AN INTERNATIONAL CONTINENCE SOCIETY (ICS) REPORT ON THE TERMINOLOGY FOR PELVIC FLOOR MUSCLE ASSESSMENT

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ABSTRACT

Introduction: The terminology for female and male pelvic floor muscle (PFM) assessment has expanded considerably since the first PFM function and dysfunction standardisation of terminology document in 2005. New terms have entered assessment reports, and new investigations to measure PFM function and dysfunction have been developed. An update of this terminology was required to comprehensively document the terms and their definitions, and to describe the assessment method and interpretation of the finding, in order to standardise assessment procedures and aid diagnostic decision-making.

Methods: This report combines the input of members of the Standardisation Committee of the International Continence Society (ICS) Working Group 16, with contributions from recognized experts in the field and external referees. A logical, sequential clinically-directed assessment framework was created against which the assessment process was mapped. Within categories and subclassifications, each term was assigned a numeric coding. A transparent process of 11 rounds of full working group and external review was undertaken to exhaustively examine each definition, plus additional extensive internal development, with decision-making by collective opinion (consensus).

Results: A Terminology Report for the symptoms, signs, investigations and diagnoses associated with PFM function and dysfunction, encompassing 185 separate definitions/descriptors, has been developed. It is clinically-based with the most common assessment processes defined. Clarity and user-friendliness have been key aims to make it interpretable by clinicians and researchers of different disciplines.

Conclusion: A consensus-based Terminology Report for assessment of PFM function and dysfunction has been produced to aid clinical practice and be a stimulus for research.

WORDS

(Abstract): 248

*(**Introduction-Section 4**):* including tables and figures: 18,265

(Footnotes): 2,144

(Appendix): -

TABLES 27

FIGURES 12

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INTRODUCTION:

The current terminology used in the assessment and diagnosis of pelvic floor muscle (PFM) function and dysfunction is both diverse and variably defined, with no current consensus which captures, defines and describes all terms. This document lists and describes terms which are used in the neuro-myo-fascial assessment and diagnosis of the PFM to aid teaching and standardisation of terminology in this field. The terminology covers the assessment of both structure and function of the PFM. The pelvic floor structures defined in this document include muscular tissues in the pelvic floor and their neural connections, and the fascial (connective tissue) layers surrounding the PFM fibres/fascicles. In this document, assessment of the PFM is presented according to the perineal and pelvic regions of PFM. While PFM anatomy nomenclature varies according to texts, the following structures are considered to be the muscles that make up the perineum and the pelvic floor/levator ani[1]. The perineal region is divided into the anterior and posterior triangles. The anterior urogenital triangle comprises the superficial urogenital muscles (bulbospongiosus/bulbocavernosus, ischiocavernosus and the superficial transverse perinei), and the deep urogenital muscles (external urethral sphincter and deep transverse perinei). The posterior (anal) triangle comprises the external anal sphincter. The levator ani is comprised of pubococcygeus (which includes puborectalis, pubovisceralis, pubovaginalis, etc), iliococcygeus and ischiococcygeus/coccygeus (considered vestigial). The female and male perineal and PFM, inferior and superior views, are illustrated in Figure 1.

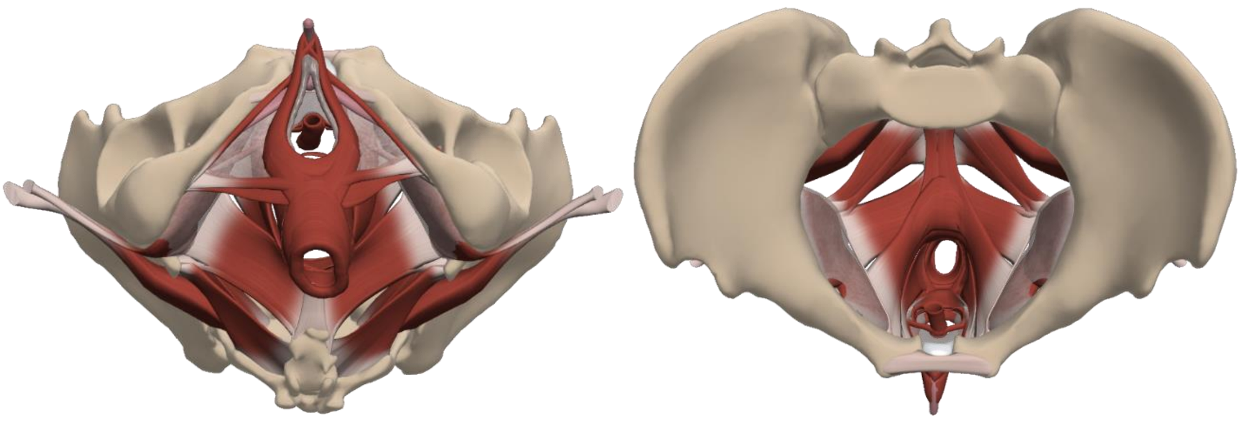


Figure 1a Muscles of the female perineum and pelvic floor, inferior and superior views (reprinted with permission from Primal pictures[2])

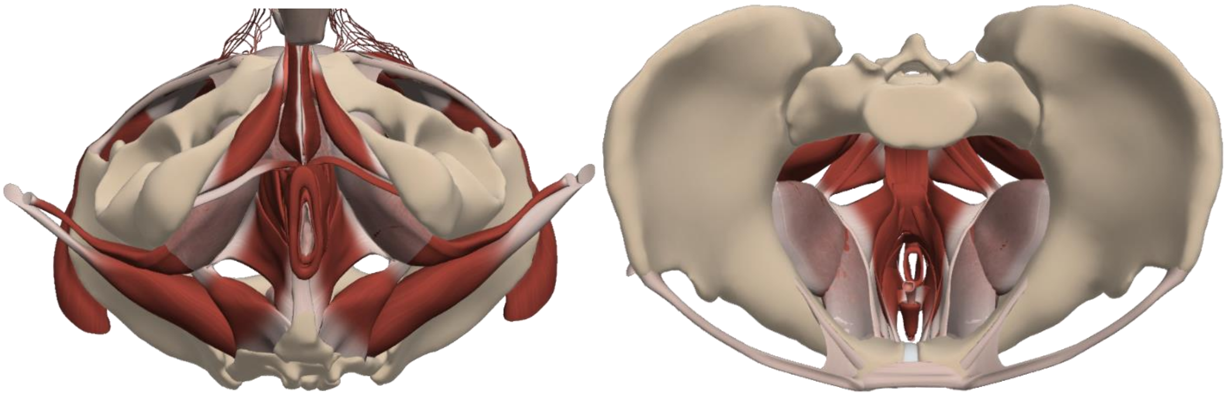


Figure 1b Muscles of the male perineum and pelvic floor, inferior and superior views (reprinted with permission from Primal pictures[2])

When referencing this document, the reader is asked to keep the term in context with PFM assessment. The PFM terms included apply to adult females and males presenting with different types of pelvic floor disorders. Assessment techniques are undertaken externally (*per perineum* (PP), and internally (*per vaginam* (*PV*) or *per rectum* (*PR*)). Where the definition or description of the term requires modification to differentiate between female *(f)* and male *(m)* assessment, this is indicated.

The search strategy used for this document was performed according to International Continence Society (ICS) Standardisation Steering Committee guidelines. The working group of multi-national and multi-disciplinary committee members applied expert opinion to identify existing terms that refer to PFM assessment. Existing published ICS Standardization of Terminology documents were searched and terms added to cover all published terms or in common clinical use that refer to the assessment of PFM function and dysfunction. Inclusion of the final list of terms was achieved via a consensus process, which took place between 2017 – 2019. The final list of terms serves as a reference for future refinement and testing for clinical utility. This document is not a clinical protocol or guideline for how to perform a PFM assessment, it defines and describes terms which may be used in a clinical assessment of PFM function. As such, this document does not include within its scope other important considerations when undertaking a PFM assessment. These include but are not limited to competency of the assessor, clinical reasoning required for diagnostic decision-making, protocol when conducting a sensitive examination of an intimate body part, appropriate informed consent, and ethical and legal considerations[(3)]. Further, only a brief, introductory level description of how to undertake the test is provided, not a detailed description of the exercise protocol using that tool, with the reader directed to other texts for more detailed description.

If a term relevant to PFM assessment does not currently exist in an ICS Standardisation of Terminology document, it is indicated as a "**NEW**" term. When a term appears in an existing ICS Standardisation of Terminology document, the term definition and description is reproduced here with reference to the original terminology document, in order to present a complete framework of PFM assessment. When a modification to the existing term occurs, the word "**CHANGED**" is used. If the change is a significant alteration from the existing term, a footnote is used to explain the reason for modification, and a reference to the original term cited. Several of the terms related to ultrasound imaging have been drawn from the AIUM/IUGA practice parameter for the performance of Urogynecological ultrasound examinations document[(4)]. Similarly, terms in the algometry section already exist in the field of pain science, and terms related to muscle function exist in the field of exercise physiology, etc. These terms are labelled **NEW** for the purposes of this document however we acknowledge that these terms are already published and may be in widespread use.

Table 1: Total, new and changed ICS definitions

Section	New Definitions / Descriptors	Changed Definitions / Descriptors	Unchanged Definitions / Descriptors	Total
Introduction & Symptoms	1	1	0	2
Signs	31	15	12	58
Investigations	80	18	17	115
Diagnoses	7	3	0	10
Total	119 (64%)	37 (20%)	29 (16%)	185

There is a plethora of existing terms and conceptual and operational definitions related to PFM function and dysfunction [(5)]. Saltiel et al[(5)] observed inconsistency and redundancy in PFM function terminology and suggested that a further consideration of PFM function terms relevant to research and to clinical practice is required[(5)]. A mapping of PFM function terms to the WHO International Classification of Functioning, Disability and Health (ICF) framework has been recently proposed[(6)], leading to a list of the most frequently used terms[(7)]. In this paper, we define the assessment term, describe the application of the test and interpretation of its finding within a framework of diagnostic decision-making and clinical reasoning. This follows the usual order of assessment undertaken by a clinician or researcher (referred to in this paper as an ‘assessor’), leading to a presumed diagnosis and formulation of a treatment plan, to help guide clinical practice. This process includes the use of a patient's history, patient-reported symptoms/outcomes, and information gained from clinical signs and the results of investigations. It is important to recognize that neuro-musculo-skeletal structures beyond the PFM muscles (e.g. intra- and extra pelvic muscles, the bony pelvis and pelvic girdle joints and central nervous system factors) may impact on PFM function, however terminology relating to the assessment of these structures and systems is beyond the scope of this paper.

We hope the terminology sited within this framework provides greater clarity and aids standardisation of the usage of these terms. Where possible, the sequence of the terminology follows this order: the region of assessment, the type of evaluation being undertaken, the name ('term') of the test / assessment being undertaken, the definition of that term, the description of how that assessment method is undertaken, how the assessment is rated and the terminology used to describe the finding.

Limitations

Normative data of PFM structure and function are lacking for the majority of PFM terms, which hinders the ability to rate or interpret the finding as 'normal' or 'abnormal'. In addition, due to the lack of known validity, reliability and responsiveness to change and diagnostic test accuracy (sensitivity, specificity) of many of the commonly used PFM clinical assessment methods, investigations and diagnoses, the clinical utility of these terms remains unknown. Therefore, this document is not intended to be an evidence-based recommendation of which tests should be included in a PFM assessment; rather our aim is to define and describe currently used terms, which subsequent research may recommend for or against using in PFM assessment. Evidence to support or abandon the use of any of these terms and assessment methods is eagerly awaited. In the meantime, we advise assessors to exercise great caution in their interpretation of clinical findings, especially those measured with visual observation, digital palpation and outputs of some of the available assessment tools, as despite their widespread clinical usage, these tests can yield subjective and highly variable findings. Due to the abundance and variety of terms used in the literature related to methods and techniques of measurements, word count has necessitated that this document describes only the most frequently published, or methods and techniques using that particular tool in common clinical usage.

With these limitations in mind, we recommend rating of PFM symptoms as present or absent; if present, a severity and/or bother scale can be added to aid re-assessment in response to an intervention. Some of the signs and investigations terms have rating scales associated with their method and these should be used; if not, we recommend that assessors employ linear measurements (mm/cm) or specify ISI international units of measurement (e.g. s=seconds) where applicable to aid objectivity of the assessment method. If ‘normal’ observations or values are not known, we recommend avoidance of the term ‘abnormal’ or suggestion of pathology or disorder, as this cannot be confirmed with current knowledge. When using assessment methods which measure on a continuous scale but lack reference data of a ‘normal’ value, the terms ‘increased’/‘elevated’/‘higher’/‘faster’, or ‘decreased’/‘reduced’/‘lower’/‘slower’ may be used as this is the limit of our certainty at this point in time. Nevertheless, we acknowledge the subjectivity of these relative rating terms.

SECTION 1: SYMPTOMS

This section lists symptoms a patient may use to describe a sensation which could be related to a disorder of PFM structure or function. We recommend the assessor accurately documents the term the patient uses to describe the symptom, rather than an assessor-interpreted term, as symptoms may be used as a patient-reported outcome. A patient-reported outcome is any report of the status of a patient's health condition that comes directly from the patient, without interpretation of the patient's response by an assessor [8,9].

Pelvic floor muscle-related symptoms are divided into sensory and motor categories. Pelvic floor muscle-related symptoms may co-exist with symptoms of pelvic floor disorders such as urinary incontinence, voiding dysfunction, faecal incontinence, defecatory dysfunction, sexual dysfunction or pelvic organ prolapse, as well as co-exist with other disorders of neuro-musculo-skeletal structures in the pelvis or spine $_{FN1.1}$: the assessor should document the patient’s symptoms and identify which of these s/he considers to be related to the PFM. Examples are provided of words a patient may use to describe their symptoms to the assessor. These words are not specific to neural or myofascial structures in the PFM – they are generic and may be used by a patient to describe altered sensation in any body part – and are therefore not different to standard definitions of these terms in English dictionaries. For this reason, definitions are not provided for these terms in this document, as they are not PFM-specific. The likely exception is the term 'wind', which is defined below. In addition to documenting the patient's symptom (term) and any other descriptors the patient uses to describe the symptom, the assessor documents the perceived location, frequency of occurrence, severity, distress, bother or impact of these symptoms to the patient.

1.1 PFM sensory symptoms: patient terms may include numbness, reduced feeling, decreased sensation, tingling, pins and needles, sensitivity/hypersensitivity, or increased or unusual sensation in the region the patient perceives to be related to the PFM. Terms used to describe painful symptoms may include pain, tender, ache, burning or discomfort in the region the patient perceives to be related to the PFM; use of existing descriptors in published scales[10] is recommended.

1.2 PFM motor symptoms*:* patient terms may include loose, lax, gaping, sagging, open, weak, bulging, heaviness, full, loss of control, or difficulty to relax, tight, tense, narrow or constricted. A patient may describe 'wind' as a noise or passage of gas.

1.2.1 Vaginal wind: an involuntary passage of odourless air through the vagina, which is often audible and/or sensible, and usually associated with a change in posture **(CHANGED)**[11,12]. $_{\text{FN1.2}}$ This may occur when legs are abducted and a change of position occurs and during times of low estrogen (e.g. breast-feeding).

1.2.2 Anal wind: $_{\text{FN1.3}}$ complaint of involuntary loss of flatus (gas). **(NEW)**

Following the assessment of a patient’s symptom(s), the assessor will formulate provisional differential diagnoses which will be refined following the clinical examination.

FN1.1 For complete assessment, include as indicated: posture, abdominal, spinal, functional.

FN1.2 ‘Vaginal flatus’ is the term used by Sultan(11) however Neels(13) distinguishes vaginal ‘wind’ from vaginal ‘flatus’; assigning the term flatus to wind that is passed through the vagina due to an enterovaginal fistula. This type of ‘vaginal wind’ will not be odourless. The term ‘vaginal flatus’ is more likely to be used by the clinician, not the patient.

FN1.3 This symptom is called ‘flatus incontinence’ by Sultan et al(11).

SECTION 2: SIGNS

Signs are elicited from the clinical examination, which includes visual observation, physical inspection and simple tests FN2.1. The majority of PFM clinical signs are tested using digital palpation. The term ‘palpation’ (latin origin: *palpare*) means to touch gently or to use the fingers or hands to examine[14]. Palpation allows the assessor to feel the texture, size, consistency and location of certain body parts with the hands, or in the case of PFM assessment, with the fingers or finger-tips FN2.2. Due to the inherent subjective nature of visual and digital assessment, many of these characteristics and properties of the PFM are more accurately assessed using investigations. While some terms will be defined in signs, the measurement of that term may be better done in investigations. If an assessor does not have access to investigations, findings from signs may be used to guide practice, however subsequent research may cast doubt on the certainty of findings from signs.

There are several aspects for the assessor to be aware of during the clinical assessment which apply to all measured aspects of PFM function, as variations in the examination conditions or maneuvers may alter the results of the test and reduce the certainty of the finding. These are listed in Box 1. We recommend all of these aspects should be reported by assessors to enable reproducibility of assessment. Akin to published checklists for exercise prescription[15], checklists of clinical assessment may improve completeness and quality of research reports.

