International Urogynecology Journal (2019) 30:1593–1595
https://doi.org/10.1007/s00192-019-03986-x

IMAGES IN UROGYNECOLOGY

Levels of pelvic floor support: what do they look like on magnetic resonance imaging?

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Received: 24 January 2019 / Accepted: 13 May 2019 / Published online: 29 May 2019

Keywords Levels of support · Pelvic floor · Magnetic resonance imaging (MRI) · Pelvic organ prolapse

The nature of pelvic organ support can be understood by recognizing the anatomical differences among three Levels of support [1]. The purpose of this "Images in urogynecology" article is to provide a detailed visual guide to the appearances of each level and the transitions between levels to form the foundation for understanding how they are altered in apical, vaginal or perineal failure (Fig. 1). To review, Level I has long mesenteric attachments (cardinal and uterosacral ligaments), Level II has more direct connections to the pelvic walls (e.g., paravaginal attachments), and Level III has a direct fusion of the vagina with the levator ani muscles, perineal membrane and body. A general description (MRI) of the three different levels was published over 2 decades ago [2], but lacks the detail now possible with improved MRI image quality.

This is a secondary analysis of an IRB-approved case-control MRI study where $N = 10$ healthy parous women (mean age 57.5 ± 6.2 years) who volunteered to serve as normal controls on studies of pelvic organ prolapse, who were asymptomatic on standard prolapse questionnaires and who had normal support on POP-Q examination were selected from our research MRI database.

Figure 2 displays and describes these characteristic findings. Axial images best display the relationship between the genital tract and pelvic walls at each level including the nature of the attachments. Coronal images also show these relationships and are best for examining cardinal ligaments in Level I and identifying the precise transition points between levels. The characteristic appearance of each level and their points of transition could be identified in all ten scans.

In conclusion, MRI reveals the characteristic appearance of the specific anatomical structures previously described as Levels of support. Gaining insights into the MRI anatomy of pelvic organ prolapse and its recurrence might help to improve surgical approaches to this common disease.

This work was presented at the 43rd Annual Meeting of the International Urogynecological Association (IUGA), 27–30 June 2018, Vienna, Austria; at PFD Week 2018, 9–13 October 2018, Chicago, IL, USA; and at the 62nd Congress of the German Society of Gynecology and Obstetrics (DGGG), 31 October–3 November 2018, Berlin, Germany.

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s00192-019-03986-x) contains supplementary material, which is available to authorized users.

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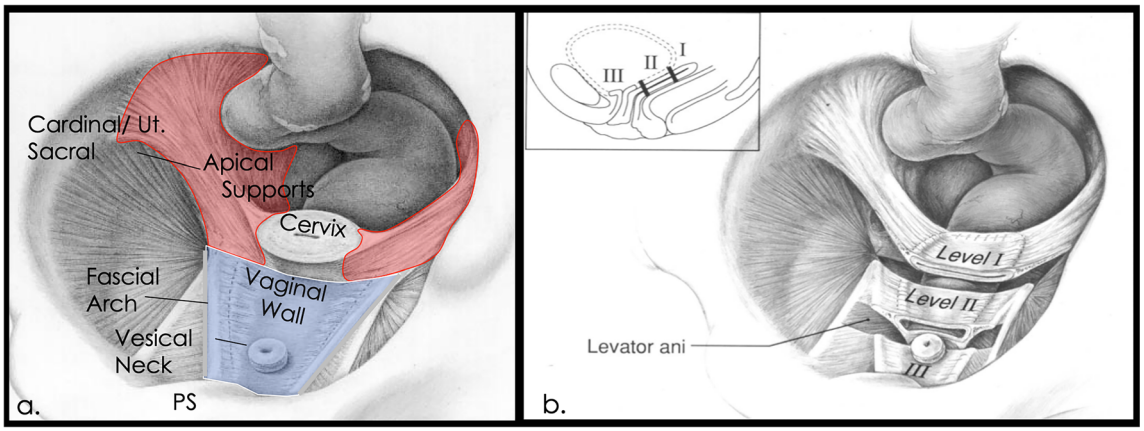

Fig. 1 Schematic drawing of the female pelvis from above. **a** After subtotal removal of the uterus, pelvic organ supporting structures are visualized. The red area provides Level I support, whereas the blue area shows Level II support. (PS, pubic symphysis). **b** All three Levels of support after total hysterectomy as described previously [1]. © DeLancey

