

Endo-FLIP assessment of anal canal resistance and its correlation to continence

introduction



 It is difficult to define anal continence clearly; nonetheless it implies the ability to completely control defecation. Anal continence is a complex serial process achieved by conscious will and local reflex (Cho, *2010)*.

 In 1998 Farag stated that the anal sphincter muscles acts through the anal canal length and anal diameter, thus changing the anal canal resistance over a range of 704 folds from full contraction during maximum squeeze to full relaxation during defecation.

 According to the flow equation by (Farag, **2009)** (Flow = Pressure/Resistance). Accordingly the recto-anal interaction is a pressure/resistance interaction rather than pressure/pressure interaction. The anal canal resistance is directly proportionate to dynamic viscosity (DV) or consistency of stools and anal canal length (ACL), and inversely proportionate to anal canal diameter.



3.14 X (ACD)⁴

The flow equation will be finally as follows:

3.14 X (ACD)⁴

Flow = IRP x ----

128 x DV x ACL



Endo FLIP



- The Endo-FLIP (Endolumenal Functional Lumen Imaging Probe) Imaging System is a revolutionary new technology used to measure the dimensions and function of a variety of hollow organs and sphincteric regions throughout the gastrointestinal tract.
- The Endo-FLIP System uses a technique called impedance planimetry to characterize the geometry of the measurement area





 The catheter balloon contains an array of 16 electrodes



(16 measurements)

 The change in voltage across each is used to estimate the diameter at that point



Aim of the study



 Measurement of the anal canal length and average anal canal diameter using endo FLIP hence the resistance can be calculated in normal Egyptian controls.

Patients and methods



- Number
- Inclusion criteria
 - Healthy volunteers
 - Accepting procedure
 - No previous anal surgery
- Exclusion criteria
 - Previous Surgery
 - Incontinence
 - Obstructed Defecation
- Consent
- Examination
- assessment

procedure

- Kasr Colorectal Unit
- The volunteers were prepared by rectal enemas to evacuate the rectum
- They were positioned in left lateral position with hip and knee flexed
- The pressure within the endo FLIP bag was adjusted to zero through a function on the system
- The catheter was introduced until it straddled the anal canal

Snap shot at rest





Snap shot at squeeze

Al-Ainy



Comparison







- The length is calculated number of blue electrodes and they are half Cm spaced
- The average diameter is calculated (sum of diameters divided by their number)
- Then according to the flow equation a specially designed electronic calculator is used to calculate the resistance of anal canal







percent of male: female

- 1. Number
- 2. Age



ACL



- Mean anal canal length at rest 3.04 cm
- Squeeze is 3.24 cm



The change in the mean anal canal length was from 3.04±0.41 cm at rest to 3.24±0.44 cm during squeeze with p<0.001 which was statistically significant

ACD



- Mean ACD at rest is 7.18 mm
- Squeeze 7.07 mm



 The change in the mean anal canal diameter was from 7.18±0.63 mm at rest to 7.07±0.45 mm during squeeze with p=0.254 which was statistically non-significant.

Resistance



- Mean anal canal resistance at rest is 9268.4
- Mean anal canal resistance at squeeze is 10302.83



The change in the mean anal canal resistance was from 9268.4±2813.07 at rest to 10302.83±2725.46 during squeeze with p=0.012 which was statistically significant

Correlations: 1st length



The anal canal length at rest shows a positive correlation with resistance at rest with a p value (0.538) which is not statistically significant. The anal canal length during squeeze shows a positive correlation with resistance during squeeze with a p value (0.041) which is statistically significant

	Resistance rest		Resistance squeeze	
	r	p value	r	p value
ACL rest	0.100	0.538	0.382*	0.015
ACL squeeze	0.253	0.116	0.324*	0.041





2nd Diameter vs resistance



The anal canal diameter at rest shows a negative correlation with resistance at rest with a (p value <0.001) which is statistically significant. The anal canal diameter during squeeze shows a negative correlation with the resistance during squeeze with a (p value < 0.001) which is statistically significant.