Box 1: Checklist of PFM clinical assessment, applicable to signs and investigations

Aspect to standardize		**Details to record**
1.	Patient’s body position for the PFM assessment.	• lying or upright • if lying, hip/knee flexion, supine, side-lying or lithotomy

		• number of pillows, +/- support from assessor's body • bladder empty or not.
2.	Testing of left and right sides of PFM. Symmetry: A measure of comparability of resting tone or shape between left and right sides of the muscle. If examining in side-lying, there will be a gravity effect and the dependent side may have a different feel to the upper side and appear as asymmetrical. This may affect assessor perception of PFM resting tone.	Record if symmetry / asymmetry is present at rest and on activity (contraction / relaxation). Rate as: • symmetry between left and right (on a particular aspect/parameter) • asymmetry present. Identify what aspect/parameter is asymmetrical, e.g. tone, L<R[16].
3.	Amount of pressure (light / moderate / strong) applied during digital palpation tests. Particular care is required when undertaking a PFM assessment in the presence of pelvic floor pain, however even in an asymptomatic individual, the assessor may provoke pain or discomfort due to undue pressure applied during palpation or application of an instrument.	• if discomfort or pain is provoked, note pain location, intensity, duration (transient or persistent), if it reproduces the pain the patient complains of, and if referral of pain occurs to other locations.

4.	Number of digits (and which digit) used during digital palpation.	• for single digit examination (*PV* or *PR*), usually the index finger is used • for 2-digit examination (*PV*), usually the index and middle digits are used.
5.	Orientation (e.g. lateral placement or posterior midline) and depth of examining finger(s) during internal digital palpation examination FN2.3.	• the examining finger must be as close as possible to the PFM tissue in order to assess PFM response. • when performing a *PV* examination, assessor decision as to which side or midline to examine will be determined by lumen capacity, presence of tenderness or defect and presence of firm stool within the rectum • when performing a *PR* examination, external anal sphincter and puborectalis strength should be assessed separately • record depth of insertion of examining finger for differential assessment of perineal vs levator ani muscle layers. Further identification of individual muscles is not possible in all individuals.
6.	Instruction to perform a maximum voluntary contraction (MVC).	• provide details of the instruction (wording, number of repetitions and rest between repetitions) to ensure the test can be reproduced as an MVC.
7.	Contraction of muscles other than those of the pelvic floor.	• if this is perceived to influence the PFM assessment, an attempt to minimize this should be made unless the purpose is to assess function of the other muscle.

		• List specific muscle, such as abdominal, hip adductor, etc.

Abbreviations: PFM, pelvic floor muscle(s); L, left; R, right; *PV*, *per vaginam*; *PR*, *per rectum*; MVC, maximum voluntary contraction.

This section divides the clinical examination into an external PP assessment and an internal *PV* or *PR* assessment. The order of examination for PP assessment is visual observation before digital palpation. The full description of each term appears in the subsequent tables and text. Not all tests may be applicable for each patient; the decision to perform a test should be based upon clinical judgement.

2.1 External assessment per perineum

Visual observation: all terms related to the visual observation per perineum under different PFM states (at rest, on contraction and with raised intra-abdominal pressure [IAP]) are listed and defined in Table 2.

Table 2. External assessment *per perineum*: visual observation.

Tests of visual observation *per perineum* at rest	
Test	**Rating**
2.1.1 Perineal skin assessment: assessment of the perineal skin to note presence of: scars, lesions (e.g. fissure), trophic changes / atrophy, color, erythema, swelling and other conditions which could affect the function of the PFM. **(NEW)**	• normal skin • altered (detail the observation including extent of alteration)

2.1.2 Perineal body length (*f*): distance from posterior margin of vestibule to anterior anal verge[18].	• state if < or > 3cm[19,20]
2.1.3 Perineal body position at rest: relationship of the position of the perineal body to ischial tuberosities FN2.4. **(*NEW*).** Palpate ischial tuberosity and visually estimate the relationship.	• **2.1.3.1 Descended perineum:** perineal body rests below the plane of the ischial tuberosities[23] **(NEW)** • normal: at or slightly above the level of the ischial tuberosities • elevated: significantly indrawn perineum at rest
2.1.4 Introital gaping: opening, or non-coaptation of vagina at rest. **(NEW)** If the introitus is not visible at rest the labia may need to be parted	• present • absent
2.1.5 Keyhole deformity at anus: characteristic posterior midline furrow deformity. This complication is seen when the anus is inspected by gently retracting the buttocks laterally. The anus is no longer slit-like, but appears in shape like a keyhole[25]. **(NEW)**	• present • note location of deformity with reference to a clock-face (where 12 o'clock is anterior/ventral) • absent
2.1.6 Anal gaping: non-coaptation of anal mucosa at rest[11].	• present • note location of deformity with reference to a clock-face • absent
Tests of visual observation *per perineum* with a PFM contraction	
2.1.7 Voluntary contraction of the PFM: self-initiated activation of the PFM. **(CHANGED)**[26]	• present • uncertain

Contraction of the bulbospongiosus / bulbocavernosus, ischiocavernosus, transverse perineii muscles may be observed FN2.5. The assessor may need to gently move the external genitalia (parting of the labia, lifting of the scrotum to one side) to effectively visualize the perineal response.	• absent
	• Response can be further described according to perineal movement observed:
	• **2.1.7.1 Perineal elevation**: inward (ventrocephalad) movement of the vulva (*f*), perineum, and anus(11,27) = normal finding
	• no change
	• sex-specific changes on perineal elevation:
	    ○ *f*: closure of the urethral meatus ('wink'); a clitoral 'nod'
	    ○ *m*: closure of the anus, cephalad testicular lift and penile retraction (the shaft of the penis draws in FN2.6)(28-30).
	• **2.1.7.2 Perineal descent**: dorsocaudal movement of the perineum, or anus 1 cm or greater beyond resting level **(CHANGED)**(27) FN2.7

2.1.8 Relaxation of the PFM: return of the perineum to its original resting position following the voluntary contraction **(NEW)**	If present, rate as: • yes: full relaxation visible directly after instruction; normal finding(16)

	• partial or delayed relaxation[16] • **2.1.8.1 Non-relaxing PFM:** no relaxation visualized of the PFM **(CHANGED)**[26] FN2.8.
Tests of visual observation *per perineum* with an increase in intra-abdominal pressure (IAP)	
2.1.9 Perineal movement with a sustained increase in IAP: direction of perineal movement during a sustained effort FN2.9. **(NEW).** As there may be a difference in PFM response to bearing down *versus* valsalva[31], it is important to state exact test instruction depending on the test, as the observed response may vary. • **2.1.9.1 Valsalva**: Forceful exhalation against a closed mouth, glottis and nose[31]. **(NEW)** Valsalva has been shown to result in an increase in IAP and usually an increase in PFM activation[31]. • **2.1.9.2 Bearing down (as if defecating):** a strain or push, which results in an increase in IAP which exerts a downward pressure, usually accompanied by PFM relaxation. **(NEW)**	• perineal elevation (see 2.1.7.1) FN2.10 • no change • perineal descent (see 2.1.7.2) • **2.1.9.3 Excessive perineal descent with bearing down:** movement of the perineum 3 cm or more below resting position[21] FN2.11. **(NEW)**
2.1.10 Perineal movement with rapid increase in IAP: direction of perineal movement during a rapid increase in IAP such as coughing, lifting, throwing. **(NEW)** Clarify if the patient is instructed to contract PFM before cough in order to differentiate voluntary	• perineal elevation (see 2.1.7.1)[26] FN2.12, FN2.13 • May be due to:

(learned) response from an involuntary response (un-learned).	• voluntary contraction (see 2.1.19) – pre-contraction may be a learned response FN2.14 • **2.1.10.1 Involuntary contraction**: a contraction which occurs reflexively or automatically, without volition or conscious control. Observe this response before instructing in a voluntary pre-contraction in order to differentiate from the voluntary pre-contraction response. **(CHANGED)**(26) • no change • perineal descent FN2.15

Abbreviations: *f*, female; *m*, male; PFM, pelvic floor muscles; IAP, intra-abdominal pressure

Digital palpation: all terms related to digital palpation *per perineum* under different PFM states (at rest, on contraction and with raised IAP) are listed and defined in Table 3.

Table 3. External assessment *per perineum*: digital palpation

Tests of digital palpation *per perineum* at rest	
Test	**Rating**
2.1.11 Sensation: Test for presence, absence or altered quality of sensation in dermatomal	• allodynic, anaesthetic, dysesthetic, hyperalgesic, hyperesthesic,

distributions especially S2-4. May include light touch, blunt, sharp, pain, cold, vibration modalities. **(NEW)**	hypoalgesic, hypoesthesic, paresthesic, neuralgic[34].
2.1.12 Perineal scarring: presence of scar tissue on perineum. (**NEW**). Using a finger-tip, attempt to slide the scar in all directions. Assess for adhesion or lack of skin mobility over underlying tissue $_{\mathrm{FN2.16}}$.	• present • degree of healing • location of scar in relation to vulva/scrotum or anus • location of adhesion • extent/magnitude of scar mobility[35]. • absent
2.1.13 Tone: state of the muscle, usually defined by its resting tension, clinically determined by resistance to passive movement[27]. The recommended position of the examining digit(s) is to place the palmar surface of the examining finger on the ischiocavernosus, bulbospongiosus (*f*) / bulbocavernosus (*m*) or transverse perineal muscle belly at the thickest portion of the muscle belly, *per perineum*. Pressure or stretch is applied perpendicular to the muscle fibres to assess tone. Tone is described in more detail in 2.2.3.	• normal • decreased tone (see 2.2.3.4) • increased tone (see 2.2.3.5)
2.1.14 Tenderness: sensation of discomfort with or without pain; discomfort elicited through palpation of any tissue indicates unusual sensitivity to pressure or touch[27]. May be generalised within a muscle.	• note location of pressure application • note location of pain (where pressure applied, or if pain referral present, note location of pain referral)

2.1.14.1 Tender point: area of localised tenderness occurring in muscle, muscle-tendon junction, bursa, or fat pad **(CHANGED)**[27] FN2.17.	• rate severity of pain on a numeric rating scale (NRS) 0 – 10[37]
2.1.15 Pudendal nerve neurodynamics: neurodynamic assessment evaluates the length and mobility of the nerve in order to assess neurogenic origin of pain[38] **(NEW)**. Tension is applied to the nerve or specific component of the nerve by lengthening the nerve or by distracting imposing tissues[38]. Specific components of the pudendal nerve can be put under tension such as the inferior rectal branch, the dorsal branch and the perineal branch.	• positive: if pain, sensation of burning or stabbing are experienced in the distribution of the nerve. This assessment can be uncomfortable in asymptomatic individuals, however reproduction of patient's pain is suggestive of a neurogenic origin of pain • negative
2.1.16 Cotton swab test (*f*) FN2.18**:** a test for vestibular tissue sensitivity. **(NEW)** The test is performed with a cotton swab moistened with water or lubricating gel. Gentle pressure is applied to the following areas of the vaginal vestibule FN2.19 in random order: 12:00, and quadrants 12-3:00, 3:00-6:00, 6:00-9:00, 9:00-12:00 FN2.20.	• positive if gentle pressure reproduces patient's pain • report location of pain and severity on NRS 0 – 10[37] • negative
Tests of digital palpation *per perineum* for sacral reflex function	
2.1.17 Sacral reflex testing: a measure of the involuntary function of sacral nerves. **(CHANGED)**[12] FN2.21 Tests are described below.	• present: observation of anal sphincter contraction. Indicative of intact spinal reflex arcs (S2–S4 spinal segments) with afferent and efferent nerves through the pudendal nerve[41]

	• absent: no sphincter activity
2.1.17.1 Bulbocavernosus reflex (*f*): A reflex contraction of the anal sphincter and bulbocavernosus in response to squeezing the clitoris **(CHANGED)**[12].	• present • absent
2.1.17.2 Bulbospongiosus reflex (*m*): a reflex contraction of the striated muscles of the pelvic floor (anal sphincter) including bulbospongiosus muscles that occurs in response to various stimuli in the perineum or genitalia. Most commonly tested by placing a finger in the rectum and then squeezing the glans penis[42].	• present • absent
2.1.17.3 Anal reflex: a reflex contraction of the anal sphincter in response to a painful pin prick delivered to the perianal skin[12]. **(CHANGED)** FN2.22	• present • absent
Tests of digital palpation *per perineum* with PFM contraction FN2.23	
2.1.18 Voluntary contraction of the PFM: self-initiated activation of the PFM (same term as 2.1.7). Each of the bulbospongiosus / bulbocavernosus, ischiocavernosus and transverse perineii muscles may be palpated separately. The assessor may need to gently move the external genitalia (parting of the labia, lifting of the scrotum to one side) to effectively palpate the perineal response.	• present • absent • uncertain

Abbreviations: PFM, pelvic floor muscles; *f*, female; *m*, male; NRS, numeric rating scale.

2.2 Internal assessment *per vaginam* (*PV*) or *per rectum* (*PR*) by digital palpation

Resting state**:** The following terms (in Tables 4 and 5) are used to define, describe and rate PFM assessment in the resting state *per vaginam* (*PV*) or *per rectum* (*PR*) by digital palpation. Terms related to muscle tone are expanded upon in subsequent text in order to provide greater explanation of the term definitions and descriptions.

Table 4. Tests of digital palpation *per vaginam* / *per rectum*, resting state

Test	Rating
2.2.1 Sensation: test for presence, absence or altered quality of light touch sensation as for 2.1.12.	• present • absent • altered: increased or decreased
2.2.2 Presence of scarring: presence of scar tissue along vaginal walls or apex. **(NEW)**. Using a finger-tip, attempt to slide the scar in all directions. Assess for adhesion or lack of mucosal / vaginal wall mobility over underlying tissue. FN2.24	• present • location of adhesion • degree of healing • extent/magnitude amount of scar mobility • absent
2.2.3 Tone: see 2.1.13. The recommended position of the examining digit(s) is to place the palmar surface of the examining finger on the leavtor ani, *PV* or *PR*. Pressure or stretch is applied perpendicular to the muscle fibres to assess tone.	• normal • decreased tone (see 2.2.3.4) • increased tone (see 2.2.3.5)

Further details regarding terminology and assessment of muscle tone are provided in text section 2.2.3 below.	
2.2.4 Fasciculation: individual brief twitches in a muscle. They may occur at rest or after muscle contraction and may last several minutes[27,43].	• present • absent
2.2.5 Tenderness: see 2.1.15 and 2.1.15.1	See 2.1.15 and 2.1.15.1
2.2.6 Pudendal nerve provocation test: palpation of the pudendal nerve to reproduce patient's pain if entrapment is suspected. The nerve may be palpated at the ischial spine, sacrospinous and sacrotuberous ligaments, or pudendal canal. [44,45]. **(NEW)**	• positive (pain response) • negative
Per rectum only: **2.2.7 Digital rectal examination (DRE)** FN2.25**:** palpatory examination of the anorectal tissues FN2.26. **(CHANGED)**[42]	
2.2.8 Palpable anal sphincter gap (PR): a clear ''gap'' in the anal sphincter on digital examination indicates an anal sphincter tear. **(CHANGED)**[11] FN2.27	• present • absent • note location

Abbreviations: NRS, numeric rating scale; PR, *per rectum*

2.2.3 Muscle tone

Tone exists on a continuum, from hypotonicity (low tone) to hypertonicity (high tone). Normal tone may overlap with abnormally decreased muscle tone or abnormally increased muscle tone at either end of the tone spectrum, as illustrated in Figure 2. Tone is a dynamic physiological state modulated by many inputs: spinal cord, cortex, brainstem relays, stretch reflexes and cutaneous receptors, visceromotor reflex pathways, emotions and pain (anticipation or experience of pain).

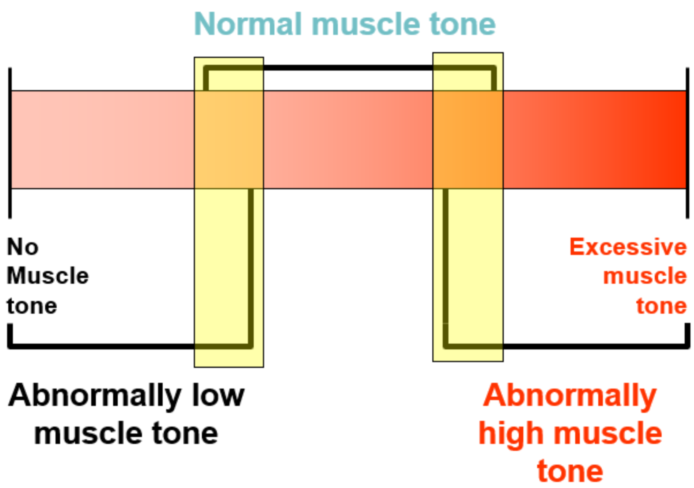


Figure 2: Spectrum of muscle tone (adapted from Allen & Widener 2009)[47]

We recommend terms to indicate alterations to normal tone are differentiated according to the presence or absence of a neurological disorder, as illustrated in Figure 3. Abnormal tone related to a neurological disorder (hypotonicity, hypertonicity, dystonia) should not be used when describing PFM tone in a patient who does not have a diagnosed neurological disorder.

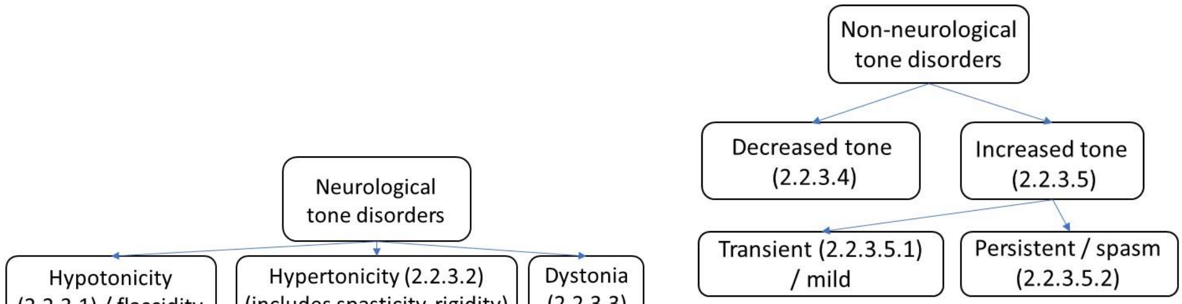


Figure 3a Terms for disorders of tone due to a neurological disorder

Figure 3b Terms for disorders of tone due to a non-neurological disorder

Figure 3 Terms for disorders of tone due to a neurological disorder (3a) and a non-neurological disorder (3b).