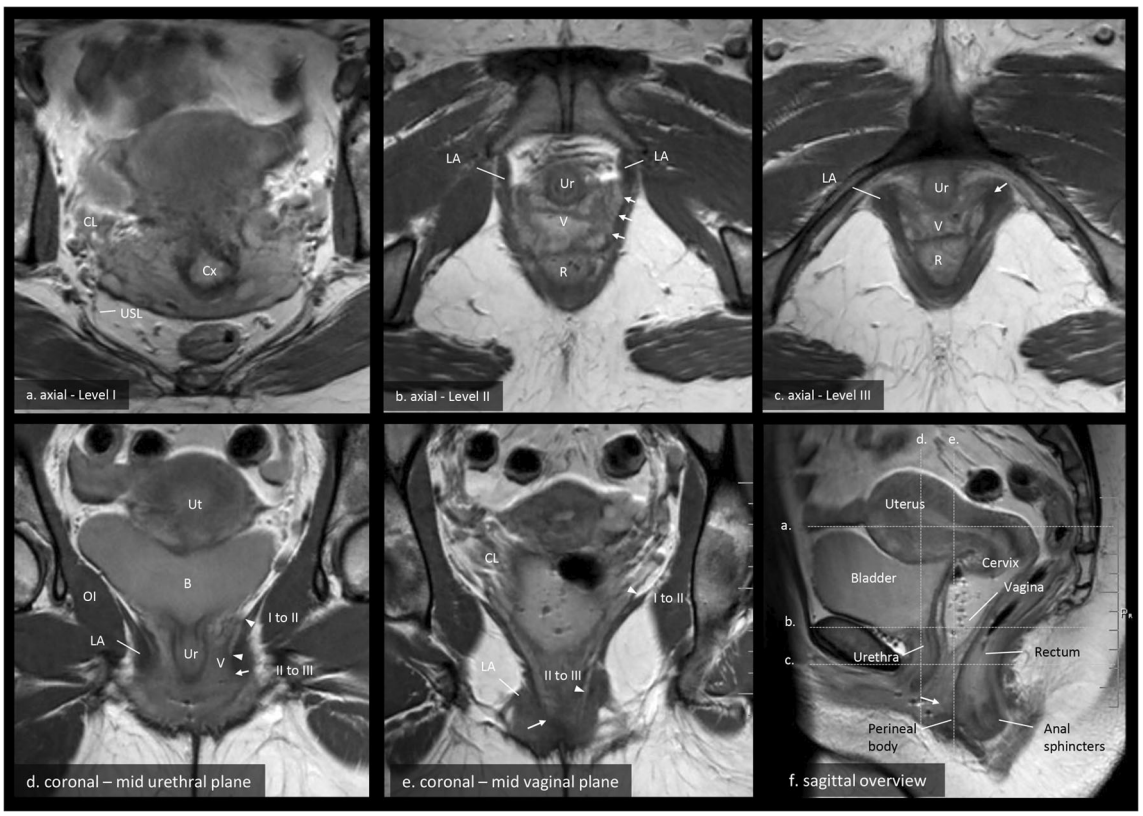

Fig. 2 MRI characteristics of Levels of support. T2-weighted proton-density images at rest; orthogonal planes. (Ut, uterus; B, bladder; LA, levator ani muscle; Ur, urethra; V, vagina; CL, cardinal ligament; USL, uterosacral ligament; Cx, cervix; R, rectum; OI, obturator internus muscle). Bilateral features have been indicated on one side so the other side can be viewed without marking. The first row contains axial scans at Level I, II and III. **a** Level I: Apical support structures known as cardinal and uterosacral ligaments are visible. **b** Level II: The vagina can be identified adjacent to the levator ani muscle, but with a distinct border between these two structures (white arrows). **c** Level III: Loss of separation between vagina and levator ani muscles where they are fused to the vagina (white arrow). The second row displays two coronal scan planes (**d** and **e**) as well as a sagittal scan plane (**f**) for orientation. **d** Mid-urethral coronal scan: White arrowheads show the transition between Levels I and II where the vagina contacts the pelvic wall and II to III where the vagina becomes fused with the levator. White arrow shows the loss of separation. **e** Mid-vaginal coronal scan: The cardinal ligaments are visible and the transition between Levels I and II as well as II and III can be identified; fusion of the levator and vagina is shown. White arrowheads show the transition between Levels I and II where the vagina contacts the pelvic wall and II to III where the vagina becomes fused with the levator. White arrow shows the loss of separation. **f** Sagittal scan: The perineal body can be seen where it is fused with the distal vagina (arrow). The locations of the other planes: dashed lines. (N.B. It is admittedly difficult to distinguish precisely between adjacent and fused in this region but a transition between distinct borders and blurred boundaries can typically be seen)

Compliance with ethical standards

Conflicts of interest None.

Consent Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

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