Summary

Magnetic resonance imaging is a simple and non-invasive technique, which allows evaluating all the pelvic compartments with high iconographic quality. Moreover, through the application of fast sequences, it is now possible to combine the morphological study with a dynamic functional one, which is essential in the study of pelvic dynamics.

The purpose of this study was to evaluate the role of static and dynamic MRI as an aiding imaging modality in the diagnosis and selection of best treatment plans for females patients with urinary incontinence and to study utero-sacral ligament morphology by MRI, to explore and understand the connective tissue differences in healthy females and those with urge urinary incontinence in order to improve treatment.

Our study is a prospective randomized study consisted of 103 subjects including 41 control females and 62 urinary incontinence (UI) patients. The control patients were subdivided according to dynamic cine MRI findings into: group **A**: (14 patients with no pelvic organ prolapse) and group **B** (27 patients with pelvic organ prolapse). The urinary incontinence patients were subdivided according to the clinical findings into; group **G** (n= 14) including patients with genuine UI, group **U** (n=26) including patients with urge UI and group **M** (n=22) including patients with mixed UI. Each group was also further subdivided according to dynamic cine MRI findings into those without pelvic organ prolapse **G1** (n=6), **U1** (n=17) and **M1** (n= 14) and those who had in addition pelvic organ prolapse **G2** (n=8)**, U2** (n=9) and **M2** (n=8).

We obtained axial, sagittal and coronal static (T2 weighted turbo spin echo sequences) and sagittal, axial and coronal dynamic (cine) MR and sagittal MR Defecography BFFE sequences.

In the analysis dynamic (cine) MR images we found either significant ($P<0.05$) or highly significant ($p <0.001$) statistical difference between the non prolapse groups (A, G1, U1 and M1) and the prolapse group (B, G2, U2 and M2), regarding the H line, M line ,LPA , WLH and IcA indicating pelvic floor muscle weakness.

Results obtained from static axial images showed that the highest frequency of urethral support system defect was in Genuine and mixed SUI, while the least frequency in the control continent and urge UI groups.

Our results regarding vaginal support system defect was not specific for POP +ve groups; level I / II Para vaginal endopelvic fascial defects were also detected in POP –ve groups.

We found a noteworthy relationship between static and dynamic MR imaging findings. This relationship provided insight into the association between MR imaging findings and pelvic floor symptoms.

In our results; in study groups with POP +ve by using combined analysis of the static and dynamic MR images; we were able to differentiate whether POP was due to endopelvic fascial defects, to marked levator muscle weakness or to both.

We conducted selective studies on several points regarding pelvic organs descent and pelvic supporting measurements.

Comparing between MR Defecography and dynamic (cine), MRI findings revealed increase in the number of female with POP +ve by MR Defecography compared to dynamic (cine) MRI. Also there is increase in the number of compartments defects in POP +ve groups by MR Defecography compared to dynamic (cine) MRI.

The highest frequency of anterior compartment defect (cystocele) and level III fascial defect among UI patients groups was in genuine UI patients followed by mixed UI patients. Regarding the frequency of compartments defect in POP +ve groups; we found that the highest frequency regarding the anterior compartment defect was in the Genuine UI then Mixed UI patients ,while the highest frequency regarding the middle compartment defect was in the genuine UI patients and the highest frequency regarding the posterior compartment defect was in the continent females and urge UI patients. The similarity of findings in both Genuine and mixed UI could be explained by that they are sharing a common pathology (SUI) which is a disease of pubo-cervical fascia while Urge UI is a different entity and having a different underlying pathology other than pubo-cervical fascial defect.

The comparison between different patients groups regarding pelvic organ descent and pelvic supporting measurements; showed significant statistical difference regarding ARJD and BND between genuine and mixed UI versus Urge UI, while there was no significant statistical difference between Genuine versus Mixed UI groups and this reinforce that Genuine and Mixed UI share the same pathology (SUI), while Urge UI had different underlying pathology other than pubo-cervical fascial disease

We studied the uterosacral ligaments (USLs)on both sides in 41 control females and 26 urge UI patients regarding the anatomical site and level of their origin and insertion, their lengths and score of visibility in both T2 and PD WI's axial images.

In this study we found highly significant difference from the mean length of USLs in the control females. In urge UI the mean length of the right USL was 38.34 + 11mm while the left USL was 31.5 + 11mm in their cranio-caudal extent while in control females the mean length of the right USL was 21.6 $\pm$ 9 mm while the left USL was 19.8 $\pm$ 9 mm in their cranio-caudal extent.

Regarding the site of origin of USLs, our results showed that the most frequent site of origin in the control females is both vagina and cervix, while in the Urge UI patients, the most frequent site of origin is the vagina.

Regarding the site of insertion of USLs, our results showed that the most frequent site of insertion in control females and urge UI patients is the sacrospinous ligament coccygeus muscle complex.

By using the grid system; the images number on which the origin and insertion of USL could be visualized, in control females; the origin of USLs was found most frequently at images number +2 and +3 while the insertion of USL was found most frequently at images number +5, +6 and +7. In urge UI patients the origin of USLs was found most frequently at a lower level at images number A, +1 and+2 while the insertion of USL was found most frequently at a higher level at images number +6, +7 and +8.

In our study the MR imaging for USL data sets of both urge urinary incontinence and control groups were assessed by three observers. Inter observer creditability was evaluated for the collected data by the observers. The highest value of agreement was that regarding the images number on which the origin and insertion could be visualized (Cronbach's alpha between 0.7 and 0.9) followed by that regarding number of slices on which USL could be visualized (Cronbach's alpha between 0.6 and 0.75). We found no agreement regarding the visibility score of USLs in both T2 and PD WI's and the least agreement was that regarding site of origin and insertion of USL.

From our study we recommend the use of MRI pelvic floor examination for proper treatment plan selection, pre-operative assessment of urinary incontinence patients and comprehensive evaluation of all pelvic compartments in order to reduce recurrence or denovo conditions. Also we recommend the use of MR defecography as a routine sequence in MRI pelvic floor examination to reveal hidden pathologies could be underestimated by dynamic (cine) MRI.

We recommend further study of USLs in order to specify or not specify the increase of USL length as a main cause of urge UI.

Conclusion

Magnetic resonance imaging is a simple and non-invasive technique, which allows the evaluation of all the pelvic compartments with high iconographic quality.

MRI pelvic floor may be an adjuvant tool for the clinicians for preoperative planning and management of patients with pelvic floor disorders (PFDs) specially POP to reduce incidence of postoperative recurrence or denovo events as UUI.

The static and dynamic MR proved to be helpful aiding imaging modality in the diagnosis and selection of best treatment plans for females patients with urinary incontinence.

Pelvic floor MR imaging was also found to play a role in the detection of the changes of utero-sacral ligament morphology in patients with urge urinary incontinence in contrast to healthy females, which could play a role in treatment improvement.