Physiological basis of muscle tone

Muscle tone has two components: the physiological contractile component, created by the activation of motor units, and the non-contractile viscoelastic, or biomechanical component. The active component (EMG activity) of tone is the component that is related to the neural drive, therefore it is subject to variation and ongoing adjustment. The viscoelastic component is independent of neural activity and reflects the passive physical properties of the viscoelastic tension of the muscle tissues (e.g. the extensibility of actin-myosin cross-bridges); non-contractile cytoskeleton proteins and connective tissues surrounding the entire muscle (epimysium), muscle fascicle (perimysium), and muscle fiber (endomysium) as well as the osmotic pressure of the cells. Alterations in either the active or passive component can affect the resting tone; digital palpation cannot differentiate between these elements however investigations that combine EMG with another measure that assesses passive properties can identify specific components.

A localised area of increased tone within a muscle may be referred to as a taut band(48). A trigger point is considered to be a tender nodule within a taut band(48). The trigger point is considered by some authors to be part of the active component of tone(48) given the local disturbance in electrical activity, and by others as a separate category distinct from the active or passive components of tone(49). Given the uncertainty about the characterisation of a trigger point(50,51), we propose describing palpatory findings by use of the terms ‘tender point’ (2.1.15.1) and ‘increased tone’ (2.2.3.4) if both observations coincide at the tested site, or use only ‘tender point’ (2.1.15.1) or ‘increased tone’ (2.2.3.4) if only one of those signs is observed at the tested site.

Assessment and rating

Tone can be assessed by application of digital site-specific compression and/or overall muscle stretch. Digital palpation is inherently subjective and may be limited by pain provocation. Several scales to quantify resting PFM tone in the absence of a neurological disorder have been proposed using either a 3-point[52,53], 6-point[54] or 7-point[55] scale.

Definitions and descriptions

2.2.3.1 Hypotonicity: a decrease in muscle tone in a patient **with** a neurological disorder. It may be due to a lower motor neuron or a muscle disorder. The term flaccidity[56] is often used interchangeably. (**NEW**)

2.2.3.2 Hypertonicity: an increase in muscle tone in a patient **with** a neurological disorder. It may be due to an upper motor neuron or extrapyramidal lesion, which in turn may lead to spasticity[56] or rigidity[56] (**NEW)**

2.2.3.3 Dystonia: a disorder characterized by abnormalities of muscle tone and movements/postures in a patient **with** a neurological disorder[57]. It is often due to damage to the basal ganglia or other brain regions that control movement. **(NEW)**

2.2.3.4 Decreased PFM tone: a decrease in resting muscle tone in a patient **without** a neurological condition **(CHANGED)**[43]

2.2.3.5 Increased PFM tone: an increase in muscle resting tone in a patient **without** a neurological disorder. **(CHANGED)**[43] . Increased tone may occur without patient report of pain.

2.2.3.5.1 Transient increased muscle tone: Increased muscle tone that decreases with verbal instruction, re-assurance or gentle pressure **(NEW).** Transient increase in tone may occur at any time during the examination.

2.2.3.5.2 Muscle spasm: persistent contraction of muscle that cannot be reduced voluntarily[11,27,43]. Spasms may occur at irregular intervals with variable frequency and extent, and over time may lead to increased viscoelastic stiffness and shortening in the muscular and connective tissues [FN2.28], [FN2.29].

Resting state *per vaginam* (*PV*) only (*f*)*:* terms related to digital palpation of the vaginal tissues with the PFMs in a resting state are listed in Table 5.

Table 5 Tests of digital palpation *per vaginam* only with the PFM in a resting state.

Test	Rating
2.2.9 Flexibility of the vaginal opening: the capacity of the vaginal opening to expand in response to stretching. **(NEW)** Assessed by separating index and middle finger in the medio-lateral direction[58]. Digital assessment of the vaginal opening is likely to represent the width of the levator hiatus [FN2.30].	• estimate the number of finger widths between the muscle bellies • can be converted to cm width for the recording from that assessor.
2.2.10 Levator injury/avulsion: a discontinuity of the levator muscle at its attachment to the inferior pubic ramus. **(NEW)** Discontinuity may represent a partial tear, full tear or thinning. Test for levator injury / avulsion: palpation of levator tissue, by placing finger(s) between the side of the urethra and the edge of the muscle measured on each side. The test is performed at rest and confirmed by asking the patient to	• absent: palpable PFM contraction next to the urethra on the inferior pubic ramus • present: a distance of > 3.5 finger widths between the two sides of puborectalis muscle insertion on PFM contraction[27] [FN2.31]. • rate number of finger widths palpable in the gap.

contract and feeling for the edge of the contractile tissue of the levator muscle.	• several rating scales exist[54,59].

Abbreviations: PFM, pelvic floor muscles.

Pelvic floor muscle contraction: the following terms in Table 6 are used in the definition and the ratings of digital assessment *per vaginam* / *per rectum* of the PFMs during contraction.

Table 6 Tests of digital palpation *per vaginam* / *per rectum* on PFM contraction.

Test	**Rating**
2.2.11 Voluntary contraction of the PFM: self-initiated activation of the PFM (same term as 2.1.7). A contraction is felt as a tightening, lifting, and squeezing action under the examining finger. Technique: • the recommended position of the examining digit(s) to assess levator ani contraction (*PV*) unilaterally is to place the palmar surface of the examining finger on the lateral levator ani muscle belly surface or 'edge', which may be identified by asking the patient to contract then relax • the recommended position of the examining digit to assess anal sphincter and puborectalis muscle function (PR) is to place the palmar surface of the well-lubricated examining finger at the anal verge initially, wait for relaxation of EAS, then insert	Presence of contraction may be rated as: • no contraction • correct contraction (cephalad and ventral movement) • contraction only with help from other muscles • uncertain • straining[61] Absent: **2.2.11.1 Non-contracting PFM**: during palpation there is no palpable voluntary or involuntary contraction of the PFM[26] $_{FN2.32}$.

gently along the posterior wall of the anal canal[60]. Once anal sphincter function is assessed the examining digit remains pressed against the posterior wall and is inserted slowly into the rectum, passing over puborectalis at the anorectal junction.	
2.2.12 Digital muscle test (DMT): a test to evaluate PFM strength **(NEW)**. **2.2.12.1 Strength**: force-generating capacity of a muscle. Usually expressed as a maximum voluntary contraction measurement (MVC)[27]. A manual muscle test (MMT) evaluates the strength of a muscle by moving the muscle through its full-range of motion against gravity and then against gravity with resistance[14]. However, because joint range of motion is not being assessed in the pelvic floor and PFM examination is performed with a digit, not a hand, the term DMT is preferred. There are more than 25 published DMT scales[62,63] which provide grade of strength ranging from absence, to weakness to increasing strength.	• Commonly used scales include: ICS scale: absent, weak, normal (we propose the word 'moderate' instead of normal), or strong[26] • modified Oxford grading scale 0-5[64] • Brink scale[65] grades 3 components (pressure, displacement, and time) on a scale of 1 to 4 • many others [62,63]
2.2.13 Direction of pelvic floor movement: direction of pelvic floor movement during voluntary PFM contraction palpated *PV* (on the posterior vaginal wall) or *PR*. **(NEW)**	• pelvic floor elevation: normal finding • pelvic floor descent: palpation of downward movement of the PFM during attempted PFM contraction

	• no change
2.2.14 Endurance: Muscular endurance refers to the ability of a muscle or muscle group to perform repeated contractions or to maintain a contraction for a predetermined period of time[66,67]. (**CHANGED)**[27]	**2.2.14.1 Fatigue:** a decreased capacity to perform a maximum voluntary muscle action or a series of repetitive contractions. **(NEW)** Fatigue may occur due to central or peripheral mechanisms[68]. A fatigued muscle is unable to continue working even when the type of activity is changed FN2.33. Record the time at which fatigue starts to occur, or the number of contractions in a row before onset of fatigue.
2.2.14.2 Sustained contraction endurance test: the number of seconds the patient can hold near maximal or maximal PFM contraction. **(NEW)**	• record number of seconds contraction is sustained at near maximal or maximal intensity
2.2.14.3 Repeatability of contraction: the ability to repeatedly develop near maximal or maximal force determined by assessing the maximum number of repetitions the patient can perform **(CHANGED)**[27] FN2.34.	• record number of contractions in a row
2.2.15 Number of rapid contractions performed: the number of repeated, quick MVCs performed **(NEW)**. This can be measured in two ways, according to the instruction: 1. number of contractions repeated within a specific duration (i.e. a 10-s period[5])	Use the rating appropriate to the instruction: 1. record the number of contractions repeated and the duration allowed to perform them

2. the elapsed time to perform a pre-specified number of contractions (e.g. 10-s[70]). A contraction should comprise an ascending and a descending phase with the PFM force returning to the resting state in between. If the maximal force declines, the assessment ceases.	2. specify the exact number of contractions to be repeated and record the number of seconds to completion. • qualitative descriptions can include quality and extent of contraction and relaxation phases.
2.2.16 Relaxation post-contraction: return of the PFM to its original resting tone following the voluntary contraction **(CHANGED)**[26] FN2.35. The patient is able to relax the PFMs on demand, after a contraction has been performed. Relaxation is felt as a termination of the contraction.	• yes: relaxation felt directly after instruction: normal finding • partial or delayed relaxation • no: absent = non-relaxing PFM (see 2.1.8.1).
2.2.17 Co-ordination: the ability to use different parts of the body together smoothly and efficiently[27]. In the pelvic floor, co-ordination may be an action between PFMs and organ function (e.g. PFM relaxation during voiding), PFMs and an external environmental event (e.g. movement of a limb) and PFMs and a rise in IAP (e.g. PFM contraction prior to a cough). Co-ordination is an aspect of motor control.	• present • absent. If absent, describe pattern of incoordination. e.g. paradoxical contraction: the inability to maintain PFM relaxation when it is expected; or lack of PFM contraction when it is expected.
2.2.17.1 Co-contraction: contraction of two or more muscles at the same time[27]. Co-contraction of muscles can be synergistic (e.g., resulting in an augmentation of motor activity) or it could be counterproductive to normal function (e.g., contraction of antagonistic muscles	• if present, identify which muscles are co-contracting, and whether the co-contraction is synergistic or counter-productive FN2.36.

resulting in abnormal movement or training other muscles instead of the targeted ones, e.g., training of gluteal muscles instead of the PFM)[27]. Activation or inhibition of PFM contraction may be task-dependent.	

Abbreviations: PFM, pelvic floor muscles; *PV*, *per vaginam*; *PR*, *per rectum*; EAS, external anal sphincter; DMT, digital muscle test; *f*, female; *m*, male; MVC, maximum voluntary contraction; IAP, intra-abdominal pressure.

Pelvic floor muscle contraction per vaginam (*PV*) only (*f*): terms related to digital palpation *per vaginam* only (*f*), on PFM contraction are listed in Table 7.

Table 7. Tests of digital palpation *per vaginam* only *(f)*, on PFM contraction FN2.37.

Test	**Rating**
2.2.19 Urethral lift: elevation of the urethra in a cephalad direction[16]. **(NEW)** Index finger is placed alongthe line of the urethra (on the anterior vaginal wall).	• yes: urethral lift palpable • no: no urethral lift palpable
2.2.20 Levator closure: movement of right and left muscle bellies closer together during a PFM contraction (palpated on the lateral vaginal wall)[16]. **(NEW).** May be tested unilaterally if bi-digital assessment is uncomfortable for the patient.	• yes: levator closure movement palpable • partial / uncertain: some closure movement palpable, but could be un-certain, or asymmetrical • no: no levator closure movement palpable
2.2.21 Levator hiatus size: the size of the levator hiatus measured during maximal	• with 2 fingers in the vagina, distance measured in centimeters (converted

contraction by a digital examination[71] FN2.38. **(NEW)**	approximately from finger widths) during PFM contraction • LH transverse: the distance between the left and right muscle bellies just inferior to the pubic bone • LH sagittal: the distance between the back of the pubic symphysis and the midline raphe of the puborectalis[71].

Abbreviations: *PV*, *per vaginam;* LH, levator hiatus.

Pelvic floor muscle response to intra-abdominal pressure *per vaginam* or *per rectum*

2.2.22 Direction of PFM movement during sustained increase in IAP: as per 2.1.9. Specify task instruction, as response may differ depending on wording. Rate as elevation, no change, descent (normal finding), excessive descent.

Following the assessment of a patient's clinical signs, the assessor will formulate a provisional differential diagnosis which will be refined following the results of the investigations.

FN2.1 Included in the physical examination may be the use of simple tools, such as a pin, cotton wool, reflex hammer etc.

FN2.2 When assessing sensory changes *PV* or *PR*, the clinician needs to determine whether s/he is detecting sensory change in the mucosa (mucosal sensitivity), or the underlying muscle (muscle tenderness) by attempting to differentiate the depth and firmness of palpation.

FN2.3 Depth of insertion of examining finger has been described for *per vaginam* assessment[17].

FN2.4 Visual observation of the exact position maybe influenced by variations in adipose tissue over the ischial tuberosities[21-24].

FN2.5 As the levator ani are likely to be co-contracting with the superficial PFM, the observed response is unlikely to be due to the superficial PFM layer alone, as the levator ani contraction is likely to be contributing to the observed response.

FN2.6 These movements may be observed alongside perineal elevation and may be better visualized in standing than supine. These observations to be checked against movement of the scrotum and the whole penis.

FN2.7 Modification: the word "excessive" has been removed from the previous definition[27] as some downward movement of the perineum is normal with coughing or bearing down such as in defecation.

FN2.8 The term ‘non-relaxing PFM’[26] was previously used as a diagnosis, however this term describes a sign, and is not recommended to be used as a diagnosis. This sign may be combined with symptoms to inform a clinical diagnosis.

FN2.9 The term ‘involuntary relaxation’ is not recommended to define perineal movement as it not possible to determine if the downward PFM movement is related to voluntary muscle relaxation or passive elongation of non-contractile tissue.

FN2.10 Some patients will not allow full relaxation during assessment for fear of releasing gas or urine, therefore may voluntarily contract during this test.

FN2.11 Adipose tissue at the ischial tuberosities will affect the measurement[21].

FN2.12 Perineal elevation with cough is expected but not always present.

FN2.13 Messelink et al described the response of perineal elevation to a rapid increase in IAP as the test for an involuntary contraction[26]. However it is not possible to say if this is an involuntary or reflex activation of muscle spindles resulting in a contraction, or a voluntary pre-contraction of the PFM before increased IAP. Strategies may differ or be combined[31].

FN2.14 This manoeuvre is also called “the knack”[32].

FN2.15 A small degree of descent may be normal[33].

FN2.16 Adherent skin could impact function of PFM beneath the scar.

FN2.17 Tender points (2.1.15.1) differ from trigger points (see 2.2.3) therefore the terms should not be used interchangeably[36].

FN2.18 This test is also referred to as the "Q Tip test". "Cotton swab" is preferred to avoid proprietary names.

FN2.19 Excessive pressure could provoke underlying structures (such as the PFM) misleading the report of pain to vestibular tissues.

FN2.20 Examination tip: in patients with high irritability, it is recommended to test the most severe pain area last to avoid an amplified response due to carry-over irritation as the test progresses[39,40]. In addition if an area provokes increased pain, it is important to wait for the pain to subside before testing other locations.

FN2.21 This term is listed as a modification of the term in Rogers et al[12].

FN2.22 In contrast to the bulbocavernosus reflex the anal reflex is a nociceptive reflex and the correct stimulus is painful. If a single stimulus does not activate the reflex, several pricks in a fast sequence should be delivered. It is often difficult to elicit in the elderly, and it should not be declared absent if only a single stimulus is used. A “voluntary” movement away from the (painful) stimulus (pin prick) can usually be interpreted correctly. The patient should be told that painful stimuli are going to be delivered, and usually they can “keep still” and only the reflex contraction of the anal sphincter is observed. It is often absent even in patients without a neural lesion.

FN2.23 Some of the tests performed in the external examination section may be repeated during the internal examination.

FN2.24 Adherent skin could impact function of PFM beneath the scar.

FN2.25 Despite the name (DRE), the purpose of the examination is usually to assess anal canal tissue, not rectal tissue.

FN2.26 DRE may be less useful in male urinary dysfunctions where the urethral sphincter, inaccessible to DRE, has a more important role[46].

FN2.27 An assessment can be made of a palpable anal sphincter gap to assess if there has been previous obstetric or surgical damage[11].

FN2.28 Terms such as short or elevated PFM may not be discernible via digital palpation and are therefore not recommended as sign terms.

FN2.29 If the spasm is painful, this is usually described as a muscle cramp.

FN2.30 Levator hiatus may be better measured with instruments (see Section 3).

FN2.31 <3.5cm may represent a partial avulsion, however digital palpation cannot reliably determine this distance of discontinuity

FN2.32 This term is referring to a sign and not recommended to be used as a diagnosis. This sign may be combined with symptoms to inform a clinical diagnosis.

FN2.33 Endurance training can delay the onset of fatigue[69].

FN2.34 Modification from Bo et al[27]: removal of "at a given percentage of 1 RM" as definition already states "near maximal or maximal force".

FN2.35 This can only be graded if the patient is able to generate a PFM contraction.

FN2.36 Antagonistic contraction has not been included in this document as there is not a muscle whose action counteracts the action of the PFM.

FN2.37 These tests are likely to produce more accurate results if measured using ultrasound imaging.

FN2.38 This test was performed in patients with POP; the same technique may be uncomfortable in women with pelvic floor pain or increased tone.

