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Beyond tailored sphincterotomy: an endoanal ultrasound-based morphometric study for anal fissure

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ABSTRACT

Introduction: This study aimed to demonstrate the clinical value of endoanal ultrasonography (EAUS) in patients with chronic and/or recurrent anal fissures, compare sphincter thickness in primary cases with healthy EAUS norms, determine the classification performance of EAUS in differentiating operated from non-operated sphincter anatomy, and quantitatively assess sphincterotomy adequacy.

Materials and Methods: In this single-center observational study, 48 patients were evaluated in two distinct groups: the chronic anal fissure group and the postoperative anal fissure group. Morphometric EAUS findings in patients with chronic anal fissures were compared with normal anal canal anatomy. The detectability of the postoperative sphincterotomy line, adequacy of sphincterotomy, quality of internal and external sphincterotomy, and classification performance for unintended external sphincterotomy were examined.

Results: In the anal fissure group, the detection rates with EAUS were 91.3% for the IAS and 87.0% for the EAS; in the postoperative group, they were 100% for the IAS and 96.0% for the EAS. The specificity for differentiating operated from non-operated sphincter anatomy was 100%, and the sensitivity was 76–80%. In the anal fissure group, the IAS thickness was 3.53±0.89 mm and the EAS thickness was 8.86±1.92 mm, both of which were greater than the healthy EAUS norms reported in the literature. In the postoperative group, unintended external sphincterotomy was detected in nine cases (36.0%).

Conclusions: EAUS may serve as a complementary tool to strengthen diagnostic and treatment decisions by providing inexpensive, rapid, reproducible, and quantitative morphometric data on anal fissures. These findings are consistent with internal anal sphincter hypertrophy in primary fissures and may enable the quantification of sphincterotomy adequacy and the identification of unintended external sphincter effects in the postoperative period.

Keywords: Anal fissure, Endoanal ultrasonography (EAUS), Lateral internal sphincterotomy (LIS), sphincter morphometry, tailored sphincterotomy

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Introduction

Anal fissure is a common benign condition that causes discomfort and functional impairment. The treatment algorithm offers numerous options, ranging from medical to surgical treatment.[1] Although current guidelines indicate that lateral internal sphincterotomy (LIS) is the "gold standard," the risk of incontinence and recurrence, as well as the management of nonhealing fissures after surgery, remain challenging.[2]

Endoanal ultrasound (EAUS) is a fast, accessible, and reproducible modality that displays the layers of the anal sphincter complex with high spatial resolution.[3] It is considered the "gold standard" for detecting sphincter damage or defects. Studies have demonstrated that EAUS effectively reveals sphincter morphology for clinical decision-making, establishing a reference baseline for normal anal sphincter anatomy and internal anal sphincter (IAS) thickness ranges. Furthermore, comparative studies with MRI have demonstrated the reliability of EAUS in measuring IAS thickness.[4] However, the sphincter morphology related to the etiopathogenesis of fissures and the adequacy of the applied sphincterotomy have not been thoroughly investigated in the literature.[5]

The most widely accepted pathophysiological mechanism underlying chronic anal fissures is hypertrophy of the internal anal sphincter, and the resulting nonhealing cycle is caused by decreased perfusion in the distal anal canal.[6] It is thought that the morphological counterpart of this cycle may be IAS thickening measurable by EAUS and increased resting pressure measurable by manometry; however, these measurements have not shown a consistent relationship in clinical practice. Indeed, prospective series have failed to demonstrate clear correlations between EAUS measurements of sphincter thickness and manometric findings in most patients with fissures.[7] These findings emphasize the importance of both morphological and physiological assessments, which are complementary but do not always coincide, and highlight the need for additional analysis.

The surgically critical question, "How much of the IAS should be divided for ideal sphincterotomy?" is addressed in current practice with tailored LIS; however, the importance of prior morphometric mapping in surgical planning and determining the actual upper limit of the postoperative incision remains to be fully established.[8,9] One of the most common and correctable causes of recurrent or nonhealing fissures is incomplete sphincterotomy or incision in the wrong plane. EAUS can directly demonstrate these technical failures. Furthermore, the strong relationship between recurrence and incomplete incision after closed LIS, as well as recurrence and continence outcomes in larger series comparing open versus closed LIS using EAUS-based zoning, may also be explained by the proximal extent of the incision.[10] This body of evidence supports the evaluation of the sphincterotomy line and its completeness with EAUS as an initial step in the assessment of recurrent anal fissure. On the other hand, occult sphincter defects, overt sphincter damage, and the potential risk of incontinence during fissure treatment can be quantitatively demonstrated using endosonographic findings.[11]

This study aimed to investigate the effects of anal canal anatomy and IAS/EAS morphometry on the physiology and pathogenesis of chronic or recurrent anal fissures and to model these findings together with clinical determinants by objectively evaluating the fissure or sphincterotomy line using EAUS.

