it has limited ability to explain variations in symptoms, disease progression, and postoperative functional outcomes. Recent imaging studies suggest that the morphology of the levator hiatus and pelvic floor support structures contains clinically relevant information beyond organ position alone. On this basis, this Perspective proposes a two-layer anatomical-support functional phenotyping framework. The anatomical layer retains S-POP-Q measurements and records anterior, apical, and posterior compartment prolapse in an A/C/P format. The support functional layer introduces the W value, which assesses the transverse opening of the deep hiatus at rest by transvaginal palpation. The W value is intended to explore whether clinically meaningful hiatal information can be captured through a simple bedside method; the three-finger cutoff is currently only a prespecified research threshold. Using three clinical scenarios defined by combinations of W values and anterior compartment prolapse, this article further proposes testable hypotheses regarding symptoms, disease progression, and treatment response, and outlines a three-stage research pathway encompassing measurement validity, incremental clinical value, and external validation. This framework is not intended to replace POP-Q staging, but rather to add information on support status beyond standardized anatomical documentation, thereby providing a research basis for functional stratification in pelvic floor disorders. This article presents a hypothesis-generating

conceptual framework and does not propose an established clinical classification system or treatment recommendation.

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Introduction: From Anatomical Description to Functional Classification

Female pelvic floor disorders are typically named and managed according to the predominant symptom or the most evident anatomical manifestation, including stress urinary incontinence (SUI), pelvic organ prolapse (POP), vaginal laxity, and voiding dysfunction. This approach is consistent with routine clinical workflows and facilitates subspecialty organization, but it may also divide different functional abnormalities of the same pelvic floor system into separate disease labels. In clinical practice, urinary leakage, vaginal wall bulging, vaginal laxity, and urinary symptoms often coexist in the same patient, and their manifestations may change with childbirth-related injury, aging, tissue degeneration, and therapeutic intervention. Therefore, classification based solely on the chief complaint or the most apparent prolapse compartment may not fully capture the state of pelvic floor dysfunction.

The POP-Q system provides a standardized and reproducible method for the anatomical description of POP and serves as an important foundation for clinical communication and research comparison^{[1][2]}. By recording the positions of the anterior vaginal wall, apex, and posterior vaginal wall relative to the hymenal ring, POP-Q enables different clinical centers to describe prolapse severity in a relatively consistent manner. However, the primary purpose of POP-Q is to document anatomical position; it is not intended to determine etiology or provide functional phenotyping. Patients with identical or similar anatomical stages may have different symptom burdens, continence status, and postoperative outcomes. Reduction of prolapse may also leave pre-existing symptoms unchanged or unmask occult SUI. Studies of the genital hiatus, levator hiatus, and pelvic floor imaging parameters further suggest that structural information related to support status exists beyond organ position alone^{[3][4]}.

These observations do not diminish the value of POP-Q. Rather, they point to an unresolved clinical question: beyond standardized anatomical description, should the functional state of the pelvic floor support system under dynamic load also be recorded? If such information can be measured reliably and

provides independent explanatory value for symptoms, recurrence risk, or treatment outcomes, it may serve as a complementary layer linking anatomical phenotype to clinical decision-making.

Previous studies on the integrated pelvic floor, the definition of pelvic floor stress dysfunction (PFSD), biomechanical anatomy, and dynamic mechanical equilibrium provide theoretical clues for this question^{[5][6]}. On this basis, this article proposes a two-layer anatomical-support phenotyping framework. The anatomical layer uses the Ba, Bp, C, and D points of S-POP-Q and presents anterior, apical, and posterior compartment prolapse in an A/C/P format. The functional layer records the bedside palpation phenotype of the deep hiatus at rest using the W value. The aim of this article is not to declare an established classification standard, but to address three areas that remain insufficiently developed: to record anatomical descent and support status as parallel dimensions; to propose an operational approach for translating hiatal information into bedside assessment; and, on this basis, to formulate a set of falsifiable predictions regarding symptoms, disease progression, and treatment response.

