The Role of MR Defecography in assessment of Anal incontinence, Obstructed Defecation and Simple Anal Diseases (Anal fissure, Hemorrhoids and Perianal Fistula)

Thesis

Submitted for Fulfillment of Master Degree in Radiodiagnosis

By

Tagwa Ahmed Adam Idris

(MBBCH)

Faculty of Medicine

University of Khartoum – Sudan

Supervisors

Professor. Mamdouh Mahfouz Ali

Professor of Radiodiagnosis

Faculty of Medicine

Cairo University

Professor. Ahmed Farag Ahmed Farag

Professor of General Surgery

Faculty of Medicine

Cairo University

Dr. Rania Farouk Elsayed

Lecturer of Radiodiagnosis

Faculty of Medicine

Cairo University

Cairo University

2014

Acknowledgments

No such work can be produced without cooperation and help of dedicated persons, my sincere and deep gratitude to:

- ***Professor. Mamdouh Mahfouz Ali***, Professor of Radiodiagnosis, Faculty of Medicine, Cairo University.
- ***Professor. Ahmed Farag Ahmed Farag*** ,Professor of General Surgery ,Faculty of Medicine ,Cairo University
- ***Dr. Rania Farouk Elsayed***, Lecturer of Radiodiagnosis, Faculty of Medicine, Cairo University. For their non-limited support, guidance & advice.

My warm thanks to:

- MRI unit's high nurses, technicians, and workers.
- My lovely family "mother, sister and brothers".
- My magnificent husband and kid.
- My friends and colleagues.
- The patients.

Also especial thank to **Egypt** which gave me such opportunity.

Here and after, thanks to **almighty Allah**, asking him the straight path "amen".

Abstract

The new information obtained with such modality most likely to be higher than conventional defecography especially in patients with AI. We believe that MRI with its lack of ionization, capability of multi planar acquisitions and the presence of different imaging types with the newly established normal parameters of the evacuation phase in male and female are capable to allocate the MR imagining in a corner stone position when it comes to the assessment of patients with PFD.

Keyword

ARA,HAPCs,STP.MRI, Hemorrhoids, Anal fissure

Index

1. List of figures 1
2. List of tables1
3. List of abbreviations1
4. Introduction&Aim of the work1
5. Embryology5
6. Anatomy9
7. Physiology of defecation & anal continence52
8. Anorectal dysfunctions65
9. Clinical evaluation82
10. Investigations : physiological tests89
11. Investigations: imaging of anorectal dysfunctions95
12. Methods134
13. Results146
14. Case presentation164
15. Discussion188
16. Summary 204
17. conclusion 208
18. References210
19. Arabic Summary

Contents

Number		Page number
1	The tail end of a human embryo, about 4 weeks old.	5
2	Embryologic development of the rectum and anal canal.	7
3	Embryology of anal canal	8
4	Passive and active structures of the pelvic floor	10
5	Three-dimensional schematic of the components of the pelvic floor	11
6	Bony pelvis AP & Lateral Views	11
7	Diagram of the levator ani	13
8	Cranial view of the female pelvic floor	15
9	Schematic representation of the pelvic floor (coronal plane)	16
10	Perineal muscles.	16
11	MRI axial anatomy of levator ani muscles.	22
12	MRI coronal anatomy of levator ani muscles.	23
13	MRI sagittal anatomy of levator ani muscles.	24
14	MRI Coronal section through midpelvis.	25
15	MRI coronal BFFE shows iliococcygeus angle .	25
16	3D structural orientation of levator ani muscles.	28
17	MRI axial T2-weighted image shows intact puborectalis	29
18	MRI Sagittal sections at rest& straining, showing the changes in the levator ani muscles	29
19	MRI axial section shows width of levator hiatus.	29
20	schematic diagram of (RVF) rectovaginal fascia	31
21	Drawing of anal canal.	33
22	Schematic diagram shows Blood supply of rectum & anal canal.	38
23	Schematic drawing of the nerves of the female pelvic region.	38
24	Schematic drawing of external anal sphincter and puborectalis.	39
25	MRI sagittal images show Perineal body.	42
26	MRI Axial T2WI image of anal sphincter at the mid anal level.	45
27	MRI axial & coronal contrast-enhanced TIWI of the anal canal.	45
28	Endo anal MRI axial images show external anal sphincter.	46
29	Endo anal MRI axial images show external anal sphincter and Internal anal sphincter.	47
30	MRI axial T2WI of anal canal in male and female.	48
31	MRI Coronal T2WIs show anal canal in male and female.	50
32	MRI coronal T2WI shows levator ani inserts onto the internal obturator muscle.	50

