



*Endo-FLIP assessment of anal canal resistance in
normal Egyptian controls*

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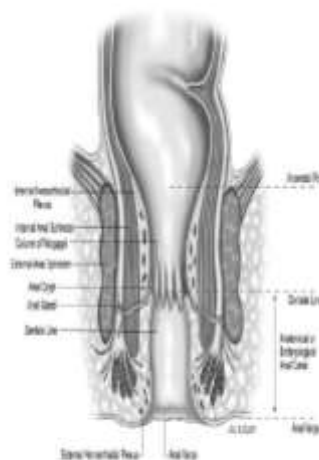
Aim of the study

- Measurement of the anal canal length and average anal canal diameter using endo FLIP in normal Egyptian controls.

- Two definitions are found describing the anal canal , The “anatomic” or “embryologic” anal canal is only 2.0 cm long, extending from the anal verge to the dentate line. The “surgical” or “functional” anal canal is longer, extending for approximately 4.0 cm from the anal verge to the anorectal ring (levator ani) (**Bruce et al., 2007**).

- Muscles of the anal canal

- The internal anal sphincter
- The external anal sphincter
- The conjoined longitudinal muscle



- Normal defecation requires a series of integrated actions, starting with relaxation of the puborectalis muscles, descent of the pelvic floor with straightening of the anorectal angle, inhibition of segmental colonic peristalsis, contraction of the abdominal wall muscles and finally relaxation of the external anal sphincter with expulsion of feces (**Lawrence et al., 2011**).

The action of 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 (**Farag, 2000**).

Endo FLIP

Functional luminal Imaging Probe

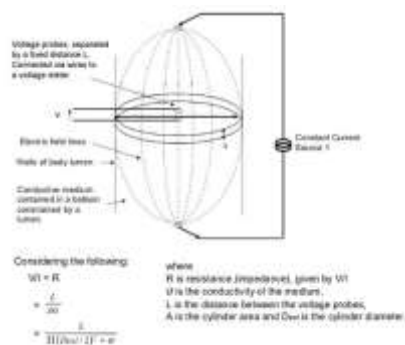
- Measurement of cross sectional areas of alimentary tract



Technology of endo-FLIP

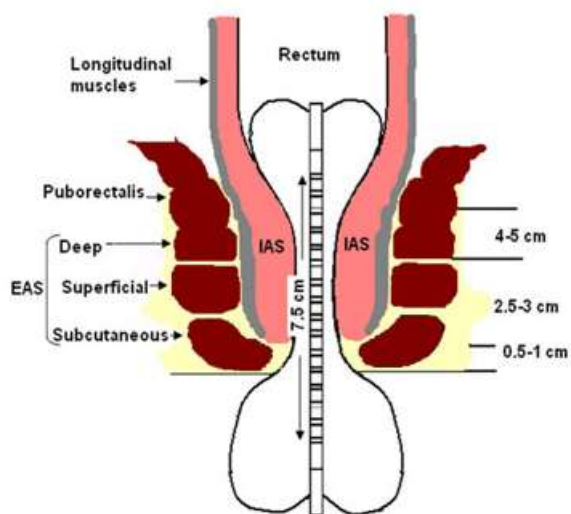
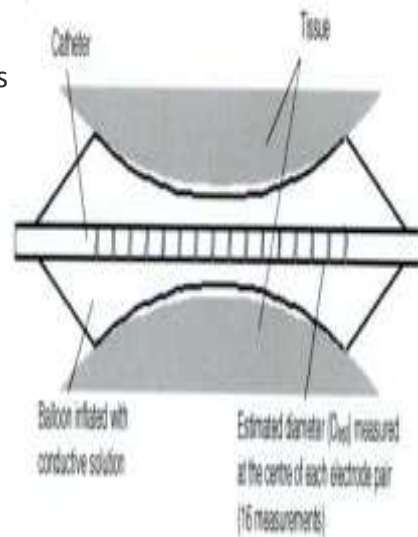
- Impedance plainometry
- $R = V / I$