Clinical and Biomechanical Rationale for Functional Classification

The first rationale for proposing functional classification is that the relationship between anatomical findings and clinical outcomes is not simply linear. Classic studies have shown that patients are more likely to experience bulge-related symptoms when prolapse approaches or extends beyond the hymenal ring; however, POP-Q points still do not fully explain interindividual differences in symptom burden^[7]. Similarly, postoperative “success” cannot be defined by anatomical correction alone, but should also incorporate symptom improvement, retreatment, and patient-reported outcomes^[8]. This indicates that anatomical staging can describe the prolapse phenotype, but may not encompass all information that determines patients’ experiences and treatment outcomes.

The second rationale comes from studies of hiatal morphology and levator ani integrity. Levator ani injury, enlargement of the levator hiatus, and widening of the genital hiatus have been associated with the occurrence, severity, or postoperative recurrence of POP^{[9][10][11][12]}. Three-dimensional or four-dimensional transperineal ultrasonography can quantify levator hiatal distension during maximal Valsalva, known as hiatal ballooning^[13]. Longitudinal studies have also shown that a larger genital hiatus is associated with the development or early progression of POP^{[14][15]}. These studies establish two premises relevant to the present Perspective: hiatal morphology can be objectively quantified, and hiatal enlargement is clinically associated with the occurrence, progression, or recurrence of POP. The

translational question raised here is therefore whether the hiatal information revealed by imaging can be converted into a simple and reproducible bedside sign. The W value is an operational attempt to address this question.

The third rationale arises from the interaction between POP and urinary continence. In some patients, SUI may be masked by prolapse and become apparent after anatomical reduction. Prophylactic treatment of occult SUI at the time of prolapse repair may reduce the risk of postoperative urinary incontinence, but may also increase certain adverse events^{[16][17]}. Systematic reviews and long-term follow-up studies of midurethral sling procedures likewise show that, although these procedures are generally effective, some patients experience persistent or recurrent urinary incontinence, complications, and repeat interventions^{[18][19][20][21]}. These findings suggest that continence outcomes are not determined solely by local urethral factors, but may also be influenced by the overall state of pelvic floor support and its postoperative changes. However, current evidence is not sufficient to conclude that hiatal width can predict sling efficacy or directly determine the choice of surgical procedure.

On the basis of these clinical data, our team's studies on the "holistic pelvic floor," the definition of pelvic floor stress dysfunction, biomechanical anatomy, dynamic continence mechanisms, dynamic equilibrium in POP, and finite element modeling provide mechanistic explanations for the relationships among different pelvic floor phenotypes^{[3][5][6][22][23][24]}. These studies conceptualize the pelvic floor as a dynamic mechanical system involving the coordinated participation of muscles, fascia, the vagina, the urethra, and related support structures, with particular attention to changes in hiatal constraint, support axes, and load transfer. These studies provide a mechanistic rationale for the framework.

Taken together, existing evidence supports hiatal morphology as a clinically meaningful source of information in the assessment of pelvic floor support and demonstrates that it can be quantified by ultrasonography or MRI. Building on this foundation, the two-layer framework further introduces the W value, aiming to obtain corresponding bedside information through transvaginal palpation. Thus, the core innovation of this Perspective is not to re-establish the importance of the hiatus, but to propose and test a method for translating imaging-based hiatal phenotypes into bedside functional phenotypes.

Proposed Framework: Anatomical Phenotype and Support Status

The proposed framework consists of two layers: an anatomical layer and a functional layer. The anatomical layer records the pelvic support phenotype using A/C/P anatomical grading, whereas the

functional layer uses the W value to assess posterior pelvic support status. Combining these two layers is intended to identify different support-function states underlying similar anatomical phenotypes. Each patient is recorded using a combination of W status and A/C/P anatomical grading. The basic format is “W status + A grade + C grade + P grade.” In patients with a retained uterus, the C domain also retains the C point, D point, and C-D distance. A, C, and P are parallel anatomical dimensions used to evaluate anterior, apical, and posterior compartment prolapse, respectively. A schematic diagram of the classification framework is shown in Figure 1.

