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RESEARCH ARTICLE

Goodsall's Rule Revisited: An MRI-Based Assessment of its Accuracy in Perianal Fistulas

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ABSTRACT

Aim: The aim of this study is to evaluate the accuracy of Goodsall's rule in predicting the internal orifice of perianal fistulas based on magnetic resonance imaging (MRI) findings and to assess its relevance in contemporary imaging and surgical planning.

Method: In the retrospective analysis of 1,473 consecutive MRI scans performed for perianal fistulas, a total of 305 patients (men/women: 214/91) with a single fistula were included in the study. Fistulas were classified as anterior or posterior based on the external orifice position relative to the transverse anal line.

Results: Posteriorly located fistulas were more common (61.3% vs. 38.7%). The accuracy of Goodsall's rule was higher in anterior fistulas (64.4%) than in posterior fistulas (39.6%; p<0.001). There was no statistically significant difference in adherence to the rule between genders (p=0.416), different types of fistulas according to the Parks classification (p=0.588), or presence of abscess (p=0.464). Comorbidities significantly affected the accuracy of the rule (p=0.017). In the Bonferroni-adjusted analysis, no significant difference in adherence was found between the cryptoglandular and Crohn's disease groups (p>0.05). Among the 11 patients with malignancy, only 1 (9.1%) adhered to the rule, indicating reduced accuracy.

Conclusion: Goodsall's rule is more accurate for anterior fistulas; however, it does not apply to all perianal fistula cases, with greater exceptions observed in posterior fistulas. MRI should be considered for all perianal fistulas when possible to improve diagnosis and outcomes.

Keywords: Perianal fistula, magnetic resonance imaging, Goodsall's rule

INTRODUCTION

Perianal fistulas are pathological tracts connecting the anal canal to the perianal skin.[1] Their incidence varies across different populations. They most commonly affect individuals between the ages of 30 and 50 and are more frequently observed in men than in women.[2] These fistulas pose substantial challenges in both diagnosis and management. Magnetic resonance imaging (MRI) has emerged as the gold standard for preoperative assessment due to its superior ability to delineate fistulous tracts and associated abscesses, and surgery remains the primary modality for treatment.[3,4] Surgical success depends on factors such as the type and complexity of the fistula as well as the accurate identification of the internal orifice. Precise localization of the internal orifice is critical to achieving high healing rates and preventing recurrence.[5]

In 1900, the surgeon Goodsall introduced a rule to predict the internal orifice of perianal fistulas based on the location of the external orifice. According to Goodsall's rule, fistulas with an

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external orifice anterior to an imaginary transverse line across the anal canal tend to have a straight course to the internal orifice, whereas those with an external orifice posterior to the line are more likely to have a curved course, opening posteriorly at the midline.[6] Anterior fistulas located more than 2.5 cm from the anal verge are an exception to the rule, as they may follow a curvilinear course, similar to posterior fistulas, and open into the posterior midline of the anal canal.[7]

Although Goodsall's rule remains widely used in clinical practice, particularly in centers with limited access to MRI, its accuracy continues to be debated. Multiple studies have evaluated its reliability using intraoperative findings and endoanal ultrasonography (EAUS), with various results.[8-11] However, the application of advanced imaging modalities such as MRI to assess the rule's validity has been less extensively documented.[12] The purpose of this study is to evaluate the accuracy of Goodsall's rule based on MRI findings and to contribute to the understanding of its applicability in modern imaging and surgical planning.

Materials and Methods

Participants

This study was approved by the Ankara University Human Research Ethics Committee (approval number: I5-370-21, dated: 25.06.2021). All participants provided written informed consent prior to the examination. A retrospective analysis was conducted on 1,437 consecutive MRI examinations performed in the radiology department between August 2011 and May 2021 for patients over 18 years of age who were referred for suspected perianal fistula.

A total of 638 patients without perianal fistulas, 110 patients with repeated MRI examinations, 76 patients treated with setons, 50 patients with chronic fistulas, and 18 patients with external orifices located directly on the transverse line at the 3 or 9 o'clock anal positions (precluding the evaluation of Goodsall's rule) were excluded from the study. Additionally, 276 patients with multiple fistulas or fistulas complicated by secondary tracts were excluded, whereas fistulas complicated by abscesses were not. In total, 305 patients with a single active fistula were included in the study. The flowchart depicting the selection process is presented in Figure 1.

Imaging Technique

MRI scans were conducted using a 3-Tesla MR system (MAGNETOM Verio; Siemens Medical Solutions, Erlangen, Germany) with a standard body matrix coil. The coil was positioned to extend at least 10 cm below the symphysis pubis to ensure optimal signal acquisition from the anal canal.The imaging protocol included T2-weighted turbo spin-echo (TSE) sagittal and axial sequences, high-resolution (HR) T2-weighted TSE oblique axial sequences, and HR contrast-enhanced fat-