33	MRI sagittal T2WIs show anal canal in male and female.	51
34	Diagram of normal anatomy and physiology of the pelvic floor in the sagittal plane at rest and during normal defecation.	54
35	Diagram of Internal sphincter innervations in state of relaxation or contraction.	57
36	Section through the anal canal showing the anal sphincters and anal cushions.	59
37	Equation of interaction between the Sensory and Reflex Factors in the Anorectal Segment.	62
38	Defecography during Rest, Squeeze and defecation shows anal resistance.	63
39	Illustrative diagram of anterior and posterior rectoceles.	76
40	Levels of rectal prolapse.	77
41	Proctoscopic biopsy of solitary rectal ulcer.	78
42	Diagram shows enteroceles and rectocele.	81
43	Anorectal manometry in a healthy individual and a patient with dyssynergia defecation.	90
44	Anorectal manometry in a healthy individual and a patient with fecal incontinence.	91
45	Neurophysiological changes following trans lumbar magnetic stimulation in healthy and incontinence subjects.	93
46	Normal conventional defecography.	98
47	Conventional defecography shows Rectocele.	100
48	Conventional defecography shows rectal prolapse.	101
49	Conventional defecography shows Solitary rectal ulcer syndrome.	102
50	Conventional defecography shows descending perineum syndrome.	104
51	Conventional defecography shows dyskinesia puborectalis muscle syndrome	104
52	Conventional defecography shows enteroceles & sigmoidocele.	105
53	Conventional defecography shows rectocele & entorocele.	106
54	Normal endoanal ultrasound appearance in male at the level of the puborectalis muscle.	109
55	Normal endoanal ultrasound appearance in an adult male (mid anal canal).	109
56	Normal endoanal ultrasound appearance in an adult male (distal to the termination of the internal anal sphincter)	109

57	Normal endoanal ultrasound appearance in an adult female (mid anal canal).	**109**
58	Endoanal ultrasound shows internal anal sphincter defect.	**110**
59	Endoanal ultrasound shows external anal sphincter defect.	**111**
60	Three-dimensional endoanal sonogram at midanal canal shows large obstetric tear involving both internal and external anal sphincters.	**112**
61	Drawing of the sagittal midline view of the female pelvis shows PCL, H &M lines.	**114**
62	Normal static and dynamic MR imaging findings in female.	**115**
63	shows anatomic landmarks used in the HMO classification system.(MRI and diagrams of normal and diseased)	**119**
64	MRI static, dynamic & defecography in female with fecal incontinence.	**123**
65	Upright MRI defecography in a female with obstructed defecation.	**124**
66	Photomicrograph of biopsy specimen of normal external anal sphincter.	**126**
67	Photomicrograph of biopsy specimen of external & internal anal sphincter, and axial endoanal MRI in a case of fecal incontinence.	**126**
68	Axial T2WI of lower part of the anal sphincter reveals scar tissue.	**127**
69	Static MR images in two patients, both with anal incontinence and POP.	**127**
70	Static and dynamic MR images in-patient with anal incontinence and POP.	**129**
71	MRI Sagittal FIESTA image obtained during defecation shows rectocele.	**130**
72	MR defecogram obtained during defecation shows intussusception	**131**
73	MRI Sagittal FIESTA images of severe three-compartment descent	**132**
74	Straining midsagittal MR image shows moderate hiatal enlargement with mild pelvic floor descent accompanied by pan compartment failure	**134**
75	Coronal& Sagittal T2WIs show important anatomic landmarks to conduct MRI examination.	**139**
76	Sagittal T2 for obtaining static axial images of anal sphincter.	**139**
77	Static MRI anal sphincter complex (axial , coronal , sagittal)	**140**
78	MRI sagittal (static & evacuation) shows how to measure anal sphincter diameter during rest & evacuation.	**141**

