Hypothesis / aims of study
Our aims were to evaluate (1) the interobserver and (2) the interdisciplinary reliabilities of levator hiatus, urethral thickness and anorectal angle measurements using 3D endovaginal ultrasound (EVUS).

Study design, materials and methods
Twenty-seven nulliparous asymptomatic females were imaged with 3D-EVUS. Analyses were conducted off-line from stored 3D volumes by six readers (two radiologists, two urogynecologists and two colorectal surgeons) using a standardized technique. The following six study parameters were measured in each 3D dataset: Levator hiatus length, Levator hiatus width, Levator hiatus area, Levator ani muscle attachment to the pubic rami on both sides, Anorectal angle, and the Urethral thickness (Figure 1). The reliability analysis consisted of an overall interobserver, intradisciplinary and interdisciplinary analysis. The overall interobserver analysis compared each parameter among the six readers. Reliabilities were determined using the Intraclass Correlation Coefficient (ICC). The Institutional Ethical Committee approved this protocol.

Results
Volunteers had mean age of 32 (range, 18-55) years and mean body mass index of 22.45 (range, 19.4-25.6) kg/m². The identification in the axial plane of the anterior (lower edge of the SP) and posterior (apex of the anorectal junction) landmarks was important because the LA was seen more clearly in this than the other levels. The two limbs of the LA were identified by the six investigators attached to the two pubic rami in all females (Cohen’s kappa = 1; perfect agreement). The correlation between LH length, width and area calculated for 27 patients and for six investigators was high (Cronbach’s alpha = 0.970), indicating that the items were measuring the same underlying construct. The interobserver, intra- and interdisciplinary reliability data are summarized in Table 2. Overall interobserver reliability for biometric indices of LH was good for LH length (ICC = 0.655) and very good for LH width (ICC = 0.889) and LH area (ICC = 0.810). A very good intradisciplinary reliability was found for all LH measurements, with the exception of LH length for urogynecologists and radiologists, which showed a good agreement (ICC = 0.643 and 0.717, respectively). The interdisciplinary reliability was good for LH length and very good for LH width and area, with the exception of LH area between urogynecologists and colorectal surgeons (ICC = 0.783, good agreement). The overall interobserver reliability for urethral thickness was good (ICC = 0.624). For this parameter, the intradisciplinary reliability was also good as was the interdisciplinary reliability between colorectal surgeons and radiologists (ICC = 0.651) and colorectal surgeons and urogynecologists (ICC = 0.671). However, moderate agreement was found between radiologists and urogynecologists (ICC = 0.565). Anorectal angle measurement showed fair overall interobserver reliability (ICC = 0.331). Slight intradisciplinary reliability was found for urogynecologists (ICC = 0.035), fair for colorectal surgeons (ICC = 0.216) and moderate for radiologists (ICC = 0.569). Interdisciplinary reliability was moderate between radiologists and colorectal surgeons (ICC = 0.434), fair between radiologists and urogynecologists (ICC = 0.327) and slight between urogynecologists and colorectal surgeons (ICC = 0.204).

Interpretation of results
3D-EVUS yields reliable measurements of levator hiatus dimensions and urethral thickness. Using a standardized technique, measurements of levator hiatus indices and urethral thickness with 3D endovaginal ultrasound showed good or very good interobserver and interdisciplinary reliabilities.

Concluding message
To establish whether measurements with 3D-EVUS could be influenced by the specialty of the reader, we selected three different specialties (urogynecology, radiology, colorectal surgery). The evaluation of pelvic floor structures appeared to be independent from which specialty performed the measurements.

Figure 1.
Three-dimensional endovaginal ultrasound. Measurements in the axial plane of minimal hiatal dimensions: LH ap - levator hiatus anterior-posterior diameter; LH ll - levator hiatus latero-lateral diameter; LHA area is marked with lines. AC anal canal, IPR inferior pubic ramus, LA levator ani, SP symphysis pubis, T transducer, U urethra
Table 1. Interobserver, Intra- and interdisciplinary reliability of three-dimensional endovaginal ultrasound

<table>
<thead>
<tr>
<th>Reliability</th>
<th>LH length</th>
<th>LH width</th>
<th>LH area</th>
<th>Urethral thickness</th>
<th>ARA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ICC</td>
<td>95%CI</td>
<td>ICC</td>
<td>95%CI</td>
<td>ICC</td>
</tr>
<tr>
<td>Overall</td>
<td>0.655</td>
<td>0.509–0.794</td>
<td>0.889</td>
<td>0.822–0.940</td>
<td>0.810</td>
</tr>
<tr>
<td>Intradisciplinary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UGN 1 vs. UGN 2</td>
<td>0.643</td>
<td>0.539–0.819</td>
<td>0.880</td>
<td>0.773–0.948</td>
<td>0.857</td>
</tr>
<tr>
<td>RAD 1 vs. RAD 2</td>
<td>0.717</td>
<td>0.473–0.860</td>
<td>0.981</td>
<td>0.958–0.991</td>
<td>0.893</td>
</tr>
<tr>
<td>CRS 1 vs. CRS 2</td>
<td>0.883</td>
<td>0.761–0.945</td>
<td>0.910</td>
<td>0.815–0.938</td>
<td>0.887</td>
</tr>
<tr>
<td>Interdisciplinary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RADs vs CRSs</td>
<td>0.677</td>
<td>0.514–0.815</td>
<td>0.915</td>
<td>0.855–0.956</td>
<td>0.831</td>
</tr>
<tr>
<td>RADs vs UGNs</td>
<td>0.639</td>
<td>0.467–0.790</td>
<td>0.897</td>
<td>0.826–0.946</td>
<td>0.851</td>
</tr>
<tr>
<td>UGNs vs CRSs</td>
<td>0.694</td>
<td>0.536–0.826</td>
<td>0.874</td>
<td>0.790–0.934</td>
<td>0.783</td>
</tr>
</tbody>
</table>

ARA = anorectal angle. CI = confidence interval. CRS = colorectal surgeon. ICC = intraclass correlation coefficient. LH = levator hiatus. RAD = radiologist. UGN = urogynecologist.

References

Specify source of funding or grant

Is this a clinical trial?

Was the study approved by an ethics committee?

Specify Name of Ethics Committee

Was the Declaration of Helsinki followed?

Was informed consent obtained from the patients?