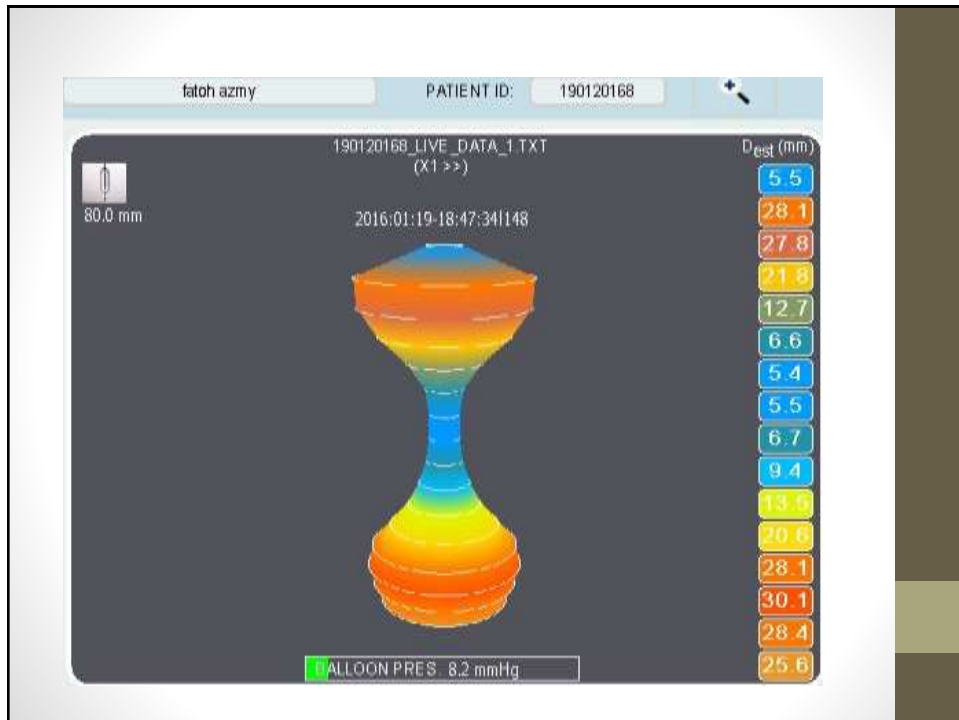
- Also $R = L / (A \times \delta)$
- $R = L / (\pi r^2 \delta)$
- $r = D/2$



The device generates constant AC current across two electrodes the conductivity of the medium is constant at a given temp. the diameter between the two electrodes can be estimated

- The catheter balloon contains an array of 16 electrodes
- The change in voltage across each is used to estimate the diameter at that point

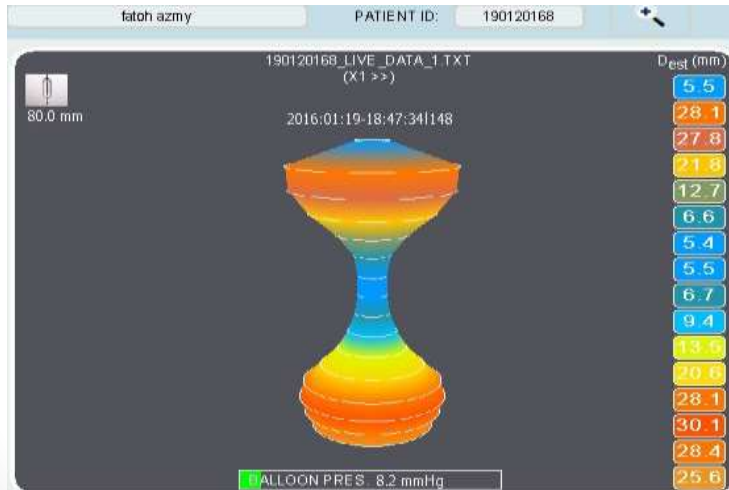




Patients and methods

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

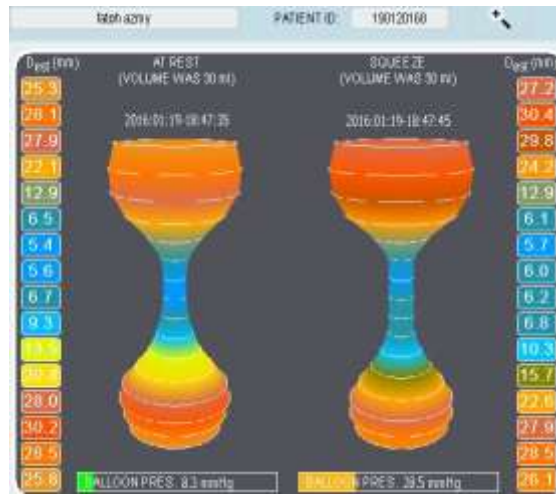
Snap shot at rest



Snap shot at squeeze



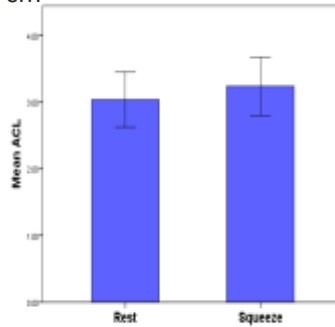
Comparison



Results

ACL

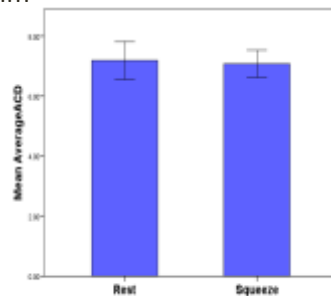
- Mean anal canal length at rest 3.04 cm
- Squeeze is 3.24 cm



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

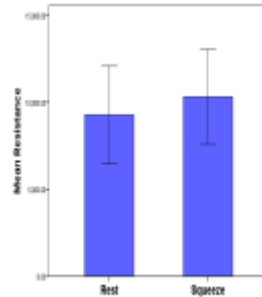
- Mean ACD at rest is 7.18 mm
- Squeeze 7.07 mm