SECTION 3: INVESTIGATIONS

An investigation is part of the differential diagnostic decision-making process. A PFM investigation is the measurement of the morphometry or function of the PFMs using mechanical or technological methods. The findings may be considered more accurate than findings from a clinical evaluation which relies on digital palpation. Some points to note regarding PFM investigations that should be considered in clinical and research application and interpretation of the finding: all devices are different and may not give the same information of a specific PFM physiological parameter or function. In addition, device specifications and analysis software options influence both the availability and measurement of PFM parameters[72,73], the size and shape of a probe / sensor / electrode / transducer also influence the interpretation of findings[72-74] and raw values may need to be normalised. New devices to measure PFM properties may become available in the near future which do not fit the existing categories entirely, and new categories may need to be added to this living document.

3.1 *Dynamometry*: an investigation that measures both muscle power and force. **(CHANGED)**. Both active (contractile) and passive (non-contractile) forces can be detected.

3.1.a Intra-vaginal PFM dynamometry: Measurement of PFM resting and contractile forces using strain gauges mounted on a speculum (a dynamometer), which is inserted into the vagina[75] **(CHANGED)**.

Several PFM dynamometers have been developed to assess the PFM function in women[76-84].. Different configurations have been proposed in terms of the number, shape and the sizes of the branches, the force vector recorded (i.e. antero-posterior, latero-lateral or multi-directional forces) and the device specifications (e.g configuration of strain gauges to avoid a lever-arm effect – the influence of the force location in regards to the gauges). In some dynamometers, the branches can be separated at a constant speed either manually or with a motorised unit to assess the passive properties during dynamic stretches[81,85]. Elastometry is a type of intra-vaginal PFM dynamometer used for this specific application of evaluating the passive properties during dynamic stretches[81].

Table 8 describes the most frequent parameters measured with intra-vaginal dynamometers as well as their definitions, specifications and findings. Parameters can be assessed at different fixed vaginal apertures or during stretching (i.e. while imposing an elongation to the tissues by separating the speculum branches)[81,84]. The parameters measured with the dynamometer alone reflect the summative contribution of the active and passive components of tone. When combined with EMG, it enables the assessment of the differential contributions of tone components[86], i.e. during passive stretch of the PFM, concurrent EMG activity detects any electrogenic contributions. The passive component can then be identified when the EMG remains negligible[86,87].

Table 8. Parameters and findings evaluated with intravaginal dynamometry

Parameters, specifications (units of measure) and measurement processes	**Outputs and interpretation of findings**
a). Parameters assessed at rest	
3.1.1 Passive forces: the average forces in N recorded at rest[84]. (**NEW)** Specify: - opening (distance between the two branches e.g minimal opening, selected opening or maximal opening) - while stretching (dynamic opening)	The finding is the resting forces of the PFMs which are indicative of PFM tone i.e. the summative contribution of the active and passive components of tone.
3.1.2 Maximal aperture: the maximal vaginal opening in mm or cm of the dynamometer branches, without provoking a pain response[86]. (**NEW)**	This aperture can be used to evaluate the flexibility $_{FN3.1}$ of the PFMs.

3.1.3 Viscoelastic stress relaxation during a static (sustained) stretch: the percentage loss in passive force during the application of a steady stretch over a prolonged period (e.g. 1 min)[85,88]. (**NEW)**	Higher percentage of force decline is indicative of an enhanced viscoelastic stress relaxation response and muscle relaxation. This could be useful in quantifying tissue relaxation following stretching or lower force decline associated with strength training[88].
b). Parameters assessed at rest during dynamic stretching: Dynamic stretches are applied by repeatedly separating the speculum branches at a constant speed until maximal vaginal aperture (lengthening phase) and then, closing back to the minimal aperture (shortening phase).	
3.1.4 Stiffness: the resistance to deformation. Passive elastic stiffness is defined as the ratio of the change in the passive resistance or passive force (ΔF) to the change in the length displacement (ΔL) or ΔF/ ΔL (N/mm)[27,43,75] FN3.2. Passive elastic stiffness should be computed for specific vaginal apertures[81,84].	The higher the N/mm value, the stiffer the muscle. This is a physiological property of muscle which contributes to the overall measurement of tone.
3.1.5 Compliance: the reciprocal of muscle stiffness (mm/N)[43]. (**NEW)**	The higher the mm/N, the more compliant the tissue.
3.1.6 Hysteresis: the area between the lengthening and shortening curves (N x mm). It corresponds to the loss of energy associated with lengthening of viscoelastic tissues[85]. (**NEW)**	Increased area indicates higher energy dissipated.
c). Parameters evaluating contractile properties	

3.1.7 Maximal strength: peak force in N generated during a MVC. (**NEW).** The resting forces recorded prior to the effort are usually subtracted from the peak value[78]. Specify: - the length of hold for the MVC e.g. 10s contraction duration - how the peak score was obtained, e.g. peak during a single MVC, best of or average of 3 contractions.	Higher peak value indicates higher muscle strength.
3.1.8 Speed of contraction: rate of force development measured as the mean slope of the ascending curve in N/s during a fast MVC[79]. (**NEW)**	Higher rate of force (steeper slope) is indicative of a faster generation of force.
3.1.9 Speed of relaxation: rate of force reduction measured as the mean slope of the descending curve in N/s during PFM relaxation[86]. (**NEW)**	Lower values are indicative of slower relaxation.
3.1.10 Number of rapid contractions: see section 2.2.16 for definition and rating. A contraction must comprise an ascending and a descending phase with the amplitude of the PFM forces returning to the resting state post contraction[79].	Higher number of contractions are suggestive of higher speed of contraction but also better motor control, as the task requires alternation between MVC and complete rest.
3.1.11 Normalised area under the force curve: the area under the force curve divided by maximal force and multiplied by 100 (in % x prescribed s) during a sustained MVC[79]. (**NEW)**	Higher normalised area is indicative of better muscle endurance.

Abbreviations: N, Newtons; PFM, pelvic floor muscles; MVC, maximum voluntary contraction.

3.2 Myotonometry*:* an investigation that measures muscle tone characteristics by applying a mechanical impulse to the tissue[89-91]. (**NEW)** The device elicits oscillations of muscle after a probe applies a brief mechanical impulse with quick release under constant pre-load to the skin over the muscle belly. Myotonometry has been used externally on the perineum to measure superficial PFM stiffness. It cannot be used intra-vaginally to measure levator ani function as the probe must be perpendicular to the muscle and therefore cannot be used to interpret levator ani function. Table 9 describes the most frequent parameters measured with myotonometry that can be computed from the oscillation curve as well as their definitions, specifications and findings[92]. It should be noted that the tissues that lie between the probe and the muscle (e.g. skin, adipose tissues, connective and fascial tissues) can also influence the measurements.

Table 9 Parameters and findings evaluated with myotonometry

Parameters, specifications (units of measure) and measurement processes	**Outputs and interpretation of findings**
3.2.1 Oscillation frequency: characterises the intrinsic tension of the muscle in its passive or resting state in the absence of voluntary contraction[93]. (**NEW)** Measured in Hz.	A higher oscillation frequency (Hz value) indicates higher muscle tone[92,93].
a). Biomechanical properties:	
3.2.2 Stiffness: as defined in 3.1.4 for dynamometry. However, the method of application of the force is different to that described in 3.2.2; with this device, an external sensor applies a deformation perpendicular to the tissue.	A higher N/m value indicates higher muscle stiffness.
3.2.3 Logarithmic decrement: characterises elasticity and dissipation of mechanical energy. Measured as 1n (D = ln	Elasticity is inversely proportional to decrement, therefore, if the decrement of a muscle decreases,

[a1/a3])[93]. It indicates the ability of the tissue (including muscle) to recover its shape after being deformed. (**NEW)**	the muscle elasticity increases. The smaller the decrement value, the smaller will be the dissipation of mechanical energy and the higher the elasticity of a tissue.
b). Viscoelastic properties:	
3.2.4 Mechanical stress relaxation time: the time for a muscle to recover its shape from deformation after a voluntary contraction or removal of an external force. **(NEW).** Measured in milliseconds[92].	The longer the time the more relaxation has occurred in the tissue.
3.2.5 Creep: the gradual elongation of a tissue over time when placed under a constant tensile stress. **(NEW)**: Measured by the the ratio of relaxation time to deformation time (Deborah number).	The higher the creep, the less elasticity the tissue has and the more likely is permanent stretch or deformation.

Abbreviations: Hz, hertz; N/m, newtons/metre.

3.3 Manometry: an investigation that measures pressure[27,75].

3.3.1 Pelvic floor manometry: Measurement of resting pressure or pressure rise generated during contraction of the PFM using a manometer connected to a sensor, which is inserted into the urethra, vagina or rectum[27]..

3.3.1.a) Intra-urethral manometry: Manometry performed via the urethra. One example is the urethral pressure profile that is undertaken as part of a urodynamic investigation[94]. (**NEW)**

3.3.1.b) Intra-vaginal manometry: Manometry performed via the vaginal canal. (**NEW)**

3.3.1.c) Intra-anal manometry: FN3.3 Manometry performed via the anal canal. (**NEW)**

Pelvic floor manometric tools traditionally have measured pressure in mmHg, hPa or cmH_2O, however new and future devices may provide output using different units. It should be specified whether the device is calibrated to zero / atmospheric pressure prior to insertion[27]. The most common parameters assessed with pelvic floor manometry (intra-vaginal and intra-anal) and their findings are described in Table 10. Several common parameters are illustrated in Figure 4.

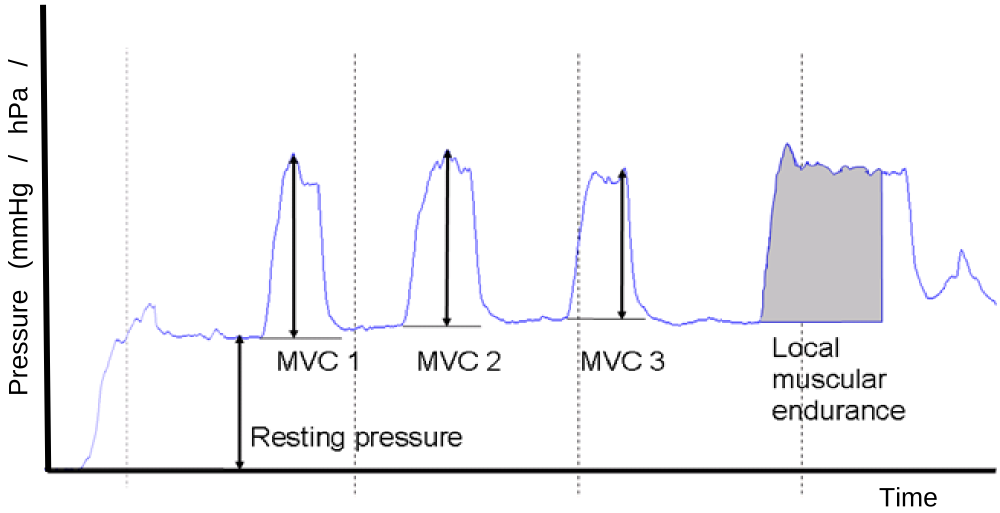


Figure 4: Graphical illustration of pelvic floor muscle manometry readings (modified from Ingeborg Hoff Braekken).

Table 10. Parameters and findings evaluated with pelvic floor manometry

Parameters, specifications (units of measure) and measurement processes	**Outputs and interpretation of findings**
a). Parameters assessed at rest	
3.3.1.1 Resting pressure: the pressure recorded at rest in mmHg, hPa or cmH_2O. For greater accuracy, a mean resting pressure	Higher resting pressure may be a surrogate measure of increased PFM tone. However, the value

may be calculated over a specified period to account for fluctuations(95,96). (**NEW)** Resting pressure may be influenced by PFM tone (i.e. summative contribution of the active and passive components).	should be interpreted with caution as the measurement is not limited to pressure originating from the PFMs (e.g. intra-abdominal pressure, vaginal tissue scaring, rectal contents may contribute to resting pressure).
b). Parameters evaluating contractile properties	
3.3.1.2 Peak pressure during a maximum voluntary contraction: highest pressure recorded during a PFM MVC in mmHg, hPa or cmH_2O. (**NEW)** As the pressure measured does not confirm its origin, it is important to ensure the validity of intra-vaginal measurement: 1) perform vaginal palpation before using the manometer to ensure the patient is able to correctly contract her PFMs; 2) observe the cranial movement of the vaginal probe during measurement of the muscle contraction and 3) ignore contractions associated with elevated intra-abdominal pressure (e.g. Valsalva maneuver), hip muscle contraction or any movement of the pelvis(97,98) FN3.4. Specify: - the length of hold for the MVC e.g. 3s/5s/10s contraction duration - How the peak score was obtained, e.g. peak during a single MVC /best of or average of 3 contractions(101-108).	Maximal pressure is often used as a surrogate of muscle strength e.g. higher pressure being related to higher strength.

3.3.1.3 Time to peak pressure: time in seconds from onset of muscle contraction to maximal pressure. (**NEW)**	Shorter time to peak is indicative of a faster generation of pressure.
3.3.1.4 Speed of contraction: rate of pressure rise measured as the mean slope of the ascending curve in hPa/s during a fast MVC. (**NEW)**	Higher rate of force (steeper slope) is indicative of a faster generation of pressure.
3.3.1.5 Speed of relaxation: rate of pressure reduction measured as the mean slope of the descending curve in hPa/s during PFM relaxation. (**NEW)**	Lower values are indicative of a slower relaxation.
3.3.1.6 Number of rapid contractions: see 2.2.16 and 3.1.10 for definitions and ratings.	See 3.1.10 for interpretation.
3.3.1.7 Time to return to baseline pressure: time in seconds from maximal pressure to relaxation state. (**NEW)**	Longer duration suggests slower relaxation.
3.3.1.8 Duration of a sustained contraction: the length of time in seconds that a contraction can be sustained during MVC or at a specific % of MVC. (**NEW).** Specify if it is a maximal contraction or a % of MVC e.g 60%[96,101,104,106,108] and the threshold used to indicate that the target is no longer maintained.	A shorter duration suggests a lower endurance. Duration of contraction could be used as an indication of endurance e.g. longer contraction being related to better endurance.
3.3.1.9 Area under the pressure curve during a sustained contraction: the area under the pressure curve in hPa multiplied by time in s during a sustained MVC or at a specific percentage of MVC. This represents the total work performed. (**NEW).** Specify the duration of the contraction e.g 10s, 30s, etc.[95,107].	Higher area under the pressure curve above resting pressure reflects better muscle endurance.

Abbreviations: PFM, pelvic floor muscles; MVC, maximum voluntary contraction.

3.3.2 Anorectal manometry FN3.5: is a pressure test to assess the structure and physiological function of the anorectal complex **(CHANGED)**[11]. Water perfused and solid-state pressure transducers are used in combination with a balloon positioned in the anal canal[26]. The most commonly used PFM parameters and findings are described in Table 11. FN3.6

Table 11. Parameters and findings evaluated with anorectal manometry

Parameters, specifications (units of measure) and measurement processes	**Outputs and interpretation of findings**
a). Parameters assessed at rest	
3.3.2.1 Functional anal length: the length (mm) of the anal canal over which resting pressure exceeds that of the rectum. **(CHANGED)**[11] The length of the canal is measured either by station pull-through or continuous pull-through[11].	Functional anal canal length has been shown to be shorter in females with fecal incontinence and longer in females with chronic constipation[109].
3.3.2.2 Maximum resting pressure: the highest pressure (in mmHg, hPa or cmH_2O) along the anal canal measured in the axial plane at a specific point. **(CHANGED)**[11]	Internal anal sphincter (IAS) (smooth muscle) is responsible for 55-85% of the anal pressure, and is variable along the length of the anal canal with the proximal two thirds being more reliant on IAS tone to maintain adequate resting pressures. Low anal resting pressure is associated with passive fecal soiling. High anal resting pressure may be a feature of constipation[110].
b). Parameters evaluating contractile properties	

3.3.2.3 Maximum pressure during MVC / maximum squeeze pressure: is the anal canal pressure (in mmHg, hPa or cmH_2O) measured during maximum voluntary contraction (MVC) in a specific location **(CHANGED)**[(11)].	The pressure increment above resting pressure during these maneuvers is primarily a representation of EAS function. Range of normative values varies according to the particular measurement device in a laboratory[(11)]. Decreased voluntary anal sphincter contraction is associated with fecal incontinence especially fecal urgency[(110)].
3.3.2.4 Duration of sustained contraction MVC / endurance squeeze pressure: is the length of time (in seconds) the individual is able to maintain the pressure during the MVC **(CHANGED)**[(11)].	Shorter duration suggests a lower endurance. To assess the endurance squeeze pressure, measurements are taken during a 5-10s squeeze. By calculating fatigability, the fatigue rate (using reduction of the mean pressure over 1-s periods throughout the endurance squeeze) can be derived[(11)].
3.3.2.5 Number of rapid contractions: see 2.2.16 and 3.1.10 for definitions and ratings.	See 3.1.10 for interpretation.
3.3.2.6 Involuntary maximum squeeze pressure: the pressure (in mmHg, hPa or cmH_2O) created involuntarily by the PFM during a maximal cough[(100)] **(CHANGED)**[(11)]. FN3.7	• present; numerical values of pressure change may be used to further quantify • absent; associated with faecal incontinence[(111)]
3.3.2.7 Balloon expulsion pressure: the anal canal pressure (in mmHg, hPa or cmH_2O) during straining with a filled balloon in the rectum[(11)]	• increase from resting pressure suggests paradoxical contraction (see 4.3.1) and is associated with evacuation dysfunctions • no change

	• decrease from resting pressure (normal)
3.3.2.8 Rectoanal inhibitory reflex (RAIR): the relaxation response in the IAS following rectal distension (in mmHg, hPa or cmH_2O) [11]. It is elicited by rapid inflation to first sensation of a balloon positioned in the distal rectum during anal manometry at the level of the proximal high-pressure zone.	• present: a drop of at least 25% of resting pressure has to occur with subsequent restoration to at least two thirds of resting pressure for the RAIR to be deemed present. This reflex is thought to underlie the sampling response that allows rectal contents to be sensed by the anal mucosa, thus ensuring continence of flatus and stool[11,112] • absent: seen in Hirchsprung disease, fecal incontinence, constipation and after anorectal surgery[110]

Abbreviations: PFM, pelvic floor muscles; MVC, maximum voluntary contraction; IAS internal anal sphincter.