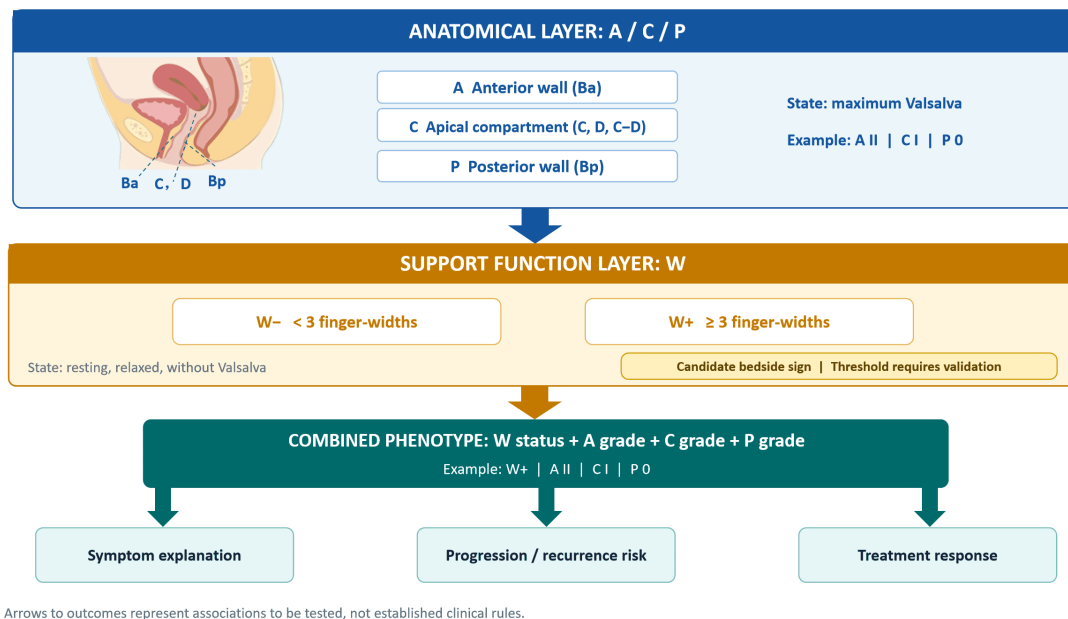


Figure 1. Two-Layer Anatomical–Support Phenotyping Framework

W Value: A Candidate Indicator of Posterior Pelvic Support Status

The W value is a transvaginal palpation-based assessment of the transverse opening of the deep vaginal hiatus at rest. In addition to the target hiatal width, the measurement may be influenced by vaginal wall compliance, tissue elasticity, perineal scarring, pain, examiner-applied force, and the patient’s degree of relaxation. Therefore, whether the W value primarily reflects the state of the levator hiatus or also incorporates information about vaginal tissue compliance is a construct question that must be distinguished through imaging and physiological measurements.

According to the proposed operational method, the patient is placed in the dorsal lithotomy position. With the pelvic floor muscles relaxed and without Valsalva maneuver, the examiner assesses the width of

approximated fingers that can be accommodated at the plane of the levator hiatus. A hiatal width of less than three fingers is recorded as W-negative, whereas accommodation of three or more fingers is recorded as W-positive. The three-finger width is a prespecified research cutoff based on bedside feasibility, rather than a physiological threshold derived from existing imaging evidence. Early studies should record the actual width, the number of fingers accommodated, and the binary W classification simultaneously. Continuous-variable analyses should then be used to evaluate whether a stable outcome inflection point exists before determining whether three fingers is appropriate as the final classification threshold.

The W value first records the degree of hiatal opening perceived by finger palpation at rest, rather than the instantaneous contractile force of the levator ani muscle. This article further proposes that it may reflect the long-term constraining capacity of the levator ani and related support structures on the hiatus: when this constraint gradually declines under repeated intra-abdominal pressure loading, the hiatus may undergo persistent widening and present as a higher W grade.