Materials and Methods

Study Design and Ethical Approval

This study had a retrospective, single-center design. Patients diagnosed with anal fissure at the General Surgery Clinic of Sakarya University Hospital between February 2024 and February 2025 were included in the study. Ethical approval for the study was obtained from the Scientific Research Ethics Committee of Sakarya University (E-43012747-050.04-450823-72). This study was conducted in accordance with the principles of the Declaration of Helsinki.

Patient Selection

The medical records of patients diagnosed with anal fissure during the study period were retrospectively reviewed. Patients who had undergone medical treatment, those who had previously undergone various treatments at other centers and were referred for clinical follow-up, those with fissures associated with inflammatory bowel disease, pregnant women, those with incomplete medical records, and those who refused to participate in the study were excluded.

Patients who were diagnosed with anal fissure during the specified period, underwent EAUS, and subsequently received treatment were evaluated in this study.

Endoanal Ultrasound Evaluation

EAUS examinations were performed by two surgeons using a 360° electronic radial endocavitary transducer on the Arietta 65 platform (Hitachi, Japan) with an EUP-R54AW series probe (10–5 MHz; center approximately 7.5 MHz). Axial images were acquired at the mid-anal and distal anal canal levels for morphometric measurements. The rectum was emptied with a rectal enema before examination, which was performed in the prone position.

EAUS was used to morphologically assess the internal and external sphincters and the sphincterotomy line in patients with anal fissures, determine whether sphincterotomy had been adequately performed in patients who underwent sphincterotomy, analyze compensatory mechanisms in the anal canal secondary to sphincterotomy, and evaluate the fissure tract in chronic anal fissures. In patients who underwent sphincterotomy, both the sphincterotomy line and the contralateral line, where no sphincterotomy had been performed, were measured separately and reported. IAS/EAS thickness was measured using a perpendicular caliper at the optimal section without dropout artifacts at 45° relative to the clock-face orientation.

The ability of EAUS to differentiate operated from non-operated sphincter anatomy was analyzed as a binary classification by reducing the three categories in the "Sphincterotomy Line" domain to 0=not seen, 1=doubtful, and 2=seen. Two separate positivity thresholds were predefined for the analysis:

- **Flexible threshold:** line≥1 (i.e., "doubtful" or "seen"=positive; "not seen"=negative)
- **Strict threshold:** line≥2 (i.e., only "seen"=positive; "doubtful" and "not seen"=negative)

Data Collection

Patient records containing demographic data, endoanal ultrasound reports, and clinical parameters for patients referred to the proctology clinic after being diagnosed with anal fissures were retrospectively retrieved from the hospital database and analyzed. Within the scope of the study, patients were categorized into two distinct groups: patients with chronic anal fissures with no history of anal surgery and patients with operated anal fissures with a history of sphincterotomy.

Statistical Analysis

SPSS version 22 (IBM SPSS Statistics, Armonk, NY, USA) was used for statistical analyses. Continuous variables are presented as mean±standard deviation or median (min–max), and categorical variables are presented as numbers and percentages. Agreement between EAUS findings and operative status was evaluated by calculating sensitivity, specificity, and accuracy. Normality of continuous variables was assessed using the Shapiro–Wilk test, and homogeneity of variances was assessed using Levene's test. When appropriate, Welch's t-test was used; otherwise, the Mann–Whitney U test was applied. Fisher's exact test was used for categorical variables. For classification metrics, sensitivity, specificity, accuracy, and Wilson 95% CIs were reported. Missing data were handled using listwise or pairwise deletion, as appropriate, with corresponding justifications provided.