3.3.2.9 Vector manometry: a three-dimensional pressure profile of the anal canal. **(CHANGED)**[11]. Measures of total anal canal pressure and symmetry are made. The vector volume is the volume of the 3D shape generated and provides a value which reflects the overall length and symmetry of the sphincter.

3.3.2.10 High resolution manometry: complete definition of the intra-anal pressure environment using a catheter with a large number of pressure sensors spaced less than 0.5 mm apart along the length of the catheter[11].

3.3.2.11 Ambulatory anorectal manometry: is a test performed using solid-state catheters in ambulant subjects an over an extended period of time **(CHANGED)**[11].

3.4 Electromyography (EMG)*:* is the recording of electrical potentials generated by the depolarization of muscle fiber membranes[27]. Investigators reporting PFM EMG studies should state the position of the patient, the recording equipment[26] and conditions used as summarised in Box 2. Nerve conduction studies e.g. pudendal nerve testing, are beyond the scope of this document.

Box 2: System specifications

Recommendations for reporting EMG studies (based on the recommendations of the International Society of Electrophysiology and Kinesiology[113]).
Reports on surface EMG should include: - electrode material (e.g., Ag/AgCl) - electrode geometry (discs, bars, rectangular) - number and size (e.g., diameter, radius, width, length) - interelectrode distance - use of gel or paste - skin/mucosal preparation (e.g. alcohol applied to cleanse skin, skin abrasion, shaving of hair, etc.) - electrode location, orientation over muscle with respect to tendons, motor point (if known) and muscle fiber direction. - type of ground electrode used, location.
Reports on intramuscular wire electrodes should include: - wire material (e.g., stainless steel) - if single- or multi-strand - if single or bipolar wire - interelectrode distance - insulation material

- length of exposed tip - method of insertion (e.g., hypodermic needle) - depth of insertion/method of insertion guidance - location of insertion in the muscle - type of ground electrode used, location.
Amplifiers should be described by the following: - type (monopolar, differential, double differential, etc.) - pre-amplification at the level of the electrode - input impedance - Common Mode Rejection Ratio (CMRR) - actual gain range used.
Filtering of the raw EMG should be specified by: FN3.8 - low and/or high pass filter properties (e.g. cut-off frequencies, order) - filter types (e.g., Butterworth, Chebyshev, Notch, etc.) - notch filter

Important considerations when interpreting EMG signals: Baseline and contractile sEMG amplitude is affected by properties of the electrode, configuration of electrodes, recording system and patient/individual characteristics. Raw amplitude cannot be compared between individuals because the signal's amplitude is affected by many factors (e.g. cutaneous/mucosal tissue thickness, vaginal lubrication, positioning/direction of electrodes with respect to the muscle and muscle fibres, and properties of the detection system[(114-116)]). As a consequence, normalisation of the sEMG amplitude is considered critical when comparing data across individuals[(117)].

3.4.a) Artefact: extraneous information in the EMG signal from sources other than the target muscle, such as the environment (e.g. electromagnetic radiation) or other body functions.

Artefact examples include movement or contact quality artefact, heart rate, skin electrode shear, and electrode bridging **(CHANGED)**[27].

3.4.b) Cross talk: muscle activity from nearby muscles that can contribute to the recorded EMG amplitude and be misinterpreted as PFM activation[27]. FN3.9

3.4.1 Intramuscular EMG: is a recording of motor unit action potentials using needle (concentric or monopolar) or wire electrodes inserted into muscles[75,119]. **(CHANGED)**[27]. This is not typically used in clinical assessment. The electrodes can be inserted to assess the superficial (e.g. bulbocavernosus) and deep layers (e.g. levator ani) of the PFMs as well as the urethral and anal sphincters[120]. This assessment as a rule focuses on the motor units to investigate motor unit physiology and pathophysiology. Parameters evaluated with concentric needle EMG can be used to differentiate between normal, denervated, reinnervated and myopathic muscle[121,122]Quantitative EMG includes analysis such as the multi-motor unit potential analysis[122] and the interference pattern analysis (turns/zero crossing or amplitude)[122].

3.4.2 Surface electromyography (sEMG): is a recording of motor unit action potentials using surface electrodes placed on the skin or mucosa close to the muscle of interest. Recordings are also used in assessment of the activation pattern/'behaviour' (sometimes referred to as kinesiological electromyography) of a particular muscle during a defined activity[121]. sEMG requires electrodes placed on the skin of the perineum or inside the urethra, vagina or rectum **(CHANGED)**[12,27]. Parameters and findings evaluated with sEMG are described in Table 12. Several common parameters are illustrated in Figure 5.

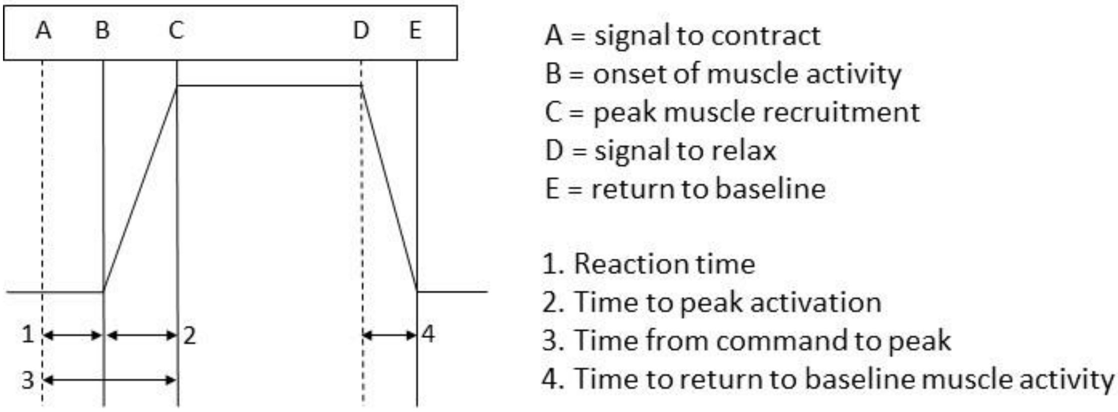


Figure 5: Parameters measured using electromyography

Table 12. Parameters and findings evaluated with sEMG

Parameters, specifications (units of measure) and measurement processes	**Outputs and interpretation of findings**
a). Parameters assessed at rest	
3.4.2.1 Baseline muscle activity: the amount of microvolts generated by activation of motor units in the target muscle during rest[27,75]. FN3.10 , FN3.11	**3.4.2.1.1 Inconsistent resting baseline**: the variation of baseline between contractions, between sets, or between days[27,75]. **3.4.2.1.2 Elevated resting activity:** an increase in the active component of muscle tone; (the passive/viscoelastic component is not captured by sEMG). (**NEW**.
b). Parameters evaluating contractile properties	
3.4.2.2 Signal amplitude: microvolts (μV) a muscle generates[27]. Specify:	sEMG amplitude reflects muscle activation[117]. Increase in sEMG amplitude is related to the recruitment of motor units and increased firing

- MVC contraction duration (s) - how the signal was processed. Signals are usually rectified and filtered to measure amplitude(114) i.e. average rectified value or root-mean-square(114).	rate(118). The amplitude of the signal should not be interpreted as a direct force measurement because the relationship between force and EMG is generally not linear and is affected by type of contraction (concentric/isometric/eccentric), speed of contraction.). During strength training, early gains in force output are mainly related to an increase in motor unit recruitment and discharge frequency which will result in a higher signal amplitude. Later gains explained by hypertrophy(27) are not reflected in increased sEMG amplitude
3.4.2.3 Peak amplitude: the highest sEMG amplitude achieved measured in microvolts(27,75). Specify the duration (s). Measured during an MVC or functional activities such as postural tasks or incontinence provocative activities(125,126). FN3.12	
3.4.2.4 Normalization of the amplitude: the value obtained during a specific task as a percent relative to the electrical activity detected during a MVC(113,117). (**NEW)**	
3.4.2.5 Time to peak muscle activation: time in ms or s from onset of muscle activity to peak activity. (**NEW)** **Rate of change:** the mean slope of the ascending curve in μVs during a fast MVC**.** (**NEW)**	**3.4.2.5.1 Slow recruitment:** a longer time to peak muscle activation in s or a slower rate of change(127) **(CHANGED)**(27). FN3.13, FN3.14
3.4.2.6 Reaction time: the latency (time in ms) between a stimulus (or the command) and the onset of muscle activation(128). **(NEW)** FN3.15 **3.4.2.7 Time from command to peak:** time in ms from stimulus to peak activity. (**NEW)** This term	**3.4.2.6.1 Slow reaction time:** a longer time to initiate muscle activation. (**NEW)**

encompasses both the reaction time and the time to peak muscle activation.	
3.4.2.8 Time to return to baseline muscle activity: time in s from peak activity to resting activity. (**NEW)** **Rate of change:** the mean slope of the descending curve in uV/s during a fast MVC**.**	**3.4.2.8.1 Slow de-recruitment**: slow relaxation of the muscle contraction(27).
3.4.2.9 Rate of change of amplitude during sustained contraction: the change in sEMG amplitude divided by the duration of the contraction: $EMG_{final} - EMG_{initial}/time(s)$(129). (**NEW).** The contraction could be sustained or intermittent at different % of MVC(129).	A higher rate of change will be indicative of lower endurance.
3.4.2.10 Timing of muscle activity: onset of the activation in milliseconds can be assessed in relation to onset of activation in other muscles, provocative activities or other aspects of a task. (**NEW)**	• normal • delayed: delayed activation of the PFM relative to the onset of a cough or a postural perturbation has been found in women with stress urinary incontinence(126)
3.4.2.11 Duration of a sustained contraction: the duration in seconds that a contraction could be sustained at a specific % of MVC(129). (**NEW)**	A shorter duration suggests lower endurance.
3.4.2.12 Power spectrum: the distribution of frequency components of the sEMG signals, measured in Hz(114). (**NEW)**	The median frequency of the sEMG power spectrum shifts to lower frequencies as a muscle fatigues due to altered muscle fiber recruitment

	and other changes in the contractile properties[130,131].

Abbreviations: sEMG, surface electromyography; MVC, maximum voluntary contraction; PFM, pelvic floor muscles; uV microvolts.

3.5 Imaging*:* refers to the process of creating images using high-energy modalities to allow visualization of body tissues. Imaging provides tissue-specific evaluation to identify if morphological properties (e.g. trauma or deficit) are present, which may relate to an individual's presenting symptoms[27,75]. In this document, we focus on ultrasound and MRI assessment and the terms related to PFM morphology and function, as well as the influence of other structures on PFM support and contractility investigated using these tools. It is not within the scope of this document to describe imaging of organ structures.

Ultrasound imaging: Pelvic floor ultrasound imaging measures PFM morphology and function via trans-abdominal, trans-perineal, trans-vaginal and trans-anal placement of the transducer **(CHANGED).**[12,43]. This investigation applies diagnostic techniques taken in B-mode that use high-frequency sound waves to image internal structures. The image is formed by the differing reflection signals produced when a beam of sound waves is projected into the body and bounces back at interfaces between those structures. Ultrasound evaluation may be undertaken as:

3.5.1.a) Two-dimensional (2D) ultrasound: the transducer sends and receives ultrasound waves in one anatomical plane. The reflected waves are used to generate grey scale images of structures in the field of view in this anatomical plane.

3.5.1.b) Three-dimensional (3D) ultrasound: creates volume data from multiple 2D images which are gathered by reflected waves at a variety of angles. Software integrates this information to create a single static 3D image.

3.5.1.c) Four-dimensional (4D) ultrasound: is similar to 3D US, but the image is repeated at intervals over time. This technique requires the use of a 3D/4D transducer and enables real-time visualization of 3D images.

3.5.1.d) Tomographic ultrasound: is viewing US imaging in sections. It allows the depiction of arbitrarily defined planes from volume data obtained in 3D or 4D US[132,133].

Measurements are best understood by referring to anatomical planes of the body, i.e coronal (frontal), sagittal and axial (horizontal or transverse) planes.

3.5.1.1 Trans-abdominal pelvic floor ultrasound: A 2D imaging technique to scan pelvic floor structures, using a convex transducer is placed in the supra-pubic region. (**NEW**) It can be oriented longitudinally to measure bladder base displacement in the mid-sagittal or parasagittal plane or oriented transversely to measure bladder base symmetry and displacement in the transverse plane. Trans-abdominal pelvic floor ultrasound is primarily used in clinical settings rather than for research purposes due to limitations measuring the image (no bony landmarks in view and difficulties for operator to keep transducer in plane - operator error is high). Artefact in measurement may also occur with incorrect PFM contraction when abdominal muscle contraction occurs (which pushes the transducer ventrally) and varying levels of bladder fullness (adherence to a fluid intake protocol may mitigate this limitation). Poor agreement between transverse and sagittal findings suggests measurement in the two planes evaluate displacement at different locations during a PFM contraction[134].[134]. Table 13 describes the parameters and anatomical landmarks evaluated in the mid-sagittal plane, during different activity states of the PFM: rest, contraction and bearing down.

Table 13. Parameters and findings evaluated with trans-abdominal ultrasound imaging in the mid-sagittal plane

Parameters, specifications (units of measure) and measurement processes	**Outputs and interpretation of findings**
3.5.1.1.1 Bladder base displacement FN3.16: a marker is placed at the point of greatest displacement (mm or cm) of the infero-posterior bladder wall at rest and at maximal contraction or bearing down[135]. Direction and displacement of the bladder base movement from rest to final position. **(NEW).** The bladder base is the most infero-posterior aspect of the bladder wall.	*PFM contraction:* Displacement from rest of the bladder base during (attempted) PFM contraction[136]: • Elevation (normal response): movement of the bladder base in a cephalad and ventral direction toward the pubic bone infers contraction of the levator ani/puborectalis • No change • Descent: movement of the bladder base caudal and posterior away from the pubic bone infers elevated intra-abdominal pressure – PFMs may be active but this cannot be confirmed. *Bearing down:* Displacement of the bladder base during sustained increased intra-abdominal pressure: • Elevation • No change • Descent

Abbreviations: PFM, pelvic floor muscles.

Parameters and findings evaluated with trans-abdominal imaging in the transverse plane – during different activity states of the PFM (rest, contraction and bearing down) – are described in Table 14.

Table 14. Parameters and findings evaluated with trans-abdominal ultrasound imaging in the transverse plane

Parameters, specifications (units of measure) and measurement processes	**Outputs and interpretation of findings**
3.5.1.1.2 Symmetry of the bladder base: equal curvature of bladder base with probe placed in the transverse plane. **(NEW)**	*Rest:* Symmetrical or asymmetrical. Asymmetry can be related to unilateral increased tone, unilateral decreased tone, operator error in probe position, or asymmetry of passive support (e.g. unilateral ligament damage/trauma). FN3.17
3.5.1.1.3 Bladder base displacement FN3.18**:** see 3.5.1.1.1. Movement of the bladder base (in mm or cm) is used as a surrogate measure for activity of the PFM.	*PFM contraction:* Displacement of the bladder base during attempted PFM contraction: • Elevation (normal response): movement of the bladder base in a cephalad/ventral directionNo change • Descent: movement of the bladder base in a caudal/dorsal direction *Bearing down:* Displacement of the bladder base during sustained increased intra-abdominal pressure: • Elevation • No change • Descent (normal response)

Abbreviations: PFM, pelvic floor muscles.

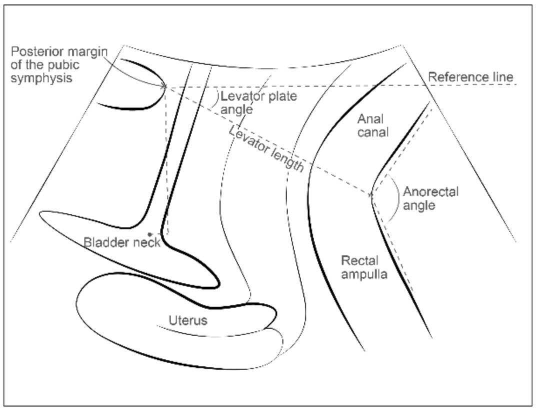
3.5.1.2 Introital pelvic floor ultrasound: 2D/3D/4D imaging technique to scan pelvic floor structures using an endocavity3.19 transducer placed against the vaginal introitus/vulva or perineum[4]. **(NEW)** The transducer may be oriented ventrally/anteriorly to assess the pelvic floor structures (prolapse, levator ani muscle anatomy and function, and periurethral area), or oriented posteriorly to assess the anal sphincter structures.