The W value differs from the genital hiatus (GH) length in POP-Q and the imaging-based levator hiatus area (LHA). GH measures the distance from the midpoint of the external urethral meatus to the posterior hymenal ring and mainly describes the degree of opening near the vaginal introitus. LHA is obtained by three-dimensional or four-dimensional transperineal ultrasonography and can demonstrate the levator hiatal area at rest, during pelvic floor muscle contraction, or during maximal Valsalva. By contrast, the W value records the transverse opening of the deeper hiatus through transvaginal palpation at rest. These three measures differ in measurement plane, physiological state, and dimensional unit, and therefore provide complementary information. Previous studies of LHA enlargement and hiatal ballooning provide direct imaging evidence for the association between hiatal morphology and abnormal pelvic floor support^{[9][10][11][12][13]}. The further question raised by the W value is whether transvaginal palpation can capture, at lower cost, the clinically meaningful portion of this information. Imaging evidence can provide anatomical and mechanistic support for this concept, but it cannot establish in advance the accuracy of palpation measurement, the superiority of the resting state, or the rationality of the three-finger threshold. Therefore, the W value is not a simplified substitute for LHA, but an independent bedside measurement scheme that must be compared with LHA, GH, and clinical outcomes. Bedside measurement of the W value and its anatomical relationship with GH and LHA are shown in Figure 2.

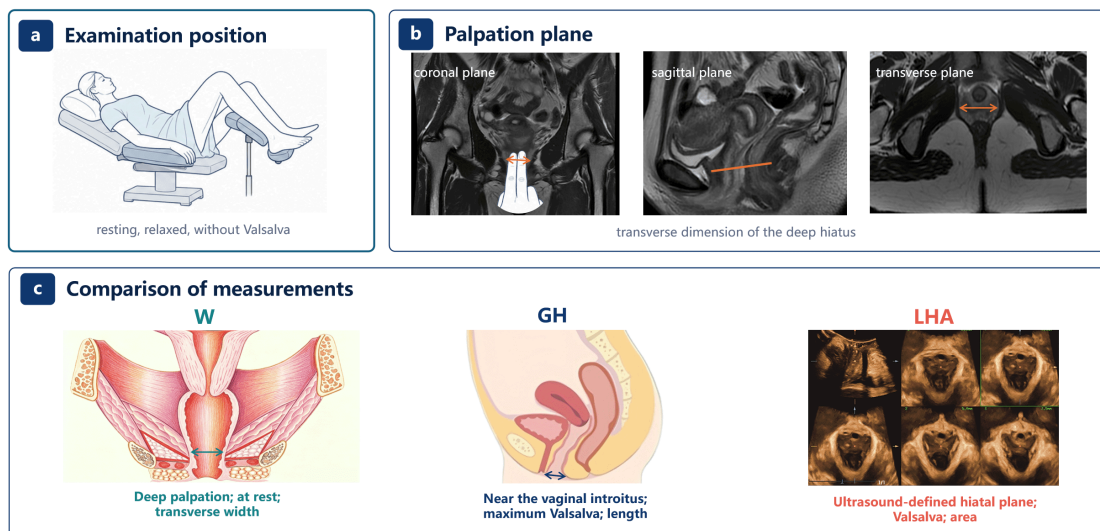


Figure 2. Bedside measurement of the W value and its anatomical relationship with GH and LHA

A/C/P Compartmental Presentation Based on S-POP-Q Measurement

The anatomical layer uses the Ba, Bp, C, and D points of S-POP-Q, whose validity for assessing prolapse has been previously demonstrated^{[25][26]}. A corresponds to the Ba point and records the most distal position of anterior vaginal wall prolapse, reflecting anterior wall support status. P corresponds to the Bp point and records the most distal position of posterior vaginal wall prolapse, reflecting the degree of posterior wall prolapse. The apical region records both the C and D points. The C point indicates the most distal edge of the cervix or the vaginal cuff after hysterectomy, whereas the D point indicates the posterior fornix in patients with a cervix. The C-D distance may serve as a clinical estimate of cervical length and may help distinguish descent dominated by cervical elongation from true apical support descent^{[1][2]}. The S-POP-Q measurement and A/C/P compartmental recording are shown in Table 1, and the grading criteria are shown in Table 2.