Results

Demographic and Morphometric Analysis

A total of 48 patients were examined in this study. Of these, 23 had primary anal fissures with no history of surgery, and 25 had postoperative anal fissures with a history of sphincterotomy. The anal fissure group comprised 13 women and 10 men, whereas the sphincterotomy group comprised 14 women and 11 men. The mean age was 50.2±15.6 years in the anal fissure group and 42.4±12.3 years in the sphincterotomy group. In the morphometric analyses, internal anal sphincter (IAS) thickness was 3.53±0.89 mm and external anal sphincter (EAS) thickness was 8.86±1.92 mm in the anal fissure group. In the sphincterotomy group, IAS and EAS thicknesses were 3.20±0.69 mm and 7.88±1.78 mm, respectively. No statistically significant differences were observed between the groups in terms of age, sex, or morphometric measurements. The demographic data are summarized in Table 1.

Sensitivity, Specificity, and Differentiation of Operated vs. Non-operated Sphincter Anatomy

EAUS demonstrated high sphincter analysis success rates in both groups (primary group: IAS, 91.3%; EAS, 87.0%; postoperative group: IAS, 100%; EAS, 96.0%). Figure 1 shows the appearance of a chronic anal fissure on EAUS. At the flexible threshold (line≥1), sensitivity was 80.0% (95% CI, 61.5–91.0), and specificity was 100.0% (95% CI, 85.7–100). At the strict threshold (line≥2), sensitivity was 76.0% (95% CI, 56.6–88.5), and specificity was 100.0% (95% CI, 85.7–100). In both scenarios, no false-positive results were detected, indicating that EAUS has very high

Table 1. Baseline demographics and anal sphincter morphometrics by group

Variable	Primary (n=23)	Postoperative (n=25)	p
Age, years (mean±SD)	50.2±15.6	42.4±12.3	0.063
Female, n (%)	13 (56.5)	14 (56.0)	> 0.99
Male, n (%)	10 (43.5)	11 (44.0)	—
IAS, mm (mean±SD)	3.53±0.89 (n=21)	3.20±0.69 (n=25)	0.176
EAS, mm (mean±SD)	8.86±1.92 (n=20)	7.88±1.78 (n=24)	0.090

Primary (no prior surgery) vs Postoperative (history of lateral internal sphincterotomy). Groupwise comparison of baseline characteristics and endoanal ultrasonography (EAUS) morphometrics. Continuous variables are summarized as mean±SD; categorical variables as n (%). Between group comparisons used Welch's t-test (continuous) and Fisher's exact test (sex). Missing measurements are reflected by the per-row n. *N*: total number of patients in the group; *n*: number with an available measurement for that row; *IAS*: Internal anal sphincter; *EAS*: External anal sphincter. Thickness values (mm) are derived from EAUS. In the postoperative group, IAS/EAS values represent measurements from a segment remote from the sphincterotomy line (i.e., the "opposite/normal" segment) to avoid local postoperative alteration. Statistical tests: Welch's *t*test for continuous variables; Fisher's exact test for sex. Two sided $p<0.05$ considered significant.

specificity for identifying the sphincterotomy line. Details are provided in Tables 2–3. Because the reference label was operative status, which represents a surrogate rather than an independent gold standard, these sensitivity and specificity values reflect classification performance for identifying a prior sphincterotomy line rather than true diagnostic accuracy.

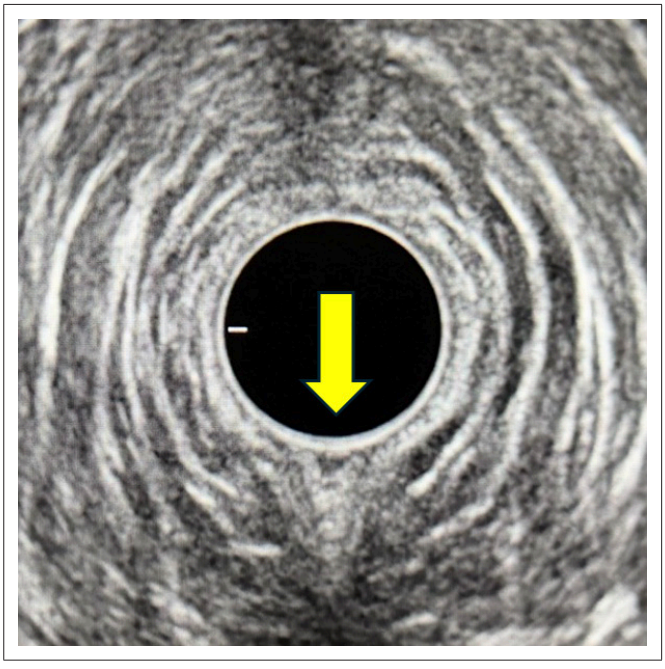

Figure 1. EAUS appearance of a chronic anal fissure. Arrow = fissure apex/location. Radial endoanal ultrasonography (EAUS) at the anal canal demonstrating a focal hypoechoic defect along the anoderm compatible with a chronic fissure. The surrounding external anal sphincter (EAS) appears on this section.