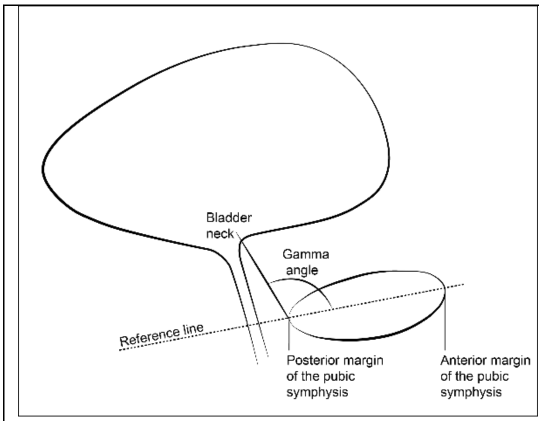
3.5.1.3 Perineal pelvic floor ultrasound: 2D/3D/4D imaging technique to scan pelvic floor structures using a convex transducer placed against the perineum/vulva[4]. **(NEW)** The transducer may be oriented longitudinally/sagittally (for bladder neck/urethra, prolapse, and levator ani muscle assessment), or oriented transversely (for assessment of anal canal, sphincters). The terms transperineal and translabial ultrasound are both used to refer to perineal ultrasound.

Parameters and findings evaluated with perineal and introital pelvic floor ultrasound – during different activity states of the PFM or actions (rest, contraction and bearing down) – are presented in Table 15.

Table 15. Parameters and findings evaluated with perineal and introital ultrasound imaging assessed in the mid-sagittal plane using a 2D/4D transducer oriented longitudinally/sagittally.

Parameters, specifications (units of measure) and measurement processes	**Outputs and interpretation of findings**
a) Parameters and anatomical landmarks assessed in the mid-sagittal plane using a 2D/4D transducer oriented longitudinally (f)	
Bladder neck parameters: measurement of bladder neck position **3.5.1.3.1 Bladder neck position:** refers to the bladder neck position relative to the pubic symphysis (PS)[137]. The position is analyzed in a horizontal (x-axis) and vertical position (y-axis)	*Rest:* Quantification of bladder neck position at rest from the horizontal and vertical distances from the PS[138,145]Resting position of the bladder neck was

relative to a horizontal reference line (measured in mm or cm). **(NEW)** Specify if using: the infero-posterior margin (Figure 6)[138] FN3.20, the lowest margin[139], or the central axis (line drawn from the anterior to the posterior margin) of the PS (Figure 7)[140]; the middle of the proximal urethra for the internal meatus[141], the anterior bladder neck[142] or equidistant points along the urethra from bladder neck to external urethral meatus[143].  Figure 6: Perineal ultrasound parameters and anatomical landmarks assessed in the mid-sagittal plane using a horizontal reference line drawn from infero-posterior margin of the pubic symphysis.	found to be higher after PFM training[143]. *PFM contraction:* Cranio-ventral displacement of the bladder neck [18] measured as: a decrease in x-value and increase in y-value. The ventro-cranial displacement of the bladder neck is measured as displacement = $\sqrt{(\Delta x^2 + \Delta y^2)}$[141,145]. The higher the value, the greater the ventro-cranial displacement of the bladder neck (bladder neck lift), which reflects the lifting action of the PFM[141,146-148]. *Bearing down:* On bearing down with the instruction to relax the PFM, the dorso-caudal displacement is measured at the point of maximal displacement during the manoeuvre[145]. As the proximal urethra descends, the x-value increases and the y-value decreases. The higher the value,

 Figure 7: Perineal ultrasound parameter (gamma angle) assessed in the mid-sagittal plane using a reference line drawn from the anterior to the posterior margin of the pubic symphysis[144].	the greater the dorso-caudal displacement of the bladder neck (bladder neck descent or mobility)[18,141,148]. Higher mobility is observed in incontinent women.
3.5.1.3.2 Angle γ (Gamma)/Pubo-urethral angle: is the angle (in degrees) between the bladder neck and a line drawn from the anterior to the posterior margin of the pubic symphysis[144] **(NEW)** (see Figure 7).	*Rest:* Quantification of the angle at rest[149]. *PFM contraction:* a change of the angle γ from rest to a maximal PFM contraction. A reduction of the angle is expected as the bladder neck displaces ventrally and caudally. *Bearing down:* method to assess bladder neck descent/mobility[144]. A larger angle indicates a greater descent of the bladder neck[138], which has been related to incontinence.

3.5.1.3.3 Perineal body: should appear as a triangular shaped, slightly hyperechoic (white) structure anterior to the anal sphincter[11].	Indicates if the integrity of the perineal body is normal or compromised.
3.5.1.3.4 Levator plate angle: the angle (in degrees) between a horizontal reference line at the level of the infero-posterior margin of the PS intersecting a line from the infero-posterior margin of the PS to the anorectal angle[145,150]. **(NEW)** (see Figure 6)	*Rest:* Quantification of the levator angle at rest. Elevated levator plate angle may be indicative of increased tone in the PFM[147]. *PFM contraction:* An increase of the levator plate angle in comparison to the angle at rest. Levator plate excursion is calculated by subtracting the angle at rest from the angle during contraction[147]. *Bearing down:* A decrease of the levator plate angle in comparison to the angle at rest. Levator plate excursion is measured as per contraction, smaller angle is expected[145].
3.5.1.3.5 Levator hiatus length: the distance (mm or cm) between the infero-posterior margin of the pubic symphysis to the anorectal angle, representing the levator hiatus antero-	*Rest:* Quantification of the levator hiatus? at rest. Smaller levator plate length could be

posterior diameter in the mid-sagittal view[146,150]. **(NEW)** (see Figure 6)	suggestive of high tone in PFM[147]. *PFM contraction:* A reduction of the levator hiatus It has been demonstrated to reflect a PFM contraction[137,149]. *Bearing down:* An increase of the levator plate length is expected.
3.5.1.3.6 Anorectal angle: the angle (in degrees), formed by the longitudinal axis of the anal canal and the posterior rectal wall[11].	*Rest:* Quantification of the anorectal angle at rest. Smaller anorectal angle could be suggestive of increased tone in the PFM[147]. *PFM Contraction:* A reduction in the anorectal angle during a PFM contraction. The excursion of the anorectal angle is calculated as the angle during contraction of the levator ani muscle minus the angle at rest. Larger excursion could be suggestive of stronger activation of the PFM[147,151,152].

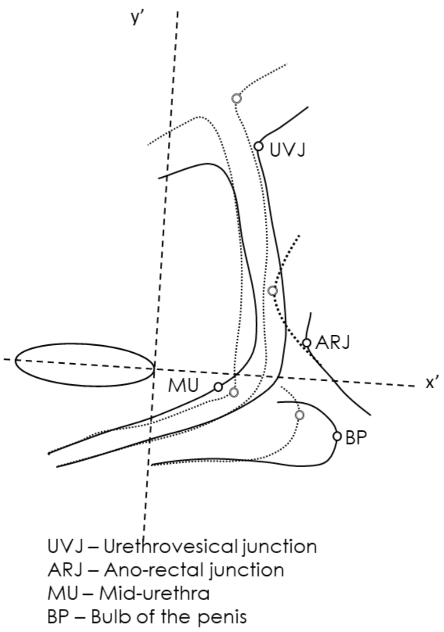
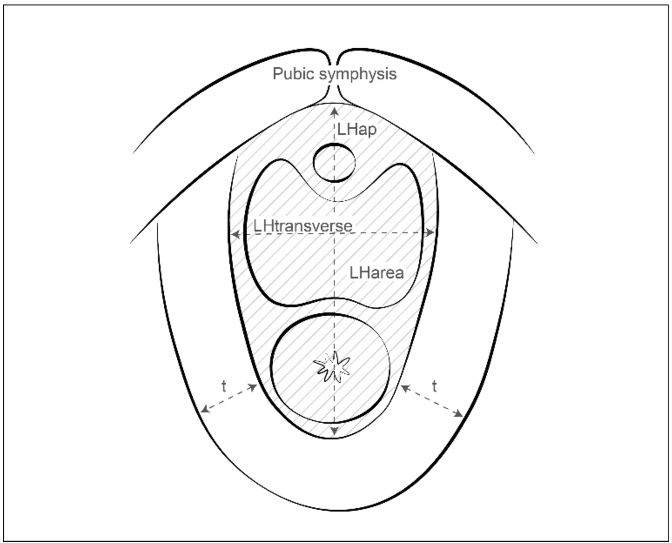
	Bearing down: Widening of the anorectal angle is expected[152]. If absent, PFM dyssynergia may be present.
b). Parameters and anatomical landmarks assessed in the mid-sagittal plane using a 2D transducer oriented longitudinally/sagittally (m)	
Displacement or position (in mm or cm) of anatomical landmarks are assessed to interpret activation of individual PFM[28,30]. **3.5.1.3.7 Urethro-vesical junction:** The point of maximal inflection of a line drawn along the dorsal border of the urethra and the bladder neck[28,30]. **(NEW)** **3.5.1.3.8 Anorectal junction:** The ventral-most point of a line drawn along the ventral aspect of the rectum at the anorectal junction. **(NEW)**  	For the displacement of the anatomical landmarks described below, the displacement during contraction and cough are measured in relation to the resting position values[28,154]. Movement of these landmarks has been correlated with activation of levator ani (puborectalis)[28] **For 3.5.1.3.7 and 3.5.1.3.8:** *Rest:* The position of these landmarks in the caudo-cranial and antero-posterior planes can be quantified relative to the dorsal pole of the PS at rest (see Figure 8). Lower resting position has been observed in incontinent men[154].

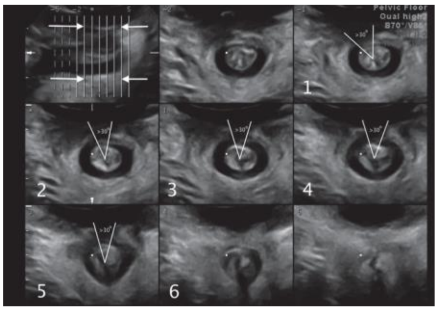
Figure 8: Parameters and anatomical landmarks assessed in the mid-sagittal plane using a 2D transducer oriented longitudinally/sagittally in men (reproduced with permission from Stafford et al[153]). Legend: This figure overlays two images illustrating the anatomy at rest (continuous lines) and during maximal pelvic floor contraction (dotted-lines).	*PFM contraction:* Cranio-ventral displacement is expected[28,155]. *Cough:* Caudal-dorsal motion can be observed during the pressurization phase of cough due to levator ani muscle lengthening (probable eccentric contraction, but this cannot be confirmed from US imaging) during the phase when intra-abdominal pressure increases. This is followed by cranial-ventral displacement that occurs due to PFM shortening (concentric contraction).
3.5.1.3.9 Bulb of the penis: the dorsal-most point on a line drawn around the bulb of the corpus cavernosum penis. (**NEW)**	*Contraction:* Cranio-ventral displacement is expected due to bulbocavernosus shortening[28,30,154]. *Cough:* Cranio-ventral displacement is expected due to bulbocavernosus shortening[30].

3.5.1.3.10 Mid-urethra: A point on the ventral border of the membranous urethra that undergoes the greatest dorsal movement during contraction. This point is located within 2.5 mm either side of a line drawn between the dorsal pole of the pubic symphysis and the most dorsal aspect of the bulb of the penis **(NEW)** (see Figure 8).	*PFM contraction:* Dorsal displacement is expected due to striated urethral sphincter shortening[28,30]. *Cough:* Dorsal displacement of the mid-urethra due to striated urethral sphincter shortening[28,30].
c). Parameters and anatomical landmarks assessed in the axial plane using the 4D transducer oriented longitudinally (f)	
3.5.1.3.11 Hiatal dimensions: cross-sectional area of the pelvic floor/levator hiatus, including antero-posterior and transverse distances[27] Measured in the plane of minimal hiatal dimensions[18]. A transverse view is obtained and the plane of minimal hiatal dimensions is identified by moving the field of view cranially and caudally until the distance between the hyperechogenic posterior aspect of the PS and the hyperechogenic anterior border of the pubovisceral muscle is at a minimum[156].	
3.5.1.3.11.1 Levator hiatus antero-posterior diameter: the distance (in mm or cm) delineated from the PS (anteriorly) to the edge of the of the puborectalis muscle (posteriorly). **(NEW)** **3.5.1.3.11.2 Levator hiatus left-right / latero-lateral / transverse diameter:** latero-lateral diameter of the levator hiatus (in mm or cm) in the plane of minimal hiatal dimensions. **(NEW)** The diameter from right to left is measured at the widest part, and perpendicular to the antero-posterior diameter[11,148].	Findings below apply to all measurements of hiatal dimensions. *Rest:* Quantification of the levator hiatus diameters/area at rest. Smaller diameter/area has been observed in women with pelvic pain and is may suggest increased tone in the PFM[147].

3.5.1.3.11.3 Levator hiatus area: defined and measured as the area (in mm^2 or cm^2) bordered by the pubovisceral muscle, PS and inferior pubic ramus in the plane of minimal hiatal dimensions[148]. **(NEW)**	Conversely, a larger hiatus has been observed in women with pelvic organ prolapse. *PFM contraction:* A reduction of the area/diameter is expected during a maximal PFM contraction. Hiatus reductions during contraction can be calculated as the percentage of change from baseline (i.e., levator hiatus narrowing = (levator hiatus at rest − levator hiatus at contraction)/levator hiatus at rest x100)[147]. *Bearing down:* An increase in the levator hiatus diameter/area is expected on bearing down with the instruction to relax the PFM[156]. The difference (or percentage of change) between the diameter at rest and on bearing down determines the degree of hiatal distension[11]. Higher distension has been

	observed in women with pelvic organ prolapse[157].
3.5.1.3.12 Maximal levator ani muscle thickness: is the maximum diameter of the levator ani muscle measured in two locations bilaterally (in mm or cm). **(NEW)** (see Figure 9). This is usually located 1 – 1.5 cm above the minimal levator hiatus dimension. Measured perpendicular to the presumed levator ani fibre direction[148,156]. **3.5.1.3.13 Levator ani muscle cross-sectional area:** is the area (in mm^2 or cm^2) delineated by tracing the outline of the levator ani muscle at the level of maximal muscle thickness **(NEW)**  Figure 9: Levator hiatal dimensions measured using perineal ultrasound. Figure legend: LHarea: levator hiatus area LHtransverse: levator hiatus transverse diameter	Provides morphologic measurements of the muscle diameter and area at rest[156]. *Rest:* increased thickness has been observed after PFM training[158]. Increased thickness may be indirectly related to strength[158].

LHap: levator hiatus antero-posterior diameter t: pubovisceral thickness	
3.5.1.3.14 Integrity of the anterior/medial fibers of the levator ani: To assess if a disruption or disconnection of the insertion is present, direct the patient to perform a PFM contraction, and identify the plane of minimal hiatal dimensions at maximal PFM contraction. Use this plane for tomographic ultrasound imaging of the puborectalis component of the levator ani, with an interslice interval of 2.5 mm[4]. **(NEW)**	**3.5.1.3.14.1 Complete avulsion** $_{FN3.21}$ is diagnosed when the 3 central slices show a loss of integrity or defect in the anterior/medial fibre of the levator ani muscle on the inferior pubic ramus resulting in a levator-urethra gap[4] **(NEW)**. A gap of more than 2.5 cm has been suggested as an indicator of avulsion[159]. **3.5.1.3.14.2 Partial avulsion:** is diagnosed when at one or two of the 3 central slices show a loss of integrity/defect of the medial fiber of the levator ani muscle **(CHANGED)**[27].
3.5.1.3.15 Urethral sphincter volume: ultrasound imaging of the urethral sphincter (morphometry of the rhabdosphincter)[18]. **(NEW)** The internal sphincter volume (in mm^3 or cm^3) including the longitudinal smooth muscle and the lumen is seen as a hypoechoic (black) core whereas the external sphincter volume	Smaller sphincter volume is related to urinary incontinence severity[163] and urethral pressure[162]. PFM training

or the circular striated muscle of the rhabdosphincter is seen as a hyperechoic (white) ellipsoid structure[160-162].	results in increased sphincter volume[164].
d). Parameters and anatomical landmarks assessed with tomographic ultrasound imaging plane using the 4D transducer oriented transversely	
3.5.1.3.16 Integrity of the anal sphincter complex: assessment of the internal and external anal sphincter to identify presence/absence of a defect (measured in degrees). **(NEW).** Using tomographic ultrasound imaging, the anal canal is visualised in the mid-sagittal plane and a set of 8 transverse slices is placed to encompass the entire external anal sphincter by locating one slice cranial to the external anal sphincter (at level of puborectalis, Slice 1) and another caudal to the internal anal sphincter (at level of subcutaneous part of external anal sphincter, Slice 8), leaving six slices to delineate the entire muscle (Slices 2–7) (see Figure 10). Interslice interval is varied depending on external anal sphincter dimensions[165,166].  Figure 10: Assessment of the integrity of the anal sphincter complex assessed with tomographic ultrasound imaging plane (reproduced with permission from Guzman Rojas et al.[165]).	*PFM contraction:* A ‘significant’ defect is diagnosed if four out of these six slices show a defect in >30◦ of the circumference of the external anal sphincter[4,166].

Abbreviations: *f*, females; *m*, males; *PS*, pubic symphysis; PFM, pelvic floor muscles; MVC, maximum voluntary contraction.

3.5.1.4 Endovaginal pelvic floor ultrasound: an endocavity transducer is inserted into the vagina (rotational mechanical probe or radial electronic probe)[4] to assess pelvic floor morphology. **(NEW)** It can be used to evaluate bladder neck/urethra, levator ani muscle, anal canal, and sphincters during different activity states of the PFM (rest, contraction and bearing down), as described in Table 16 below.

Table 16. Parameters and findings evaluated with endovaginal ultrasound imaging

Parameters, specifications (units of measure) and measurement processes	Outputs and interpretation of findings
a). Parameters and anatomical landmarks assessed in the sagittal plane (2D)	
3.5.1.4.1 Levator plate position: the distance (in mm or cm) between the levator plate and endovaginal probe[167]. **(NEW)**	*Rest:* Quantification of the distance between the levator plate and the probe with the PFM at rest. *PFM contraction:* A reduction of the distance between the levator plate and the probe is expected during a maximal PFM contraction; may be called levator plate lift. A greater levator plate lift ratio (lift/rest x 100) detected by dynamic endovaginal sonography has been associated with higher PFM strength as determined by the Modified Oxford Scale[167].