During the validation phase of the framework, the raw measurements of Ba, Bp, C, D, and TVL, the A/C/P grades, and the complete POP-Q data should all be retained. Because A/C/P does not change the S-POP-Q measurement method, validation should focus not on re-establishing the anatomical validity of each measurement point, but on evaluating whether this compartmental recording, when combined with the W value, improves symptom interpretation, risk stratification, and outcome prediction.

The framework therefore proposes a directly testable core proposition: on the basis of the anatomical phenotype recorded by A/C/P, can the addition of the W value further identify patients with different symptoms, risks of progression, and treatment responses? Whether this proposition is ultimately supported or refuted, it will help define the informational boundaries of bedside hiatal assessment in the diagnosis and treatment of PFSD.

Compartment	S-POP-Q parameter	Main purpose
A	Ba	Assessment of anterior compartment prolapse
C	C, D, and C-D*	Assessment of apical descent and differentiation of cervical elongation
P	Bp	Assessment of posterior compartment prolapse
Auxiliary parameter	TVL	Staging and assessment of vaginal length

Table 1. S-POP-Q Measurement and A/C/P Compartmental Recording

* after cervical amputation or hysterectomy, the D point is no longer applicable and should be recorded as “NA.”

Grade	Most distal position during maximal Valsalva
Grade 0	No prolapse
Grade I	More than 1 cm above the hymen, i.e., < -1 cm
Grade II	Between 1 cm above and 1 cm below the hymen, i.e., -1 to +1 cm
Grade III	More than 1 cm below the hymen but not reaching TVL-2 cm
Grade IV	The most distal portion reaches or exceeds TVL-2 cm, representing near-complete or complete eversion

Table 2. Grading Criteria for Prolapse

A, C, and P record the degree of prolapse of the anterior vaginal wall, apex, and posterior vaginal wall, respectively, during maximal Valsalva. The recommended format is “A II, C I, P 0.”

From Combined Phenotypes to Clinical Hypotheses: Three Illustrative Scenarios

The clinical value of functional classification lies in combining the posterior pelvic support status reflected by the W value with the site and severity of prolapse recorded by A/C/P, thereby generating testable predictions regarding disease progression, postoperative risk, and treatment response. The following three clinical scenarios mainly focus on combinations of W and A, and are intended to illustrate how this framework may generate testable predictions regarding SUI, disease progression, and treatment response. They do not represent all possible combinations within the two-layer framework. A is discussed preferentially here because anterior compartment support has direct clinical relevance to the bladder base, bladder neck, and urinary continence.

Scenario 1: W-negative status, minimal prolapse, and SUI as the predominant manifestation. We hypothesize that this phenotype primarily reflects dysfunction of the continence mechanism, whereas posterior pelvic support remains relatively preserved. Accordingly, it can be tested whether these patients have a more stable response to continence-directed treatment alone and a lower long-term risk of support-related progression.

Scenario 2: W-positive status with a low A grade. This phenotype represents a state in which visible anterior vaginal wall descent is not yet prominent, but the hiatal support status has already changed. The key hypothesis is whether W positivity can identify, among patients with low A grades, a subgroup associated with vaginal laxity, symptom progression, or increased long-term risk of prolapse.

Scenario 3: W-positive status combined with a higher A grade. The coexistence of hiatal widening and anterior compartment support injury may reflect more extensive changes in pelvic floor support. What needs to be tested is whether this combination corresponds to a higher risk of progression or recurrence, and whether it can identify patients who respond differently to different extents of treatment.

Previous observational studies from our team suggest that patients with extensive support injury may require a treatment pathway distinct from continence-directed treatment alone or isolated anterior compartment support. Reconstruction aimed at restoring the relationships among the vaginal axis, levator ani, perineal body, and urogenital hiatus has also shown preliminary improvements in anatomy and quality of life^{[27][28]}. These studies provide clinical rationale for adjusting treatment extent according to support phenotype and make the W value a stratification variable worthy of further investigation.