79	Comparison between mean values of H line diameter in maximum straining and evacuation phases within each studied groups (control, AI &OD).	**146**
80	Comparison between mean values of M line diameter in maximum straining and evacuation phases within each studied groups (control, AI &OD).	**148**
81	Comparison between mean values of LPA in maximum straining and evacuation phases within each studied groups (control, AI &OD).	**150**
82	Comparison between mean values of WLH in maximum straining phase for (control, AI &OD) groups.	**151**
83	Comparison between mean values of ILca in maximum straining phase for (control, AI &OD) groups.	**152**
84	Comparison between mean values of anorectal junction descent in maximum straining and evacuation phases for (control, AI &OD).	**154**
85	Comparison between the presence of rectocele in maximum straining phase for (control, AI &OD) groups.	**155**
86	Comparison between the presence of rectocele in evacuation phase for (control, AI &OD) groups.	**156**
87	percentage of reduction in anal sphincter diameter in control and simple anal disease.	**162**
88	MRI static images of pelvic floor & anal Sphincter complex	**163**
89	MRI BFFE axial oblique of anal sphincter complex in normal	**164**
90	MRI BFFE sagittal dynamic images straining & evacuation in normal	**153**
91	MRI BFFE dynamic coronal oblique & axial	**166**
92	MRI BFFE dynamic coronal oblique evacuation images	**166**
93	endoanal ultrasound at the level of midanal canal in case2	**167**
94	MRI static BFFE axial oblique plane of anal sphincter complex in case 2	**168**
95	MRI dynamic pelvic floor sagittal plane in case 2	**169**
96	MRI dynamic pelvic floor axial plane in case 2	**170**
97	MRI dynamic pelvic floor coronal plane in case 2	**170**
98	MRI static BFFE axial oblique plane of anal sphincter complex in case 3	**172**
99	MRI dynamic pelvic floor sagittal plane(Rest ,maximum straining & evacuation)in case 3.	**172**
100	MRI dynamic pelvic floor axial & coronal in case 3	**173**

101	conventional defecography case 4	**174**
102	MRI T2 midsagittal plane of case 4	**175**
103	T2 axial oblique of anal sphincter in case 4	**175**
104	T2 axial oblique of anal sphincter in case 4	**176**
105	T2 coronal of anal sphincter in case 4	**176**
106	MRI dynamic sagittal ,axial & coronal in case 4	**177**
107	Sagittal evacuation in case 4	**178**
108	MRI T2 midsagittal plane during (rest, maximum straining &evacuation phases) in Case 5	**179**
109	MRI dynamic pelvic floor axial & coronal planes during maximum straining.	**179**
110	Conventional defecography case6	**180**
111	MRI T2 midsagittal of anal sphincter case 6	**181**
112	MRI axial oblique of anal sphincter complex case 6	**181**
113	MRI coronalT2 of anal sphincter complex in case6	**182**
114	MRI dynamic pelvic floor sagittal plane during (rest & maximum straining) in case 6	**182**
115	MRI dynamic pelvic floor axial during maximum straining in case 6.	**183**
116	MRI dynamic pelvic floor coronal plane during maximum straining in case 6.	**183**
117	MRI dynamic pelvic floor evacuation phase in case 6 .	**184**
118	Anal sphincter diameter during rest &evacuation phases in case7 with simple anal disease.	**185**
119	MRI dynamic pelvic floor, rest &evacuation phases in case 8 with simple anal disease.	**186**

Table number	Content	Page number
Table 1	Dimensions of the anal sphincter complex & perianal structures	43
Table 2	Factors related to anal continence	55
Table 3	Drugs that can exacerbate fecal incontinence	68
Table 4	Pathophysiology of chronic constipation	74
Table 5	Initial clinical assessment of patient with anal incontinence	83
Table 6	Food and drink that may exacerbate fecal incontinence in patients with loose stools	84
Table 7	Wexner fecal incontinence scoring system.	84
Table 8	Rome III criteria in 2006 for constipation.	85
Table 9	Rome III Diagnostic Criteria for Irritable Bowel Syndrome.	86
Table10	Diagnostic Criteria for Functional Fecal Incontinence.	88
Table11	Diagnostic Criteria for Functional Defecation Disorders	88
Table12	MRI reporting system	117
Table13	Grading of Pelvic Floor Relaxation	120
Table14	Change of Surgical Therapy in Specific Patients	128
Table15	Demographic features of the studied groups.	145
Table16	Comparison between mean values of H-line in maximum straining phase for (control, AI &OD) groups	145
Table17	Comparison between mean values of H-line in evacuation phase for (control, AI &OD) groups	146
Table18	Comparison between mean values of H-line in maximum straining and evacuation phases within each studied	146

	groups (control, AI &OD)	
Table19	Comparison between mean values of M line diameter in maximum straining phase for (control, AI &OD) groups.	**147**
Table20	Comparison between mean values of M line diameter in evacuation phase for (control, AI &OD) groups	**147**
Table21	Comparison between mean values of M line diameter in maximum straining and evacuation phases within each studied groups (control, AI &OD).	**148**
Table22	Comparison between mean values of LPA in maximum straining phase for (control, AI &OD) groups.	**149**
Table23	Comparison between mean values of LPA in evacuation phase for (control, AI &OD) groups.	**152**
Table24	Comparison between mean values of LPA in maximum straining and evacuation phases within each studied groups (control, AI &OD).	**150**
Table25	Comparison between mean values of WLH in maximum straining phase for (control, AI &OD) groups.	**151**
Table26	Comparison between mean values of ILca in maximum straining phase for (control, AI &OD) groups.	**152**
Table27	Comparison between mean values of ARJ descent in maximum straining phase for (control, AI &OD) groups.	**153**
Table28	Comparison between mean values of ARJ descent in evacuation phase for (control, AI &OD) groups.	**153**
Table29	Comparison between mean values of ARJ descent in maximum straining and evacuation phases within each studied group.	**154**
Table30	Comparison between the presence and diameter of rectocele in maximum straining phase for (control, AI &OD) groups.	**155**