	Resistance rest		Resistance squeeze	
	r	p value	R	p value
Average ACD rest	-0.902-**	<0.001	376-*	0.017
Average ACD squeeze	-0.403-**	0.010	865-**	<0.001





3rd resistance vs continence

- In another study conducted on patients with anal incontinence in our center
- Anal canal resistance showed highly significant correlation with the clinical disease severity, assessed by Farag's score or CCS, either preoperatively or posts operatively (p value< 0.001)

		Preop. CCs	Preop. Grade
Preop. ACR	Correlation Coefficient	894-	908-
	P value	<mark>< 0.001</mark>	<mark>< 0.001</mark>
		Postop. CCs	Postop. Grade
Postop. ACR	Correlation Coefficient	834-	841-
	P value	<mark>< 0.001</mark>	<mark>< 0.001</mark>



Discussion

In 1989, **Shorvan S. J. et al.** Defecography in normal volunteers: results and implications

 stated that the anal canal length could be measured by defecography as the distance between the external anal orifice (marked by barium impregnated jelly) and the point at which the parallel straight sides of the anal canal convert to the diverging walls of the distal rectum

olorectal

- Mean ACL in men during rest 2.2 cm
- Mean ACL in men during squeeze 2.8 cm
- In females at rest 1.6 cm
- Females during squeeze 1.9 cm
- The mean squeeze anal canal length was also significantly larger in men (2.8 cm) than women (1.9 cm) (p<0.00l).

In 2011 **Olsen I. P.et al.** Functional ultrasound of the anal canal

- Measured the anal canal length by ultrasound (endo anal transducer and vaginal transducer)
- At rest using the endo-anal transducer
- the mean anal canal length measured 3.28 cm (SD 0.63) In a group of 9 women
- and 2.57 cm (SD 0.57) in a group of 20 women, both groups consisting of nulliparous women.
- it was 2.30 cm (SD 0.77) in a group of 21 multiparous women, a significant decrease was found after delivery (p > 0.002).



- Using the vaginal transducer
- the anal canal length was measured 3.64 cm (SD 0.48) 1 cm longer than in the endo-anal acquisitions, previously achieved from the same 20 nulligravida women.
- It also became significantly longer 3.86 (SD 0.39) cm during the squeeze maneuver (p> 0.007).

In 2014 Kang et al. Comparison of High-resolution Anorectal Manometry With Water-perfused Anorectal

- measured the anal canal length at rest to be 3.8 cm (2.4–6.0 cm) by water-perfused anorectal manometry
- 2.4 cm (0.9–4.0 cm) by high resolution anorectal manometry (HRARM)
- there was a statistically significant difference (P = 0.002).



	Length at rest	Length at squeeze
Defecography (Shorvan 1989)	2.2 cm, 1.6 cm	2.8 cm, 1.9 cm
Water-perfused (Kang 2014)	3.8 cm	
HRARM (Kang 2014)	2.4 cm	
Endo U.S. (Olsen 2011)	3.2 cm, 2.57 cm, 2.3 cm	
Vaginal U.S. (Olsen 2011)	3.6 cm	3.8 cm
In our study	3.04 cm	3.24 cm

In 1998, Marzio L. et al., Relationship between anal canal diameter and pressure evaluated simultaneously by endosonography and manometry in normal human subjects

- determined anal canal diameter using the ultrasonography
- He used manometry concomitantly with US, The data showed showed that anal canal pressure was inversely correlated with anal canal diameter (P<0.001)
- At rest the pressure was 87 ±18 m Bar the diameter was 19±5 mm
- During squeezing the pressure was 145±12 m Bar the diameter was 13±3 mm.



- In 1992 Laster et al used magnetic resonance imaging (MRI)
- the measured diameter of the internal sphincter ring at rest was 7.7 ± 0.8 mm, while in maximum squeeze it was 7.2 ± 0.4 mm, Thus a gap 7 to 8 mm diameter was observed



	Diameter at rest	Diameter at squeeze
U.S. (Marzio 1998)	19 mm	13 mm
MRI Laster et al 1992	7.7 mm	7.2mm
In our study	7.18 mm	7.07 mm

Conclusion



 Knowledge of the normal values of the anal canal length (ACL), anal canal diameter (ACD), anal canal resistance during rest and squeeze in Egyptian population and the correlation between them is needed to investigate patients suffering from incontinence and obstructed defecation. Hence restoring the normal values during treatment of these cases with operator independent quality control of different treatment modalities. And during follow up of these cases

Thank you

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