

AVULSION OF THE PUBORECTAL MUSCLE – AN MRI BASED 3D RECONSTRUCTION.

Hypothesis / aims of study

The puborectal muscle is considered a key structure for the proper functioning of the pelvic floor. Its damage can lead to a manifestation of pelvic floor dysfunction such as urinary stress incontinence and pelvic organs prolapse. Recent MRI and 3D ultrasound studies show, that a major trauma to the muscle – its unilateral or bilateral avulsion from the pubic bone – is a rather common finding among urogynecology patients. Due to the complicated spatial arrangement of the pelvic structures, two-dimensional images are not sufficient to demonstrate its proper relations. For this reason, we created a computer model, which makes possible the visualization of normal and altered anatomy. The aim of the study was to show normal anatomy of the pelvic floor and to compare it to unilateral and bilateral puborectal muscle avulsion.

Study design, materials and methods

We created individual computer models of 1) 26 years old healthy nullipara with normal MRI finding, 2) 34 years old woman with MRI proven unilateral puborectal muscle avulsion (Figure 1) and 3) 28 years old woman with bilateral puborectal avulsion. We produced the axial T2 weighted MRI picture (slice 3mm, gap 1 mm, pelvic phased-array coil) from the S3 sacral bone after lower region of external anal sphincter. The exam was performed in supine position with the uterus repositioned, without contrast material and with spontaneous filling of the bladder 60 minutes after voiding and without desire to void. The position of each picture was reconstructed according to the coordinates generated by the MRI machine. In each picture we manually labeled the boundary of the organ (bone, levator ani muscle, internal obturator, urethra, urinary bladder, vagina, and rectum.) The contour of the organ was then used for construction of a surface model in Lightwave 7.5[®].

Results

We were able to identify and trace the followed structures in all women. The muscle fibers of the puborectal muscle normally insert to the pubic bone. After traumatic avulsion, the residual muscle fibers do not retract to the rectum in a straight line, but point slightly laterally to the internal obturator muscle and appear to have some connection to their medial aspects (Figure 2). The resting position of urethra and urinary bladder base did not vary substantially. In the unilateral avulsion model, also the shape of the vagina was almost normal. In both patients with puborectal muscle avulsion, the deep part of external anal sphincter was intact.

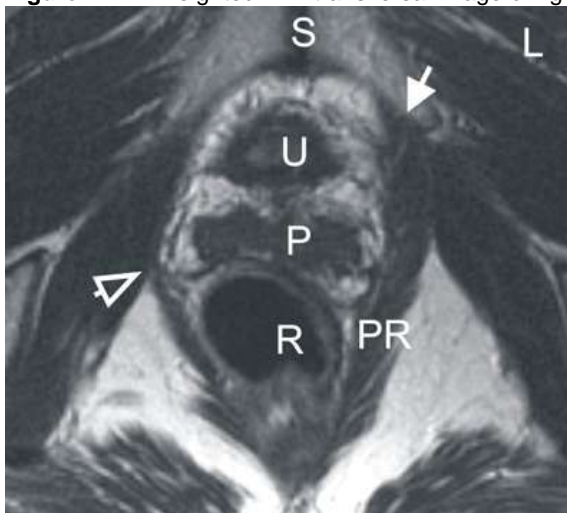
Interpretation of results

The puborectal muscle has two major functions. First, it surrounds and squeezes the urogenital hiatus and its defect lessens the active support to abdominal organs. Second, most of the endopelvic fascia is anchored to this muscle. Therefore, avulsion alters the support to the whole endopelvic fascia and makes unstable both the anterior and posterior vaginal wall. Clinical picture of traction cystocele can be the same in endopelvic fascia tear and puborectal muscle avulsion. Burch colposuspension and paravaginal defect repair lead to immediate presentation of recto-enterocele. The relation of the avulsed ventral part of the puborectal muscle to the internal obturator muscle is surprising. There can either be a partial lateral attachment of the puborectal muscle to the internal obturator muscle that retains its functions after the ventral attachment to the bone was destroyed, or the fibers just passively follow the course of the fascia of the ischiorectal fossa. More anatomical research is needed to answer this question.

Concluding message

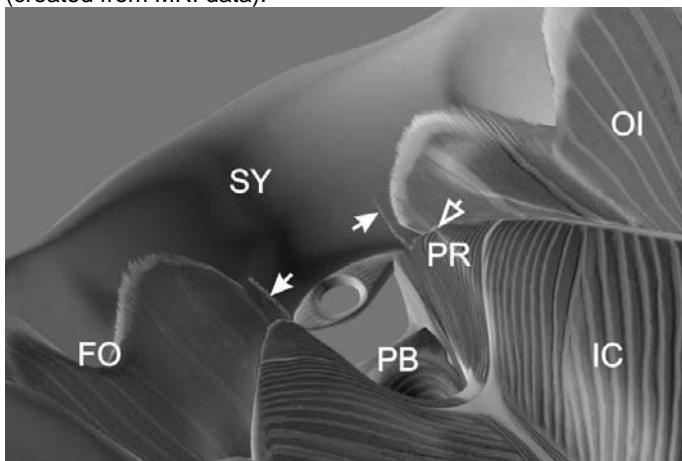
3D reconstructions based on MRI data help us understand both normal and pathologic anatomy.

Figure 1 – T2 weighted MRI transversal image of right unilateral avulsion of the puborectal muscle.



S – symphysis, U – urethra, P – vagina, R – rectum, open arrow – avulsed anterior margin of the right puborectal muscle, full arrow – normal insertion of the left puborectal muscle to the pubic bone.

Figure 2 – Bilateral postpartum avulsion of the puborectal muscle – image rendered from the 3D computer model (created from MRI data).



SY – symphysis, PR - puborectal muscle, PB – perineal body, OI – obturator internus muscle, IC – ileococcygeus muscle, FO – foramen obturatorius, full arrows – original insertions of the puborectal muscle on the posterior aspect of the pubic bone, open arrow – avulsed margin of the right puborectal muscle.

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HUMAN SUBJECTS: This study was approved by the Ethics Committee of the UPMD and followed the Declaration of Helsinki Informed consent was obtained from the patients.