Table31	Comparison between the presence and dimension of rectocele in evacuation phase for (control, AI &OD) groups	**156**
Table32	Comparison between the presence and diameter of rectocele in maximum straining phase for females of	**157**
Table33	between the presence and diameter of rectocele in evacuation phase for females of (control, AI &OD) groups.	**157**
Table34	Structural abnormalities in maximum straining .	**158**
Table35	Structural abnormalities in evacuation.	**158**
Table36	Anal sphincter diameter in control group.	**159**
Table37	EAS injury in (control, AI &OD) groups.	**159**
Table38	IAS injury in (control, AI &OD) groups.	**160**
Table39	Puborectalis injury in (control, AI &OD) groups	**160**
Table40	Iliococcygeus injury in (control, AI &OD) groups	**161**
Table41	Comparison between mean values of anal sphincter diameter in (control & simple anal disease) in straining & evacuation phases and percentage of reduction.	**162**

List of Abbreviations

- **ACL**: Anal Canal Length.
- **AF**: anal fissure.
- **AI**: Anal Incontinence.
- **ARA**: Anorectal Angle
- **ARJ**: Ano Rectal Junction.
- **AS**: Anal Sphincter.
- **ATFP**: Arcus Tendineus Fascia Pelvis.
- **ATLA**: Arcus Tendineus Levator Ani.
- **BFFE**: Balanced Fast –Field Echo.
- **DTPM**: Deep Transverse Perineal Muscle.
- **EAS**: External Anal Sphincter.
- **EMG**: Electromyography.
- **FI**: Fecal Incontinence.
- **HAPCs**: high amplitude propagated contractions.
- **IAS**: Internal Anal Sphincter.
- **ILCM**: Ilio-Coccygeus Muscle.
- **ILCMA**: Ilio-Coccygeus Muscle Angle.
- **LAM**: Levator Ani Muscle.
- **LP**: Levator Plate.
- **LPA**: Levator Plate Angle.
- **MRD**: Magnetic Resonance Defecography.
- **ODS**: Obstructed Defecation Syndrome.
- **OIM**: Obturator Internus Muscle.
- **PAF**: Perianal fistula.
- **PCL**: Pubo coccygeal Line.
- **PFD**: Pelvic Floor Dysfunction.
- **POP**: Pelvic Organ Prolapse.
- **PRM**: Pubo Rectalis Muscle.
- **STP**: Superficial Transverse Perinii Muscle.
- **T1WI**: T1 weighted image.

- **T2WI**: T2 weighted image.
- **THK**: Thickness.
- **WLH**: Width of Levator Hiatus.

Introduction & Aim of the work

Pelvic floor dysfunction (**PFD**) has a significant impaction socially, psychologically and economically. ***Elsayed R (2013)***, mentioned that each year PFD affects 300,000 to 400,000 of American women so severely that they require surgery and approximate ~ 30% of the procedures are reoperations. Pelvic floor dysfunction (PFD) is a term applied to a wide variety of clinical conditions, including urinary incontinence (UI), pelvic organ prolapse (POP), defecatory dysfunction, sensory and emptying abnormalities of the lower urinary tract, sexual dysfunction, and several chronic pain syndromes ***(Elsayed R ,2013)***.

Disorders of the anorectum and pelvic floor affect approximately 25% of the population ***(Rao, 2010)***; and bout 10% to 20% of patients seeking medical care in gastrointestinal clinics have anorectal dysfunction ***(Roost et al, 2002).***

The evaluation and treatment have been hindered by a lack of understanding of underlying mechanism (s) and a working knowledge of the diagnostic advances in this field. A meticulous evaluation of anorectal structure and its function can provide invaluable insights regarding the pathogenic mechanism(s) of these disorders. Also, significant new knowledge has emerged over the past decade that include the development of newer diagnostic tools such as high resolution manometry and MR defecography as well as a better delineation of the clinical and pathophysiological subtypes of constipation and incontinence ***(Rao, 2010).***Generally, anorectal dysfunctions divided into two main categories: **1)** ***Anal incontinence*** & **2)** ***Constipation***