Fecal Incontinence: intraoperative adjustment of the repair
Fecal incontinence is involuntary loss of rectal contents (feces, gas) through the anal canal and the inability to postpone an evacuation until socially convenient.

(Rao SS. 2004)
CLASSIFICATION:

Fecal incontinence

Passive

Stress

Urge
The knowledge about the physiology and pathophysiology of the anorectal continence remains sketchy in many aspects, particularly in correlating subjective and objective parameters in a way to allow for prediction of outcomes and absence of instruments to measure and quantitate fecal incontinence.

(Paquette IM. Et al., 2015, Kaiser AM, 2009 and Alavi K, et al., 2015)
Successful management of patients with fecal incontinence requires a good understanding of the underlying normal mechanisms and the interaction of different components that contribute to achieving fecal control.

(Ruiz, N. S., & Kaiser, A. M. 2017)
Factors affecting continence

- stool consistency
- stool volume
- colonic transit time
- Sphincter complex integrity
- anorectal sensation
- rectal compliance
- anorectal reflexes
The lack of answers to the question on how the anal sphincter works is mainly due to the fact that, the anorectal segment is functionally highly integrated and should be studied using an integrated approach.

The flow equation (Hagen-Poisuille law):

\[
\text{Flow (F)} = \frac{\text{pressure change (P)}}{\text{Resistance (R)}}
\]

It was designed to study flow of fluids.
In 1998, Farag A. applied the flow equation for the integration of anorectal physiology trying to understand how the anal sphincter works?
Flow (F) = \frac{\text{pressure change (P)}}{\text{Resistance (R)}}
Small changes in the geometry of the anorectum can produce large changes in the forces required to expel feces.

Using the Flow equation as a mathematic Model, the Anal Canal Length and Diameter are the final Common pathway of the Function of the anal sphincter, the Pelvic floor muscles and reflexes work during continence and defecation.
Functional luminal imaging probe (FLIP)
A novel modality used in measuring the anal canal dimensions.
FLIP has been developed for assessment of lumen size and sphincter dispensability in the gastrointestinal tract.

*(McMahon, B. P., et al., 2005).*
The length of the anal canal (ACL) = number of blue electrodes and each is half cm apart.

The average anal canal diameter (ACD) = the sum of diameters/ their number.

Passive --------- During Rest.

Urge ------ During Squeeze.

Stress ------During Cough.
The intraoperative use of Endo-FLIP was applied in various upper GI procedures including per oral esophageal myotomy (POEM), laparoscopic Heller’s myotomy for achalasia and post pneumatic dilatation for esophageal stricture.

In 2015 Farag A. and O’Dea, J. used intraoperative Endo-FLIP during unilateral gluteus maximus transposition for end stage incontinent male who achieved significant clinical improvement. They reported that the anal canal length was increased from 1 cm to 3 cm after gluteus maximus transposition.
METHODOLOGY
36 patients were enrolled from Colorectal unit, General surgery department, Kasr Al-Aini hospital, Cairo University.
Inclusion criteria:
Patients with major fecal incontinence due to anal sphincter complex injury who were candidates for operative repair.

Exclusion criteria:
- Unfit for surgery.
- <4 years or >75 years.
- Patients eligible for non-operative management.
- Incontinence due to cause other than sphincter damage.
Preoperative evaluation:

- **History:**
  Subjective parameters of the fecal incontinence.

  Assessment the disease severity by Wexner's score

- **Examination:**
ACL

ACD

ACR

(http://www.integratedcoloproctology.com/cal f2.htm).
Decision making:
Morphological assessment:
According degree of sphincter damage:

- Sphincteroplasty
- Unilateral Gluteus Maximus Transposition
Intraoperative:

**Anesthesia**: general anesthesia without muscle relaxation.

**Position**:
- Jack knife position for gluteus maximus transposition.
- Lithotomy position for sphincterooplasty.
Repair adjustment:

The mean ACL in normal volunteers during rest was:

- 3.26 ± 0.53 cm by TRUS (*Reginelli, A. et al., 2012*).
- 3.28 ± 0.63 cm by transvaginal US (*Olsen I. P. et al., 2011*).
- 3.25 ± 0.6 cm as High pressure zone area in ARM (*Fenner, D. E., et al. 1998*).
- 3.13 ± 0.58 cm by EndoFLIP (*Sørensen G. et al. 2013*).
The inner diameter of the internal sphincter ring was measured in the resting state by MRI. It was $7.7 \pm 0.8$ mm, while in maximum squeeze it was $7.2 \pm 0.4$ mm (Lestar, B., et al. 1992).
The anal canal resistance was adjusted intraoperatively guided by anal canal length and anal canal diameter obtained from the intraoperative use of Endo-FLIP.
RESULTS
<table>
<thead>
<tr>
<th></th>
<th>Mean (cm)</th>
<th>Standard Deviation</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>pre AC Length (cm)</td>
<td>2.17</td>
<td>0.52</td>
<td></td>
</tr>
<tr>
<td>IO AC length</td>
<td>3.23</td>
<td>0.42</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Post AC Length</td>
<td>2.93</td>
<td>0.56</td>
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<tr>
<td>Preop. ACD (cm)</td>
<td>0.94</td>
<td>0.12</td>
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</tr>
<tr>
<td>Intraop. ACD (cm)</td>
<td>0.79</td>
<td>0.03</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Postop. ACD (cm)</td>
<td>0.85</td>
<td>0.11</td>
<td></td>
</tr>
<tr>
<td>Preop. ACR</td>
<td>2534.8</td>
<td>1431.66</td>
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<tr>
<td>Intraop. ACR</td>
<td>5663.46</td>
<td>1097.84</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Postop. ACR</td>
<td>5198.56</td>
<td>1340.24</td>
<td></td>
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Short term follow up:

12 patients (80%) achieved excellent and good clinical response, 2 patients with fair results and only one patient without any improvement.
### Gluteus maximus transposition

<table>
<thead>
<tr>
<th></th>
<th>Mean (cm)</th>
<th>Standard Deviation</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preop. AC Length (cm)</td>
<td>1.17</td>
<td>0.62</td>
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<tr>
<td>Intraop. AC length</td>
<td>2.95</td>
<td>0.44</td>
<td>&lt; 0.001</td>
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<td>Postop. AC Length</td>
<td>2.26</td>
<td>0.68</td>
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<tr>
<td>Preop. ACD (cm)</td>
<td>1.28</td>
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<tr>
<td>Intraop. ACD (cm)</td>
<td>0.82</td>
<td>0.07</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Postop. ACD (cm)</td>
<td>0.98</td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td>Preop. ACR</td>
<td>475.11</td>
<td>441.15</td>
<td></td>
</tr>
<tr>
<td>Intraop. ACR</td>
<td>5587.51</td>
<td>1566.15</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Postop. ACR</td>
<td>2375.95</td>
<td>1394.85</td>
<td></td>
</tr>
</tbody>
</table>
Short term outcome:

14 patients (67%) achieved excellent and good symptomatic outcome, 3 patients (14%) with fair results and 4 patients (19%) without any improvement.
Conclusion
The visualization of the anal canal geometry and using these measurements for input to the flow equation may be used to predict likely surgical outcomes.
Best clinical results were recorded with average intraoperative ACR about 5825.16. However, poor response was documented with higher intraoperative ACR so overcorrection should be avoided guided by optimizing the intraoperative resistance.
Thank you