3.5.1.4.2 Perineal body: see 3.5.1.3.3. The depth (antero-posterior diameter) and height (supero-inferior diameter) of the perineal body can be measured in mm or cm in this plane[11,168].	*Rest:* Visibility of the structure and biometric measurements are identified at rest; indicate if the perineal body is visible or not visible[168].
3.5.1.4.3 Anorectal angle: see 3.5.1.3.6.	*Rest:* Quantification of the anorectal angle at rest[169].
b). Parameters and anatomical landmarks assessed in the axial plane (3D)	
3.5.1.4.4 Hiatal dimensions: measurements of the following parameters are taken in the place of minimal hiatal dimension[59], as described in Table 17**.**	
3.5.1.4.4.1: Hiatal antero-posterior diameter: antero-posterior diameter (in mm or cm) of the levator hiatus measured at the level of minimum dimension **(NEW)** **3.5.1.4.4.2 Hiatal transverse diameter: t**he diameter (in mm or cm) from right to left is measured at the widest part, and perpendicular to antero-posterior diameter **(NEW)** **3.5.1.4.4.3 Hiatal area:** defined and measured as the area (in mm^2 or cm^2) bordered by the pubovisceral muscle, PS and inferior pubic ramus in the plane of minimal hiatal dimensions. **(NEW)**	*Rest:* Quantification of the levator hiatus diameters/area at rest[59].
3.5.1.4.5 Levator ani thickness : defined as the diameter of the levator ani muscle (in mm or cm) at	*Rest:* Provides morphologic measurements of the levator ani diameter.

the ‘9 o'clock’ and ‘3 o'clock’ positions[59] as described in Table 15. **(NEW)**	
3.5.1.4.6 Levator plate angle: the angle (in degrees) between the reference line and the plane of minimal levator hiatal dimensions / anorectal angle, identified via a multiplanar view[169]. **(NEW)**	*Rest:* This angle quantifies the levator plate position in reference to the pubic bone and the perineal body[169].
3.5.1.4.7 Levator ani deficiency: assessed from a 3D volume. Individual levator ani muscles are evaluated in their specific axial plane where the full length of muscle can be visualised[170,171]. **(NEW)**	*Rest:* The muscles on each side for each subgroup are scored based on thickness and detachment from the pubic bone: • 0 = no defect • 1 = minimal defect with < 50 % muscle loss • 2 = major defect with >50 % muscle loss • 3 = total absence of the muscle Significant levator ani deficiency is defined as a total score within the range of 12–18[170,171].
3.5.1.4.8 Perineal body: this anatomical structure is visualized as an ovoid-shaped, mixed echogenicity structure. The width (latero-lateral diameter) (in mm or cm) of the perineal body can be measured in the axial plane[168].	as per 3.5.1.3.3

Abbreviations: PFM, pelvic floor muscles; *PS*, pubic symphysis

3.5.1.5 Endoanal ultrasound (EAUS): An endocavity transducer is inserted into the anus (linear array 3600 3D transducer or radial array 3600 3D transducer)[4]. **(NEW)** It can be used to assess the external anal sphincter (EAS) and internal anal sphincter (IAS). Parameters and findings evaluated with endoanal ultrasound imaging – during different activity states of the PFM (rest, contraction and bearing down) – are described in Table 17.

Table 17. Parameters and findings evaluated with endoanal ultrasound imaging

Parameters, specifications (units of measure) and measurement processes	**Outputs and interpretation of findings**
3.5.1.5.1 Anal sphincter defect (or pathology): assessment of the internal and external anal sphincters to identify presence/absence of a defect; observed in cross-sectional images of the anal sphincter. **(NEW)** This measure is obtained by a probe inserted into the anal canal to a depth of approximately 6 cm and gently withdrawn down the anal canal. The anal canal is divided into three levels of assessment in the axial plane referring to the following anatomical structures(11,172,173): *i.* Proximal or lower level: corresponds to the subcutaneous part of the external anal sphincter where the internal anal sphincter is absent; *ii.* Middle level: corresponds to the superficial part of the EAS (concentric band of mixed echogenicity), the conjoined longitudinal layer, the IAS (concentric hypoechoic ring), and the transverse superficial perinei muscles; *iii.* Distal or upper level: the hyperechoic sling of the puborectal muscle and the complete ring of the internal anal sphincter are visualised(11). The probe should be rotated so that the anterior aspect of the anal canal is superior (12 o'clock) and left lateral is oriented right (3 o'clock) on the screen. The acquisition of a three-dimensional data volume (3D ultrasound) of the anal sphincter is also possible.	Indicate if defect is present or absent.

Abbreviations: EAS, external anal sphincter; IAS, internal anal sphincter.

3.5.1.6 Ultrasound elastography: a non-invasive imaging technique that allows quantification of mechanical and elastic tissue properties following application of physical stress[174]. **(NEW).** Elastography imaging uses either compression/strain elastography or shear-wave elastography[155,175-179]. The primary differences between elastography techniques relate to the type or source of applied stress, and the methods of detecting displacement of the examined structures. Comparison between the elastography types and B-mode ultrasound is shown in Figure 11.

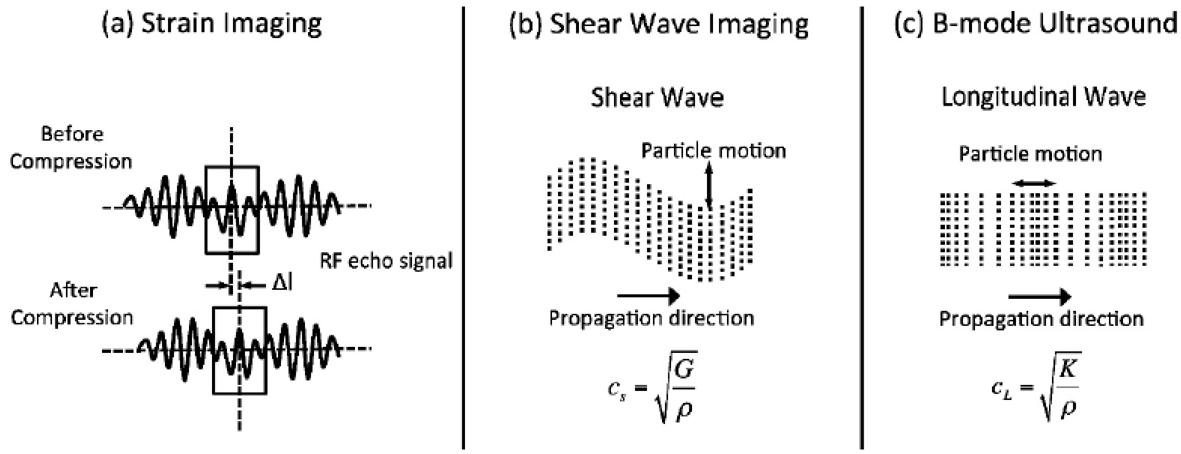


Figure 11: Ultrasound elastography physics, measurement methods (reproduced with permission from Sigrist 2017 et al[174]). In strain imaging (a), tissue displacement is measured by correlation of RF echo signals between search windows (boxes) in the states before and after compression. In shear wave imaging (b), particle motion is perpendicular to the direction of wave propagation, with shear wave speed c_s related to shear modulus *G*. In B-mode ultrasound (c), particle motion is parallel to the direction of wave propagation, with longitudinal wave speed c_L related to bulk modulus *K*.

Parameters and findings evaluated with ultrasound elastography imaging are described in Table 18.

Table 18. Parameters and findings evaluated with ultrasound elastography imaging

Parameters, specifications (units of measure) and measurement processes	**Outputs and interpretation of findings**
3.5.1.6.1 Shear wave elastography (SWE): Ultrasound elastography using shear waves generated by the US beam. **(NEW).** Different types are point SWE, 2D SWE, and transient elastography. 2D SWE uses an acoustic radiation force pulse sequence to generate shear waves, which propagate perpendicular to the ultrasound beam, causing transient displacements. The distribution of shear wave velocities at each pixel is directly related to the shear modulus in kilopascal (kPa), an absolute measure of the tissue's elastic properties. This technique is considered more objective than strain elastography(180).	Higher values indicate stiffer tissue, as shear waves propagate faster in stiffer tissues. Stiffness measures include both active (muscle contraction) and passive (viscoelastic properties) components of the tissue.
3.5.1.6.1.1 Perineal shear wave elastography: Shear wave elastography applied per perineum. **(NEW).** Only 2D SWE has been applied to the PFM(155,175,179). A linear transducer is placed against the perineum/vulva. Orientation is longitudinal (for assessing urethral sphincter), or aligned with the muscle fibers for specific PFM (e.g. puborectalis) assessment. A linear or curved transducer can be used. Stiffness is evaluated using quantitative shear modulus maps represented in a color-coded elastogram displaying shear-wave velocities in	Higher values indicate stiffer tissue. Measures may provide evidence of stiffer tissue at rest (e.g. high activation of PFM at rest) and should increase with contraction(155,175,179). Quality of measurement depends on orientation of the transducer (parallel with muscle fibres), accuracy of movement of the transducer to follow the movement of the muscle during contraction.

meters per second or tissue elasticity (shear elastic modulus) in kilopascals[181].	Measures are compromised if there are areas in the image where the measure is saturated (stiffness greater than the measurable scale) or unable to be quantified by the system.
3.5.1.6.2 Strain elastography: Ultrasound elastography which measures strain in one tissue area proportional to another. **(NEW).** Maps, or elastograms, are developed based on the relative differences in stiffness between the area of interest and the reference tissue. The assessor applies slight and constant vertical compression through the transducer along the major axis of the tissue. Elasticity is measured by means of the Young's modulus and is defined as the ratio between the pressure measured and the strain (deformation compared to the initial length) produced[182]. Soft tissue is more compressible than harder tissue and therefore has a higher strain (displacement) for the same applied stress (force). The results of strain elastography can only be expressed qualitatively or semi-quantitatively[180,182].	• **Qualitative analysis**: The different colors express different degrees of elasticity, usually varying from red (soft tissue) to blue (hard tissue) with intermediate colours representing intermediate degrees of stiffness[182]. • **Semi-quantitative analysis**: the target tissue is selected and labeled as the region of interest (ROI) A, and the reference tissue is labeled as ROI B. Elasticity of tissue expressed as a strain ratio: B/A. The higher the value of B/A, the stiffer the target tissue.
3.5.1.6.2.1 Pelvic floor strain elastography: strain elastography to assess deep PFM elasticity[176,177] and periurethral elasticity as an estimate of urethral mobility[183]. **(NEW)**	The higher the value of B/A, the stiffer the target tissue. A 4-point elasticity score has been used to represent levator ani muscle elasticity[176,177].

• To assess deep PFM: A perineal transducer is placed perpendicular to the skin in the sagittal plane to identify levator ani muscle. The levator ani muscle is selected on screen and labeled as the target tissue (region of interest [ROI] A), and the adjacent anal canal is selected and labeled as reference tissue (ROI B)[176]. • To assess urethral support tissues: an endovaginal transducer is placed parallel to the urethral meatus. The target tissue is the tissue between the urethra and the vagina (para-urethral tissue) (ROI A), and the reference tissue is set at the level of the posterior tissue of the bladder neck (ROI B).	

Abbreviations: PFM, pelvic floor muscles; SWE, shear wave elastography; ROI, region of interest.

3.5.2 Magnetic resonance imaging (MRI): is a non-invasive diagnostic technique that produces computerised images of internal body tissues and is based on nuclear magnetic resonance of atoms within the body induced by the application of radio waves[184]. **(NEW)** This technique can be applied for many purposes in urology/gynecology/gastroenterology including the assessment of PFM injury, morphometry and positioning of the PFMs and related organs as well as anorectal functioning. Considering that MRI is rarely used in clinic to assess PFM morphometry and function, only a brief overview is provided in Table 19 below and further details are available in other standardization documents[11,144].

Table 19. Parameters and findings evaluated with pelvic floor MRI

Parameters, specifications (units of measure) and measurement processes	Outputs and interpretation of findings
3.5.2.1 Levator ani defects: is damage to muscle fibers ranging from disruption of a single fascicle, to complete disruption of the muscle origin **(CHANGED)**[27]. FN3.22 There is no universally accepted system for the diagnosis and evaluation of the extent of the injury. Essentially, abnormalities are judged to have occurred when the morphology of the pubococcygeal portion of the levator ani muscle deviates from what is seen in normal nulliparous women[27].	Levator ani damage on MRI can be diagnosed when one or more of the following is present: absence of pubococcygeal muscle fibers in at least one 4-mm section, or two or more adjacent 2-mm sections in both the axial and the coronal planes[27]. Defect severity may be further scored in each muscle from 0 (no defect) to 3 (complete loss). A summed score for the two sides (0–6) is assigned and grouped as minor (0–3) or major (4–6)[11].
3.5.2.2 Levator ani position in the pelvis: location of the levator ani in the sagittal plane in relation to defined landmarks and reference points/lines[144]. **(NEW)**	May be normal, elevated or descended[27].
3.5.2.3 Hiatal dimension: see 3.5.1.3.11	See 3.5.1.3.11
3.5.2.4 MR defecography: demonstrates the anatomy of the anorectum as well as disorders of rectal evaluation. Barium paste is inserted prior to defecation over a translucent commode **(CHANGED)**[42].	This assessment focusses on anorectal function. When dyssynergia is diagnosed (see definition 4.3.1) this confirms PFM involvement[11]

Abbreviations: MRI, magnetic resonance imaging; PFM, pelvic floor muscles.

3.6 Algometry: a test to assess the pain response to application of blunt pressure. It is used to evaluate the pain threshold and pain tolerance. **(NEW).** Responses may reflect increased sensitivity (allodynia, hyperalgesia, hyperpathia) or loss of sensation. Algometry does not provide objective information regarding pathology or neurophysiological function, as do other more sophisticated quantitative sensory testing methods.

Parameters and findings evaluated with algometry are described in Table 20.

Table 20. Parameters and findings evaluated with algometry

Parameters, specifications (units of measure) and measurement processes	**Outputs and interpretation of findings**
3.6.1 Algometer/Algesiometer: an instrument for measuring the pain response to a pressure stimulus. (**NEW**) An algometry device measures pressure applied in Newtons or kg/cm^2, with an associated patient-reported pain response. • To assess vulval or vestibular pressure pain response, the assessor uses an algometer[186] or a syringe with a pre-loaded or pre-set amount of pressure, called a vulvalgesiometer[187] or a cotton swab[188] against the vulval tissue and delivers the pressure. To assess intra-vaginal pressure pain response, the assessor mounts a digital palpometer (sensor) to the palpating digit, covered by examination glove, and connected to an algometry device. The device applies a pre-set amount of pressure to the tissue[188-190].To assess pressure/pain in pelvic floor tissues, the assessor applies a pre-set amount of pressure (usually in the range of 0.5N – 2N[188,191,192]),	Results may be expressed as the pressure applied when the patient reports detection or tolerance of pain, or a specific pressure applied and the patient rating of pain at that pressure. A finding of pain with a low applied pressure may suggest allodynia, and a finding of pain with a moderate applied pressure may suggest hyperalgesia.

starting at a low pressure and assesses pain response to that pressure, or applying increasing amounts of pressure and instructing the patient to state when the pressure reaches the patient's threshold. Algometry tests: • **3.6.1.1 Pressure pain threshold (PPT):** the minimum intensity of a pressure stimulus that is perceived as painful[193]. (i.e. point at which a sensation changes from one of pressure to one of pain) (**NEW).** • **3.6.1.2 Pressure pain tolerance (PPTol)**: the highest intensity of painful pressure stimulus that an individual is able to tolerate[193]. (**NEW).**	Variability in readings can be caused by: anatomical test site (muscle belly vs. tendon[194]; mucosa vs. tendon[191], co-existence of other pain disorders[195]; left vs. right[196], stage in menstrual cycle[197], sex and gender[198], rate of pressure increase during test, dimensions of the pressure applicator.

FN3.1 See section 2.2.9 for definition.

FN3.2 Using the dynamometer alone, the stiffness value will reflect the summative contribution of the active and passive components of tone. If dynamometry is combined with EMG, the passive contribution can be identified[86].

FN3.3 This term refers to simple manometry that measures pressure in the anal sphincter. This is differentiated from sophisticated anorectal manometry – see Section 3.3.2.

FN3.4 It is not recommended to use intravaginal pressure manometry to assess the reflex contraction of the PFM during coughing[99]. Bo and Constantinou[99] explained that pressure measurement is a summation of signals including PFM and intra-abdominal pressure caused by the cough itself and therefore, it is unlikely that the PFM reflex can be assessed in isolation using pressure manometry. In contrast, ano-rectal manometry can be used to assess a reflex during an involuntary PFM contraction[100] if the transducer is located in the anus, caudal to the puborectalis/ano-rectal junction; therefore it is not impacted directly by intra-abdominal pressure.

FN3.5 This investigation is termed 'anal manometry' in Sultan et al[11]

FN3.6 This is not an exhaustive list of anorectal manometry parameters.

FN3.7 This contrast with vaginal manometry where the source of pressure during an involuntary contraction cannot be assumed to be the levator ani contraction.

FN3.8 Clinical EMG devices mainly offer pre-set filter settings.

FN3.9 Reducing the size of electrode and the inter-electrode distance may increase the system selectivity and reduce cross talk[118].

FN3.10 The recording of resting activity is highly susceptible to contamination by ambient noise. A low proportion of noise in the signal (or higher signal-to-noise ratio) is necessary for accurate assessment.

FN3.11 Unlike many other skeletal muscles[123,124], the PFMs are thought to have a level of constant EMG activity in order to maintain continence and support of pelvic/abdominal contents.

