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# 4D/3D SONOGRAPHIC DESCRIPTION OF THE SQUEEZE MECHANISM IN THE ANAL SPHINCTER

Hypothesis / aims of study

The anal squeeze mechanism in the external anal sphincter (EAS) has been described as two (alternative three) slings with different insertions that when contracting, pull different segments of the anal canal in anterior or posterior directions thus closing the anal canal (1, 2). The function in the internal anal sphincter (IAS) is to maintain the resting pressure in the anal canal and to relax, thus enabling rectal sensations and evacuation (3). The third component of the anal sphincter - the conjoined longitudinal muscle (LM) - has not been discussed in relation to continence. The aim of the present study was to describe the movements in the anal sphincter during voluntary squeeze in healthy nulliparous women using a new ultrasonographic technique.

Study design, materials and methods

Seven nulliparous women were investigated in dorsal lithotomic position using externally applied transanal 4D/3D linear ultrasound probe (5.6 –18.4 MHz). The probe was inclined against the anal verge enabling the differentiation of the LM from the EAS and the IAS. 4D/3D ultrasound volumes uptakes of voluntary squeezes were stored and analyzed off-line.

Results

During contraction, the subcutaneous EAS compressed the anoderm, the transverse superficial perineal muscle stretched and secured the caudal perineum in position. The deep mid sagittal EAS elongated from median 7.9mm (6.0-9.6)-14.2mm (10.3-16.8), (P = <0.001, paired t-test) along the anal canal around the IAS and LM. The walls of IAS were compressed and the walls of LM remained unchanged or increased slightly in thickness. In the midsagittal anterior aspects of the LM, a movement in cranial direction was observed. Simultaneously, the area inside the IAS decreased. The perineal body was stretched and elongated in cranial direction.

Interpretation of results

The squeeze affects all structures in the perineum. The most caudal parts of the perineum (the central point, the superficial perineal muscle, superficial EAS) seams to anchor the rest of the anal sphincters. From this anchor the deep EAS and the LM stretches in cranial direction along the anal canal. An explanation to the stretch in the deep EAS might be that the insertion in the anocoxygeal ligament gives a shortening of the fibres and a lift in cranial direction. As the puborectal muscle and the puboperineal muscle are inserted into deep EAS, they will also act as stretchers when contracting. The constriction of the area inside the IAS was not as impressive as the compression of the walls of IAS beneath the EAS. During the rectoanal inhibitory reflex loss of muscle tone in the IAS might be compensated for by the visible compression of the IAS walls (Fig 4.) that might stop peristalsis and evacuation.

Concluding message

During a squeeze of the anal sphincter complex, the EAS contracts by a diameter reduction and by an elongation in cranial direction. The LM moves in cranial direction along the anal canal and the walls of IAS are compressed. Thus, the present study did not confirm the old sling theory on anal continence.

Fig. 1

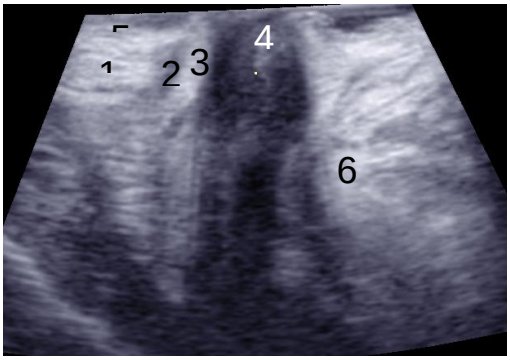



Fig.2

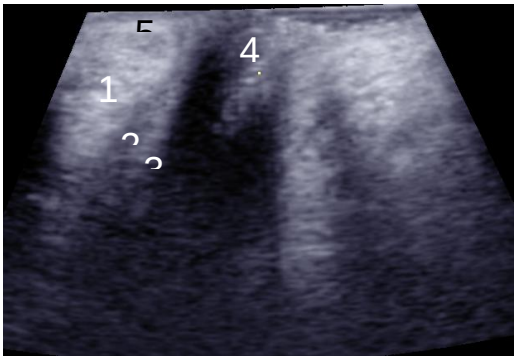
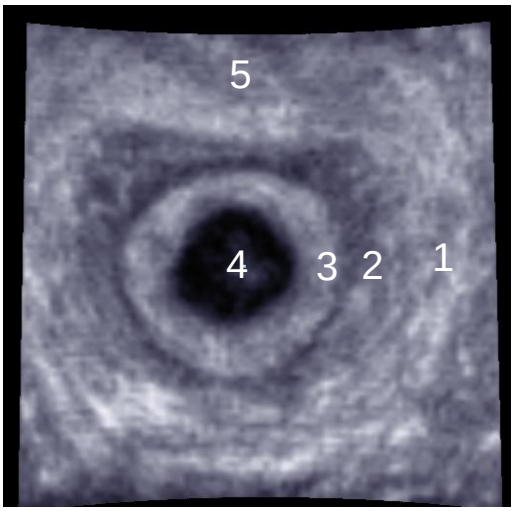



Fig 1. At rest, the midsagittal external anal sphincter (EAS) (1) almost parallels the perineum (5). The longitudinal muscle (LM) (2) is hypoechogeneic and the internal anal sphincter (IAS) (3) is hyperechogeneic on transanal sonography.
Fig 2. During a contraction, the EAS (1) is elongated in a cranial direction. The IAS (3) and the LM (2) are stretched and the walls of the IAS get thinner.

Anal canal (4), puborectal muscle (6).

Fig.3 Fig. 4



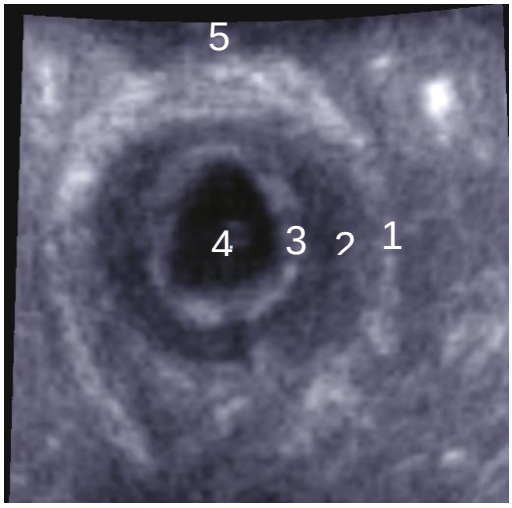




Fig 3. At rest in a transverse projection the EAS (1) and the IAS (3) are hyperechogeneic and the LM is hypoechogeneic.
Fig 4. During a squeeze the walls of the IAS (3) are compressed, while the thickness of the LM (2) increases or remains unchanged. The EAS (1) compress the anal canal. Vagina (5).

References

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| ***Is this study registered in a public clinical trials registry?*** | **No** |
| ***What were the subjects in the study?*** | **HUMAN** |
| ***Was this study approved by an ethics committee?*** | **Yes** |
| ***Specify Name of Ethics Committee*** | **Reseach Ethics Committee of the Southern Swedish Region** |
| ***Was the Declaration of Helsinki followed?*** | **Yes** |
| ***Was informed consent obtained from the patients?*** | **Yes** |