Morphometric Analysis in the Etiopathogenesis of Fissures

Patients without a history of sphincterotomy in our cohort, which was established to investigate the etiopathogenesis of primary anal fissures, were compared with selected high-quality studies in the literature involving sphincter analyses performed in healthy volunteers. The role of sphincter morphometry in the etiopathogenesis of anal fissures was thereby investigated.[12–15]

The mean IAS and EAS values in our cohort were higher than the EAUS norms reported for healthy volunteers (IAS Δ=+1.57 mm; EAS Δ=+2.51 mm; both $p<0.001$).

Sensitivity analysis of the studies in the literature and the data from our study identified IAS>3.18 mm and EAS>8.49 mm as the upper normal-limit threshold values for morphometric measurements in patients with anal fissures. Details are provided in Table 4.

Morphometric Analysis in the Assessment of Ideal Sphincterotomy

Additional morphometric measurements were performed in the sphincterotomy group to define the ideal sphincterotomy. Data from the 25-patient dataset in which sphincterotomy-side and contralateral measurements could be evaluated were matched and statistically compared. The matched subset comprised patients in whom both the sphincterotomy line and the contralateral non-sphincterotomized line could be measured during the same examination (IAS, n=18; EAS, n=19); cases in which either line was not adequately visualized were excluded from the paired comparison.

Table 2. EAUS visualization success (measurement availability) for IAS and EAS by group

Group	IAS measurable	IAS not measurable	EAS measurable	EAS not measurable
Primary (n=23)	**21/23 (91.3%)**	2 (8.7%)	**20/23 (87.0%)**	3 (13.0%)
Postoperative (n=25)	**25/25 (100%)**	0 (0.0%)	**24/25 (96.0%)**	1 (4.0%)

Primary (no prior surgery) vs Postoperative (history of lateral internal sphincterotomy). Values are n/N (%) where n = measurable examinations and N = total patients in the group. *Endoanal ultrasonography (EAUS) measurement availability across groups. "Measurable" indicates that a valid thickness reading could be obtained for the specified sphincter segment during the EAUS examination. IAS: Internal anal sphincter; EAS: External anal sphincter; EAUS:* Endoanal ultrasonography; *n/N*: number measurable / total examined in the group. Measurement availability depends on adequate visualization and a quantifiable caliper reading for the designated segment. Percentages are calculated as (n/N)×100.

Table 3. Classification performance of EAUS for differentiating operated vs. non-operated sphincter anatomy

Positivity threshold (EAUS line)	TP	FN	FP	TN	Sensitivity % (95% CI)	Specificity % (95% CI)	Accuracy % (95% CI)
Flexible: Seen or Doubtful (line ≥ 1)	20	5	0	23	**80.0** (61.5–91.0)	**100.0** (85.7–100)	**89.6** (79.8–95.5)
Strict: Seen only (line ≥ 2)	19	6	0	23	**76.0** (56.6–88.5)	**100.0** (85.7–100)	**87.5** (75.3–94.1)

Two predefined positivity thresholds are reported: a flexible threshold (line ≥ 1: "Seen" or "Doubtful" = positive) and a strict threshold (line ≥ 2: only "Seen" = positive). Classification performance of endoanal ultrasonography (EAUS) for differentiating operated from non-operated sphincter anatomy. The reference standard ("gold standard") was operative status: postoperative patients (history of LIS) were considered positive and primary patients (no prior surgery) negative. Confidence intervals are Wilson 95% CIs. Counts were computed at the patient level across all eligible cases without matching. No false positives occurred in either scenario. EAUS: Endoanal ultrasonography; *LIS*: Lateral internal sphincterotomy; *TP*: True positive; *FN*: false negative; *FP*: false positive; *TN*: True negative; *line* categories: 0 = Not seen, 1 = Doubtful, 2 = Seen. Group totals underlying the analysis were Primary N = 23 and Postoperative N = 25. The lenient threshold prioritizes sensitivity by counting "Doubtful" as positive; the strict threshold prioritizes specificity by requiring an unequivocally Seen line.