From Conceptual Framework to Clinical Tool

Evaluation of the W value can be organized around three sequential questions. First, can the W value be measured reliably, and does it truly correspond to the target hiatal structure? This stage should standardize patient position, measurement plane, and palpation method; assess interobserver agreement; and clarify its relationship with hiatal transverse diameter and LHA using concurrent ultrasonography or MRI. Comparisons among resting, contraction, and Valsalva states, as well as calibration of the three-finger cutoff, should also be completed at this stage.

Second, can the W value provide clinically meaningful information? Prospective cohorts should examine its associations with symptoms, POP progression or recurrence, and de novo or persistent SUI, and should compare different predictive models incorporating POP-Q, GH, LHA, and the W value. The key issue at this stage is not to prove that W is superior to all imaging parameters, but to determine whether it offers a reasonable balance among informational value, measurement cost, and bedside accessibility.

Third, can the W phenotype improve risk stratification or treatment decision-making? Independent multicenter studies should validate its stability across populations and centers, and further test whether different W/A/C/P combinations correspond to distinct natural histories or treatment responses. Only after support is obtained at this level can the W value evolve from a research variable into a clinical classification tool.

Limitations and Falsifiable Boundaries of the Framework

The uncertainties of this framework mainly concern the newly added functional layer. The W value is a composite sign obtained by transvaginal palpation. In addition to the target hiatal geometry, it may be influenced by vaginal wall compliance, hormonal status, childbirth- or surgery-related scarring, pain, and examination conditions. The same W value may also correspond to different pathological substrates, such as levator ani avulsion, connective tissue laxity, or perineal body injury. Therefore, the W value cannot currently localize a specific injured structure, and its interpretation as reflecting “posterior pelvic support status” remains a mechanistic explanation that requires validation.

The three-finger cutoff is currently an operational threshold prespecified for research purposes, and binary classification may obscure continuous or nonlinear relationships between the W value and clinical outcomes. Factors such as age, parity, menopausal and estrogen status, body mass index, and previous pelvic floor surgery may also influence both the W value and disease outcomes. If the association of the

W value is substantially attenuated after adjustment for these factors, or if W fails to provide stable information beyond POP-Q, GH, and LHA, its role should be revised to that of a continuous descriptive variable or a simple screening sign, rather than a core classification indicator of the two-layer framework.

The existing treatment evidence is mainly derived from the team proposing this framework and its collaborating centers, and previous studies were not prospectively stratified according to the W value. Therefore, the three clinical scenarios proposed in this article should be regarded as testable predictions rather than treatment rules. Only when different W/A/C/P combinations demonstrate reproducible differences in outcomes or heterogeneity of treatment effects can this framework further assume a role in risk stratification and treatment decision-making.

Conclusion

Assessment of PFSD should consider both organ descent and pelvic floor support status. This framework retains the anatomical recording of S-POP-Q and introduces, through the W value, a pathway for incorporating information on the deep hiatus into bedside assessment. Its current value lies in defining two parallel diagnostic dimensions, generating reproducibly recordable combined phenotypes, and proposing falsifiable predictions regarding disease progression and treatment response. Future studies need to determine whether the W value can reliably measure the target hiatus and provide clinically incremental information. Until then, this framework should primarily be regarded as a common starting point for organizing clinical observation and comparative research.

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Potential Competing Interests

The authors declare that they have no conflicts of interest.

Ethics

Not applicable. This article is a conceptual Perspective based on published literature and does not report original human-subject research, individual patient data, or identifiable clinical information.

Data Availability

No new data were generated or analysed in this article. All cited evidence is available from the published sources listed in the references.

Author Contributions

- L Li: Conceptualization, methodology, literature review, and writing – original draft.
- DM Tian: Literature review, conceptual analysis, and writing – original draft.
- XQ Wang: Literature review and evidence synthesis.
- XB Liu: Conceptual analysis, visualization, and figure preparation.
- TQ Yao: Writing – review and editing.
- JH Shen: Conceptualization, supervision, and critical revision of the manuscript.

Use of generative AI

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Declarations

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