FN3.12 Advanced EMG techniques are needed to prevent inaccurate interpretation from artefacts and muscle crosstalk.

FN3.13 Slow recruitment could be a sign of PFM dysfunction if it leads to leakage during coughing and sneezing when a quick muscle contraction is needed to counteract increased intra-abdominal pressure(27,75).

FN3.14 The definition for this term used in Bo et al(27) is the definition this document calls 'slow reaction time'.

FN3.15 This may also be considered in the motor control domain.

FN3.16 Factors that may compromise the measurement of bladder base displacement include: the lack of bony landmark as a fixed starting point and the fact that movement of the bladder base does not always reflect movement of the bladder neck(135).

FN3.17 This finding must be correlated with findings of other tests and signs (especially digital vaginal / rectal palpation) to determine reason for asymmetry.

FN3.18 Factors that may affect the measurement of bladder base displacement include: the lack of boney landmark as a fixed starting point and the fact that movement of the bladder base does not always reflect movement of the bladder neck(135).

3.19 An endocavity probe consists of an elongated probe used to perform endovaginal or endorectal examination.

FN3.20 The horizontal reference line drawn from antero-posterior margin or the lowest margin of the PS may be influenced by the angle of the transducer.

FN3.21 Synonyms are puborectalis/pubovisceralis defects or injury.

FN3.22 The term levator injury is also used synonymously(11,185).

SECTION 4: DIAGNOSES

Diagnosis: the act or process of identifying or determining the nature and cause of a disease or injury through evaluation of patient history, examination, review of investigations, and the opinion derived from such an evaluation[199]. **(CHANGED)** The diagnostic process aims to identify the most specific disorder possible. Overarching diagnoses are used when there is less certainty about the presenting disorder. Diagnoses that are specific to the PFMs may co-exist with and be used in addition to other pelvic floor diagnoses the patient presents with, e.g. voiding dysfunction, pelvic organ prolapse. The diagnoses proposed below may change as evidence emerges to support or refute these terms as diagnostic terms. In some healthcare settings, clinicians are required to assign a code for the presenting diseases, disorders, injuries and other related health conditions, using the International Classification of Diseases (ICD) coding system[200]. Not all terms below have a corresponding ICD diagnostic code. As advised by ICD, “codes that describe symptoms and signs, as opposed to diagnoses, are acceptable for reporting purposes when a related definitive diagnosis has not been established (confirmed) by the provider”.

4.0. Pelvic floor muscle disorder/dysfunction: an alteration of normal PFM function. **(NEW)** Any departure from normal function of the PFM that is of bother to the patient and has an associated sign and/or a finding from an investigation that suggests a departure from normal structure or function. If a specific disorder can be diagnosed, the following terms may be used.

4.1 Disorder of increased PFM tone

4.1.1 Pelvic floor tension myalgia: a condition of pain and increased PFM tone **(NEW).** [FN4.1] If the location can be confirmed as the levator ani, then the term can be levator ani tension myalgia. Criteria for diagnosis of pelvic floor tension myalgia are described in Table 21.

Table 21: Criteria for diagnosis of pelvic floor tension myalgia

Assessment	**Findings**
Symptoms	• may relate to sensation of pain: pain, tender, ache, discomfort • may relate to sensation of increased tone: tight, tense, narrow or constricted
Signs	tenderness or tender point on palpation of PFMs FN4.2 per perineum, per vaginam or per rectum
	as well one or more of the following signs: • lack of perineal and/or PFM descent with sustained increased intra-abdominal pressure • absent, partial or delayed relaxation of perineum and/or PFM after contraction • non-relaxing PFM • hypertonicity, or increased PFM tone, on a continuum from transient increase in tone to spasm • fasciculation • reduced flexibility of the vaginal opening
Investigations	muscle tenderness as assessed by digital algometry (palpometry)
	finding of increased tone from any tool which measures tone (dynamometry, myotonometry, manometry, EMG, ultrasound or MRI). • if EMG reveals an inconsistent or elevated resting baseline, or slow de-recruitment, this suggests increased myoelectrical activity, which may be termed overactivity in the PFM FN4.3.

Abbreviations: PFM, pelvic floor muscles; MRI, magnetic resonance; EMG, electromyography

4.1.2 Pelvic floor myofascial pain syndrome: a pelvic floor pain syndrome of myofascial origin. **(NEW)** this diagnosis has trigger points as a hallmark feature[50]. However there is no consensus of the definition and diagnostic criteria associated with trigger points[50,51]. The criteria most consistently used for diagnosis amongst researchers and expert clinicians are shown in Table 22.

Table 22: Criteria for diagnosis of pelvic floor myofascial pain syndrome

Assessment	Findings
Symptoms	presence of pain
Signs	tender point in a taut band (localized increased tone) of skeletal muscle[50,51]
	patient pain recognition on tender point palpation
	referral pattern
	local twitch response
	the paired criteria of tender points in taut bands and predicted or recognised pain referral form the most frequently cited combination of diagnostic criteria
Investigations	there is no consensus regarding objective laboratory tests for myofascial trigger point diagnosis however MR elastography and ultrasound elastography have been reported to investigate myofascial taut bands[202] and trigger points[203] in the trapezius muscle.

Abbreviations: MR, magnetic resonance

4.2 Disorder of PFM pain

4.2.1 Pelvic floor myalgia: a condition of PFM pain. **(NEW).** Criteria for diagnosis of pelvic floor myalgia are described in Table 23.

Table 23: Criteria for diagnosis of pelvic floor myalgia

Assessment	**Findings**
Symptoms	pain, tender, ache, discomfort
Signs	muscle tenderness or tender point on palpation of PFMs FN4.4 and normal tone in PFM *per perineum*, *per vaginam* or *per rectum.*
Investigations	muscle tenderness as assessed by digital algometry (palpometry)
	finding of normal tone (measured by dynamometry, myotonometry, manometry, EMG, ultrasound or MRI)

Abbreviations: PFM, pelvic floor muscles, EMG, electromyography; MRI, magnetic resonance imaging.

4.3 Disorder of decreased PFM tone*:* a condition which results from a reduction in PFM tone, due to either the contractile or the non-contractile components of tone FN4.5. **(NEW)**. Criteria for diagnosis of decreased PFM tone are described in Table 24.

Table 242: Criteria for diagnosis of decreased PFM tone

Assessment	**Findings**
Symptoms	loose, lax, gaping, sagging, open, weak, bulging, full, loss of control
Signs	hypotonicity, decreased PFM tone, anal or introital gaping, excessive flexibility of the vaginal opening, palpation of an anal sphincter gap or levator avulsion.
	deficit in PFM contractile function: absence of voluntary PFM contraction, decreased strength (weakness), decreased sustained and repeated endurance, lack of perineal or PFM elevation, no urethral lift, partial or uncertain levator closure, small to no change in levator hiatus on contraction.

Investigations	any tool which measures tone (measured by dynamometry, myotonometry, manometry, EMG, ultrasound or MRI)
	- if EMG reveals a reduced signal amplitude or peak microvolts, or shorter duration of sustained contraction this suggests decreased myoelectrical activity, which may be termed 'underactivity' in the PFM. FN4.6

Abbreviations: PFM, pelvic floor muscles; EMG, electromyography; MRI, magnetic resonance imaging.

4.4 Disorder of PFM coordination

4.4.1 PFM dyssynergia FN4.7 paradoxical PFM or sphincter contraction: a dysfunction of coordination between the PFM and a functional activity, such as a PFM contraction when relaxation is functionally required. **(NEW).** These dyssynergias may share similar symptoms and signs FN4.8, FN4.9

4.4.1.1 Anismus: spasm of the EAS with attempted defecation or anal penetration **(CHANGED)**[11]. FN4.10 This dyssynergia is shown in Figure 12.

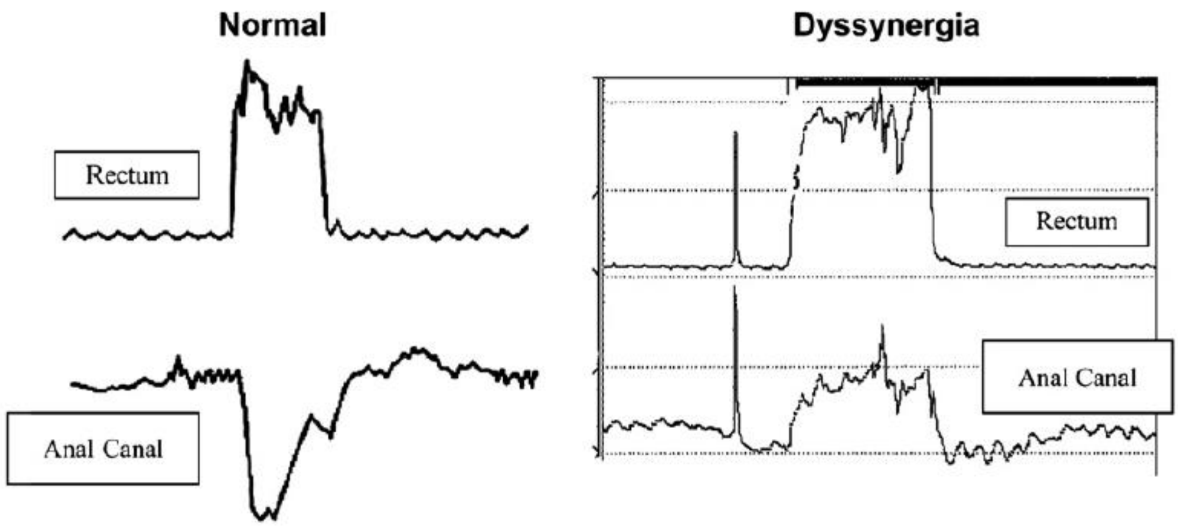


Figure 12: A normal and abnormal (dyssynergic) pattern of defecation, from Rao 2007[204]. A normal pattern consists of a rise in the intrarectal pressure coordinated with relaxation of anal

sphincter pressure. In contrast, a dyssynergic pattern is associated with a paradoxical increase in anal sphincter pressure. Typical patterns for a normal and dyssynergic pattern of defecation as measured during anorectal manometry with a pressure sensor in the rectum and a pressure sensor in the anal canal.

Criteria for diagnosis of anismus are described in Table 25.

Table 25: Criteria for diagnosis of anismus

Assessment	**Findings**
Symptoms	pain, tender, ache, discomfort during attempted defecation or anal penetration
Signs	perineal and / or PFM elevation with sustained increased IAP (bearing down) or attempted penetration
	Increased PFM tone
Investigations	balloon expulsion test
	MR defecography
	EMG: PFM activation during defecation suggesting poor motor control[205]

Abbreviations: PFM, pelvic floor muscles; IAP, intra-abdominal pressure; MR, magnetic resonance; EMG, electromyography.

4.4.1.2 Vaginismus: spasm of vaginal musculature that interferes with vaginal penetration **(CHANGED)**[12]. FN4.11 Criteria for diagnosis of vaginismus are described in Table 26. Vaginismus may also be termed genito-pelvic pain/penetration disorder, which includes fear or anxiety as a component of the disorder[206,207].

Table 26: Criteria for diagnosis of vaginismus

Assessment	Findings
Symptoms	pain, tight, tense, narrow or constricted
Signs	transient increased tone - inability to maintain relaxation with attempted vaginal penetration
	increased PFM tone
Investigations FN4.12	assessment of resting tone (measured by dynamometry, myotonometry, manometry, EMG, ultrasound or MRI)
	increased activation of PFM shown by perineal or peri-anal EMG during attempted vaginal penetration.

Abbreviations: PFM, pelvic floor muscles; EMG, electromyography; MRI, magnetic resonance imaging.

4.5 Pudendal neuralgia: Pudendal neuralgia is a chronic and severely disabling neuropathic pain syndrome caused by mechanical or non-mechanical injury of the pudendal nerve(208). **(NEW)** The Nantes criteria list 5 essential diagnostic criterion including 3 symptoms, one sign and one investigation(209). These criteria are described in Table 27.

Table 27: Criteria for diagnosis of pudendal neuralgia

Assessment	Findings
Symptoms	pain in the distribution of the pudendal nerve and it's referral areas, primarily the genitalia including the vulvovaginal, anorectal and distal urethral areas.
	worse in the sitting position
	pain does not wake the patient at night, no numbness of the perineum
	the patient may also have associated pelvic floor symptoms(208)

Signs	Nantes criteria[209] sign: no loss of sensation in the pudendal distribution on objective testing
	Other signs include • tenderness to palpation anywhere along the length of the pudendal nerve • increased tone and tenderness of the obturator internus or piriformis muscles (depending on the location of the nerve irritation) • positive pudendal nerve neurodynamic test • positive pudendal nerve provocation test
Investigations	As per Nantes criteria[209]: may be confirmed by relief of patient's pain after a pudendal nerve block with or without guided imaging. FN4.13

FN4.1 This term was first used by Sinaki et al 1977[201], however in their case series, they did not assess PFM tone or tension. Nevertheless, they proposed the cause of the pain was "habit contraction or chronic spasm of the PFM". We propose that this term should be used only when both pain and increased tone are present.

FN4.2 When assessing sensory changes *PV* or *PR*, the clinician needs to determine whether s/he is detecting sensory change in the mucosa (mucosal sensitivity), or the underlying muscle (muscle tenderness) by differentiating the depth and firmness of palpation.

FN4.3 The previously proposed term 'overactive PFM'[26] has been used to refer to increased tone in a muscle, however if the source of the increased tone (contractile or noncontractile component of tone) cannot be determined, this term is not recommended.

FN4.4 When assessing sensory changes *PV* or *PR*, the clinician needs to determine whether s/he is detecting sensory change in the mucosa (mucosal sensitivity), or the underlying muscle (muscle tenderness) by differentiating the depth and firmness of palpation.

FN4.5 It may be impossible to distinguish between the 2 subsets of this condition without access to an investigation which is able to separate the measurement of the contractile from the non-contractile components of tone. Even so, the certainty of the contribution from the contractile component of tone recorded by sEMG needs to consider the limitations of sEMG findings (noise, cross-talk etc).

FN4.6 The previously proposed term 'underactive PFM'[26] has been used to refer to decreased tone in a muscle, however if the source of the decreased tone (contractile or noncontractile component of tone) cannot be determined, this term is not recommended.

FN4.7 Dyssynergia may be similar to the condition termed "overactive pelvic floor muscles" as described by Messelink et al[26]: "A situation in which the pelvic floor muscles do not relax, or may even contract when relaxation is functionally needed for example during micturition or defecation. This condition is based on symptoms such as voiding problems, obstructed defecation, or dyspareunia and on signs like the absence of voluntary pelvic floor muscle relaxation."

FN4.8 PFM-related symptoms reported by patients may be secondary to more bothersome functional symptoms such as inability to void, defaecate or allow vaginal entry.

FN4.9 Difficulty voiding may be due to paradoxical contraction of the urethral sphincter, as occurs in conditions such as detrusor sphincter dyssynergia or voiding dysfunction, however there is no apparent PFM-related symptom that the patient reports.

FN4.10 Anismus is the PFM component of dyssynergic defecation. Diagnosis of dyssynergic defecation includes functional constipation criteria, prolonged transit, and ineffective motility to expel feces[(204)].

FN4.11 As stated in Rogers et al[(12)], there is often (phobic) avoidance and anticipation/fear/experience of pain, along with variable involuntary PFM contraction. Patients with vaginismus could present with severe fear avoidance without vulvar pain or fear avoidance with vulvar pain. Structural or other physical abnormalities must be ruled out/addressed. There is controversy of whether or not this term should be retained, with the Diagnostic and Statistical Manual of Mental Disorders 2013 proposal to replace dyspareunia and vaginismus with the term “Genito-Pelvic Pain/Penetration Disorder (GPP/PD)”[(206)], and the lack of consensus on this term[(207)].

FN4.12 Investigations may be in-conclusive, as PFM tone values may overlap in conditions such as dyspareunia and vaginismus, therefore the PFM resting tone and response to attempted penetration may not exclusively diagnose vaginismus.

FN4.13 Pudendal nerve blocks are technically difficult to perform accurately and lack of pain relief after the procedure does not rule out the condition[(208)].

CONCLUSION

This report has drawn together the most frequently published methods of PFM assessment that appear in the published literature. This process has highlighted the plethora of terms in current use. We have attempted to provide the most precise yet clinically-meaningful definitions and descriptions of these terms, and where available, provided an explanation of the finding from the assessment method. We hope this will provide clinicians and researchers with clarity and standardisation in the recording of PFM function and dysfunction. It is anticipated that some of these terms will be discarded over time and new terms will emerge, and a revision of this document will be required in the future. It is important to remember that visual observation and digital palpation are subjective forms of assessment, and the assessor must be aware that conclusions of PFM function or dysfunction based on these clinical observations may be uncertain. At present, PFM tone and involuntary action remain less well understood than properties such as strength. Where available, the use of quantitative assessment tools (investigations), may strengthen the certainty of the finding. In some instances, it may not be possible to identify a specific classification of PFM disorder, beyond the first level of diagnosis of 'PFM disorder'.

AREAS FOR FURTHER RESEARCH

A core outcome set for PFM assessment would be valuable, however this requires knowledge of the clinimetric properties of the many assessment methods currently used in clinical practice and research, and a comparison of these properties amongst the assessment methods; such knowledge is lacking. There is an urgent need for a report to compile the validity, reliability and responsiveness of PFM assessment methods, especially for the more subjective methods of visual observation and digital palpation. The clinimetric properties of some aspects of the more objective methods of PFM assessment (simple and sophisticated tools) has been undertaken, however many gaps in testing remain. Whether any of these assessment methods provide diagnostic test accuracy of PFM function and dysfunction is unknown. Future research in this area is required.

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