Table 4. Morphometric comparison of the primary anal fissure cohort against healthy EAUS norms

Measure	n	Healthy EAUS	Our mean±SD (mm)	Reference mean (mm)	Δ (mm)	95% CI (Δ)	t	p	Hedges g
IAS	21	> 3.18 mm	3.53±0.89	1.96	+1.57	+1.17; +1.98	8.10	9.62×10^{-8}	1.70
EAS	20	> 8.49 mm	8.86±1.92	6.35	+2.51	+1.61; +3.41	5.85	1.24×10^{-5}	1.25

Primary patients without prior surgery; comparisons are against endoanal ultrasonography (EAUS) reference means from healthy volunteers (IAS≈1.96 ± 0.61 mm; EAS≈6.35 ± 1.07 mm). Comparisons of internal (IAS) and external (EAS) anal sphincter thickness in the primary cohort versus healthy EAUS norms. Δ denotes (our mean − reference mean). Confidence intervals are for the mean difference (Δ); p-values are twosided. Effect sizes are reported as Hedges g with small-sample correction. For clinical context, the approximate 95% upper normal limits derived from the healthy EAUS reference are IAS > 3.18 mm and EAS > 8.49 mm. *N*: number of primary patients with an available EAUS measurement for the specified sphincter; *IAS*: Internal anal sphincter; *EAS*: External anal sphincter; *EAUS*: Endoanal ultrasonography. Measurements in the dataset were recorded as "diameter (mm)"; literature norms are typically reported as "thickness." Minor systematic differences may arise from acquisition plane/height, but the direction and magnitude of effects (Δ, *g*) support clinically meaningful hypertrophy. Upper normal limits (IAS 3.18 mm; EAS 8.49 mm) reflect mean + 2SD of the healthy EAUS reference.

The effect of sphincterotomy on the internal sphincter was analyzed. In the 18 matched patients, IAS thickness at the sphincterotomy line was 1.67±0.73 mm, whereas the measurement at the contralateral non-sphincterotomized line was 3.27±0.74 mm, corresponding to a relative reduction of 49%. A residual IAS thickness below the healthy EAUS mean (~1.96 mm) may suggest an adequate and effective sphincterotomy.

The effect of sphincterotomy on the external sphincter was also analyzed. In the 19 matched patients, EAS thickness at the sphincterotomy line was 4.89±1.72 mm, whereas the

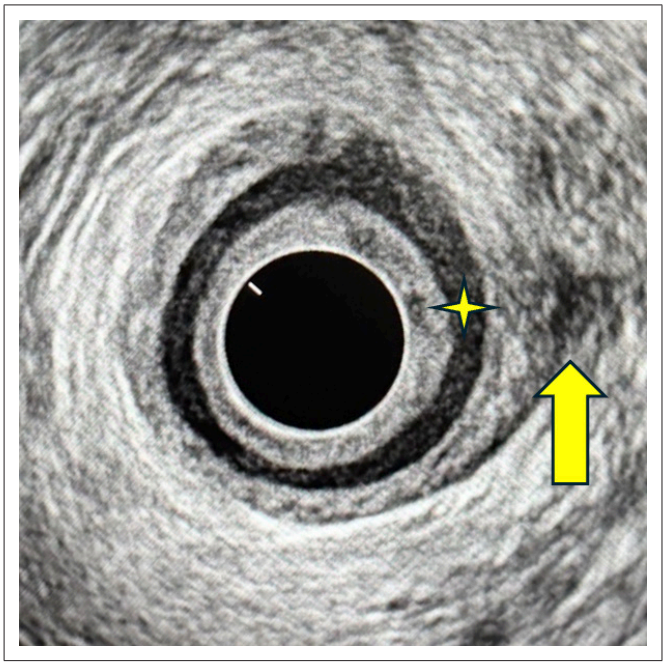

Figure 2. Unintended external sphincterotomy with preserved IAS. Arrow = site of external sphincterotomy/defect (EAS). Star = intact internal anal sphincter (IAS). Postoperative EAUS, no sphincterotomy performed in IAS, EAS exposed to unintended sphincterotomy. This finding explains the persistence of symptoms despite the apparently performed LIS.