- 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

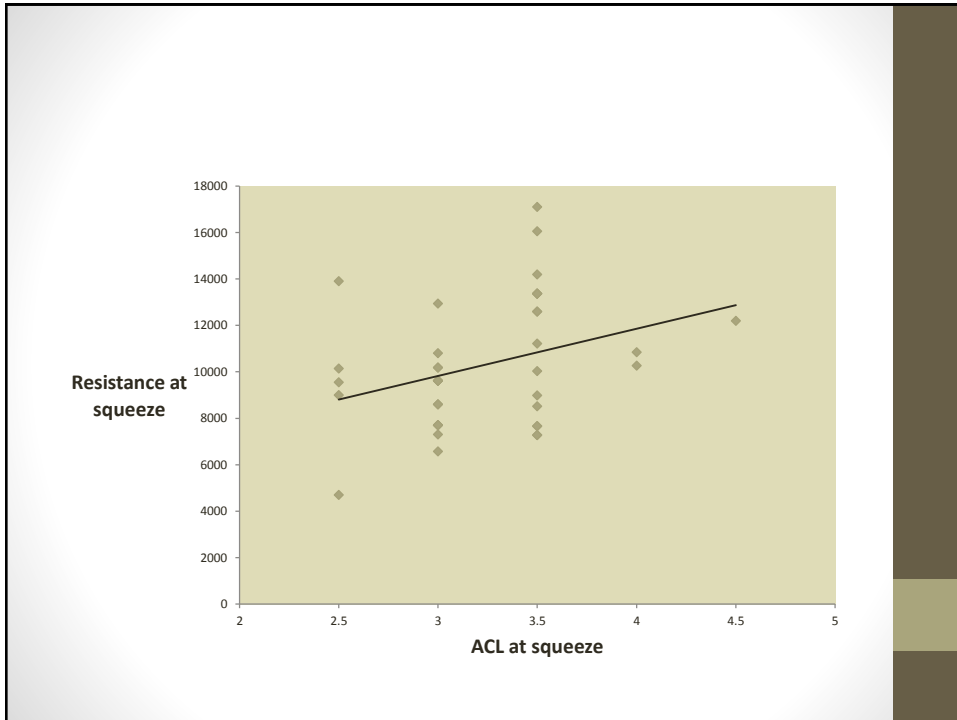


The change in the mean anal canal resistance was from 9268.4 ± 2813.07 at rest to 10302.83 ± 2725.46 during squeeze with $p=0.012$ which was statistically significant

Correlations

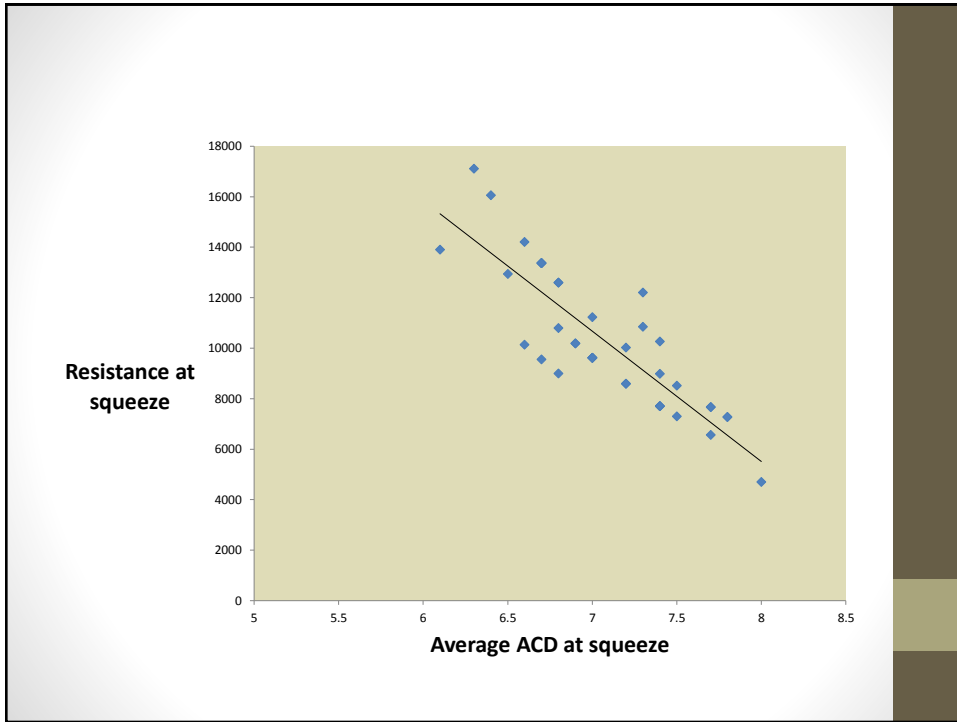
The anal canal length at rest shows a positive correlation with resistance at rest with a p value (0.538) which is not statistically significant. The anal canal length during squeeze shows a positive correlation with resistance during squeeze with a p value (0.041) which is statistically significant

	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



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



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
- 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) ($p < 0.001$).

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 ($p > 0.002$).

Functional ultrasound of the anal canal

- 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.

	Diameter at rest	Diameter at squeeze
U.S. (Marzio 1998)	19 mm	13 mm
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
- Number of volunteers should be increased for more accurate results