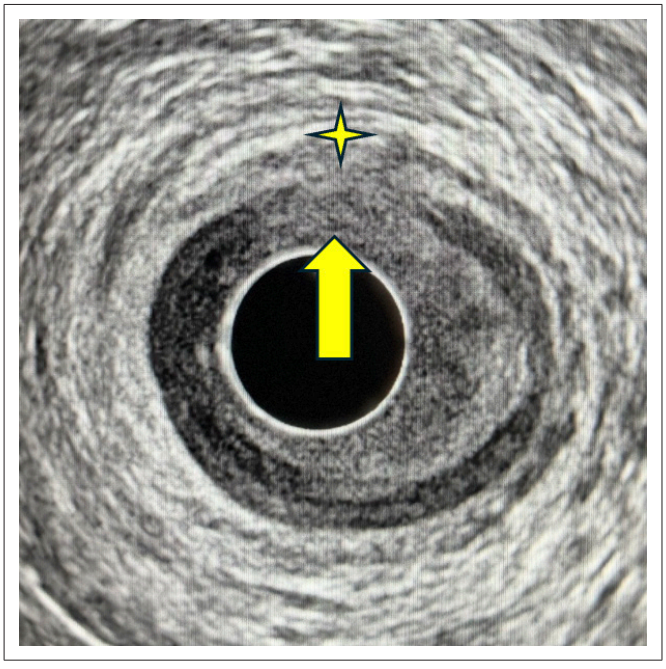

Figure 3. Combined internal and external sphincterotomy. Arrow = LIS line (IAS division). Star = external sphincterotomy/defect (EAS). EAUS depicting both a linear defect of the IAS consistent with the LIS line and a separate discontinuity within the EAS, indicating concomitant unintended external sphincterotomy.

measurement at the contralateral non-sphincterotomized line was 8.12±0.68 mm, corresponding to a relative reduction of 40%. This finding indicates unexpected external sphincter involvement, which is not normally part of the surgical technique, and represents a sonographic finding suggestive of EAS involvement rather than confirmed sphincter damage, particularly because objective continence scores were not assessed (Figs 2 and 3). Overall, unintended external sphincterotomy, defined as a sonographically evident EAS defect not intended by the surgical technique, was identified in 9 of 25 postoperative patients (36.0%).

Discussion

This study highlights the potential value of endoanal ultrasound (EAUS) as a quantitative, reproducible, and inexpensive morphometric tool for clinical decision-making in chronic and recurrent anal fissures. In our study, the finding that IAS and EAS thicknesses in patients with chronic anal fissures were greater than the healthy EAUS norms reported in the literature is consistent with evidence supporting the morphological basis of the hypertonicity-induced ischemia hypothesis involving the internal sphincter.[16] Given that the external sphincter has rarely been examined in fissure pathophysiology, the higher EAS values may reflect compensatory or measurement-related variation rather than a primary pathophysiological mechanism. This morphometric study supports the notion that the pathophysiological model centered on IAS spasm, ischemia, and the nonhealing cycle remains the most explanatory model for primary fissures.[17]

Clinical evaluation remains fundamental to the diagnosis and treatment of anal fissures.[18] Despite performing morphometric analyses in our patients, the diagnosis was based on clinical and physical examination findings. An important point is that EAUS, particularly through measurement of IAS thickness, may have predictive value in diagnosis and potentially in treatment planning. In EAS evaluation, technical shortcomings in surgical procedures that may lead to treatment failure can also be clearly analyzed. In our study, surgical interventions targeting the internal sphincter were identified through morphometric analysis of anal fissures. The specificity for LIS line visibility was 100%, whereas sensitivity ranged from 76% to 80%. Therefore, EAUS may play a unique role as an accessible and rapid first-line morphometric tool. The literature describes EAUS as the “gold standard” for evaluating sphincter pathology, but its role in the assessment of anal fissures has not been sufficiently studied.[19]

Measurements in the sphincterotomy group confirmed the expected physiological effect of sphincterotomy, and our results are consistent with endosonographic series in the literature demonstrating that measurement of the length and depth of the sphincterotomy line using EAUS is associated with recurrence.[20] The finding that incomplete sphincterotomy is strongly associated with recurrence may support further discussion regarding the potential role of routine postoperative EAUS follow-up.

Another issue that should be considered is the identification of unintended external anal sphincterotomy. The etiology of failed sphincterotomy may be related to inadvertent external sphincter incision, which can be readily detected by EAUS even in the absence of clinical signs of incontinence. The need for secondary surgery and the integrity of the internal sphincter can be easily assessed in these patients, and, if necessary, internal sphincterotomy can be repeated. This suggests that tailored sphincterotomy may provide the surgeon with an additional radiological perspective.[21] In our study group, unintended and unplanned external sphincterotomies were particularly detected in patients with recurrent anal fissures. Although none of these patients reported clinical symptoms of incontinence, external sphincterotomy was clearly visible on EAUS. This finding may indicate that patients classified as having recurrent anal fissures may not have undergone an adequate initial procedure because of incomplete internal sphincterotomy combined with unintended external sphincterotomy.

Personalization of treatment steps can be achieved using a morphometry-oriented algorithm. Our study does not merely aim to provide morphometric measurements of the sphincter; it also discusses the potential of EAUS as a tool that can be used at every stage of anal fissure treatment, including medical treatment, owing to its repeatability, ease of application, and quantitative results.[22] As a first step in planning tailored treatment, EAUS morphometry can be used to select treatment options according to an individualized risk-benefit balance. For example, an adult woman with previous subclinical sphincter damage due to birth trauma could be identified through this assessment, which could substantially influence treatment planning.

Furthermore, this morphometric analysis may provide insight into the heterogeneity of surgical techniques and outcomes, thereby contributing to the discussion of the universal question, "How much of the sphincter should be divided?" This approach reinforces the concept of tailored LIS.

Anal canal morphometry in healthy volunteers has been well defined in the literature. Although the increased measurements observed in our study support the hypothesis regarding the etiology of anal fissures when compared with normal sphincter thickness, differences in measurement methods, technical variations such as diameter measurements instead of sphincter thickness, and lack of standardization of measurement planes may introduce methodological bias into absolute value comparisons. This represents a limitation of our study. However, the aim of this study was not to reach a definitive conclusion but rather to provide preliminary insight into the standardization of the radiological assessment of anal fissures, a topic that has not been adequately addressed in the literature, and thereby stimulate further discussion.

Limitations

This study has several limitations. First, its retrospective and single-center design, along with the dependence of reporting on practitioner experience, limits the generalizability of the findings. Furthermore, EAUS measurements were limited to the mid-anal and distal anal canal segments. The use of published literature data for comparison with healthy norms, rather than the inclusion of a concurrently evaluated healthy control group, may introduce ethnic and demographic differences. Because the healthy reference values were derived from published studies rather than from a concurrently measured control group, differences in scanning techniques, measurement conventions (diameter vs. thickness), and population characteristics may affect the interpretation of IAS/EAS comparisons. In addition, objective continence scoring, such as a validated incontinence score, was not performed; therefore, the unintended external sphincter findings reflect sonographic morphometry and should be interpreted as suggestive of EAS involvement rather than confirmed functional impairment. Moreover, although EAUS is a reproducible modality, measurements were obtained by two operators, and no formal interobserver agreement statistic was calculated; therefore, the reproducibility of the morphometric measurements in this cohort was not quantified. Nevertheless, this study provides useful information as a preliminary contribution to the limited literature on this subject.

Conclusion

EAUS can be used as a complementary tool to strengthen diagnostic and treatment decisions by providing inexpensive, rapid, reproducible, and quantitative morphometric

data on anal fissures. These findings are consistent with internal anal sphincter hypertrophy in primary fissures and may enable quantitative assessment of sphincterotomy adequacy and identification of unintended external sphincter effects in the postoperative period. The findings demonstrate that routine EAUS can quantitatively document IAS/EAS morphometry, LIS line visibility, and residual IAS measurements in both pre-intervention and postoperative cases and can identify unintended EAS involvement. Endoanal ultrasound may therefore be incorporated into tailored and personalized treatment strategies.

Disclosures

Ethics Committee Approval: The study was approved by Faculty of Medicine, Sakarya University Ethics Committee (No: E-43012747-050.04-450823-72, Date: 20.02.2025).

Informed Consent: Due to the retrospective design of the study, the committee waived the requirement for written informed consent.

Conflict of Interest: The authors declare that there is no conflict of interest.

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