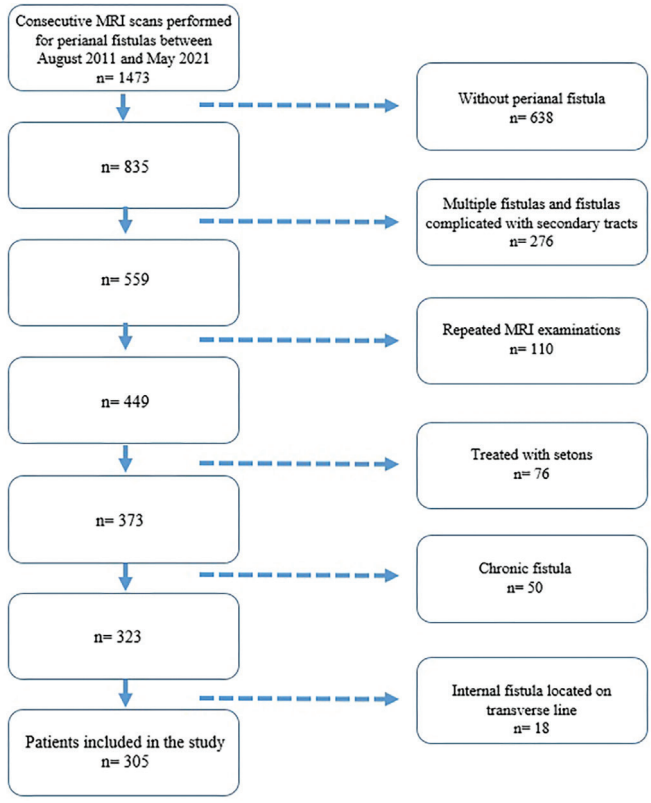


Figure 1. Flowchart summarizing patient accrual

suppressed T1-weighted TSE oblique axial and coronal sequences. Sagittal images were used to orient the oblique axial and coronal planes, aligning them perpendicularly and parallel to the long axis of the anal canal. Additional sequences included turbo inversion recovery magnitude oblique axial and coronal images, along with diffusion-weighted axial sequences. An endorectal coil was not used. The total scanning time was approximately 30-40 minutes.

Image Evaluation

Images were analyzed using a picture archiving and communication system workstation to identify the presence of perianal fistulas. Evaluated parameters included the position of the internal and external orifices according to the anal clock, the presence of associated abscesses, fistula type based on the Parks classification-categorized as intersphincteric, transsphincteric, suprasphincteric, or extrasphincteric -and the distance of the external orifice from the anal verge.[13]

All included MRI examinations were re-evaluated by consensus between two radiologists: an abdominal radiologist with 10 years of experience in proctology and a radiologist with 5 years of radiology experience.

To assess the validity of Goodsall's rule in the context of substantial comorbidities associated with perianal fistula development, patients were evaluated for comorbidities, including Crohn's disease, ulcerative colitis, hematological disorders, malignancy, and infections. This assessment was based on clinical data,

laboratory results, and histopathology results retrieved from the hospital's electronic medical record system.

Fistulas were categorized as anterior or posterior based on the location of the external orifice relative to the transverse anal line. The following were considered consistent with Goodsall's rule: anterior fistulas located within 2.5 cm of the anal verge with a radial course (Figure 2), anterior fistulas located more than 2.5 cm from the anus with a posterior midline internal orifice (Figure 3), and posterior fistulas with a curvilinear course terminating at the posterior midline (Figure 4). The accuracy of Goodsall's rule was assessed using MRI findings.

Statistical Analysis

Data analysis was performed using SPSS version 25.0 software. Categorical variables were reported as frequencies and percentages, whereas quantitative variables were presented as mean ± standard deviation. The accuracy of Goodsall's rule in identifying the internal fistula orifice was analyzed. Statistical significance was defined as a p-value less than 0.05.

Results

Among the 305 patients (mean age: 45.94±14.15 years), 214 (70.2%) were men and 91 (29.8%) were women, indicating a male predominance. According to the Parks classification, 162 fistulas (53.1%) were intersphincteric, 138 (45.2%) were transsphincteric, 3 (1.0%) were suprasphincteric, and 2 (0.7%) were extrasphincteric.

Underlying conditions included Crohn's disease in 29 patients, malignancy in 11, hematological disorders in 5, ulcerative colitis in 3, and perianal sepsis in 3. The remaining 254 patients had no associated underlying disease and were classified as cryptoglandular. Associated abscesses were observed in 54 patients (17.7%). The demographic data are presented in Table 1.

A total of 118 fistulas (38.7%) were located anteriorly, whereas 187 (61.3%) were posteriorly located. Overall, 49.2% of all fistulas were found to be consistent with Goodsall's rule. The rule was more accurate in anterior fistulas than in posterior fistulas ($p<0.001$).

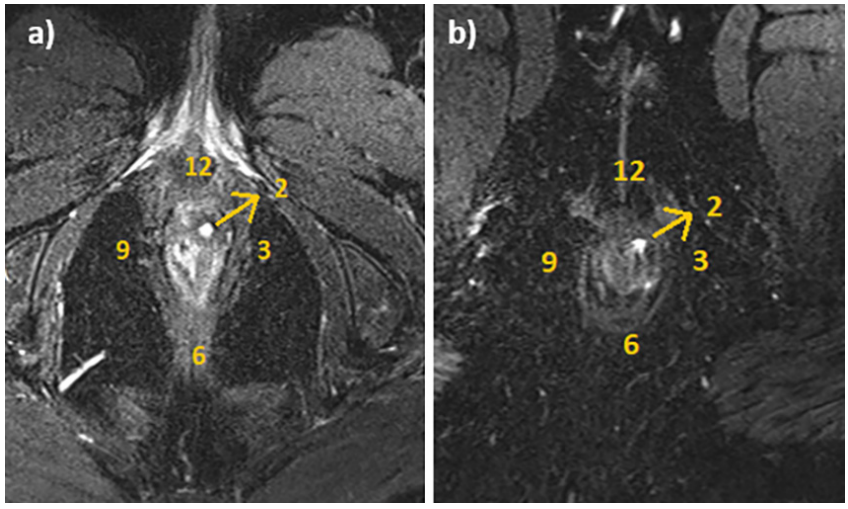


Figure 2. A 54-year-old woman with an internal orifice (a) at the 2 o'clock position at the anorectal junction. The fistula tract progresses caudally in the intersphincteric space and connects with the skin at the 2 o'clock position at the anal verge (b)

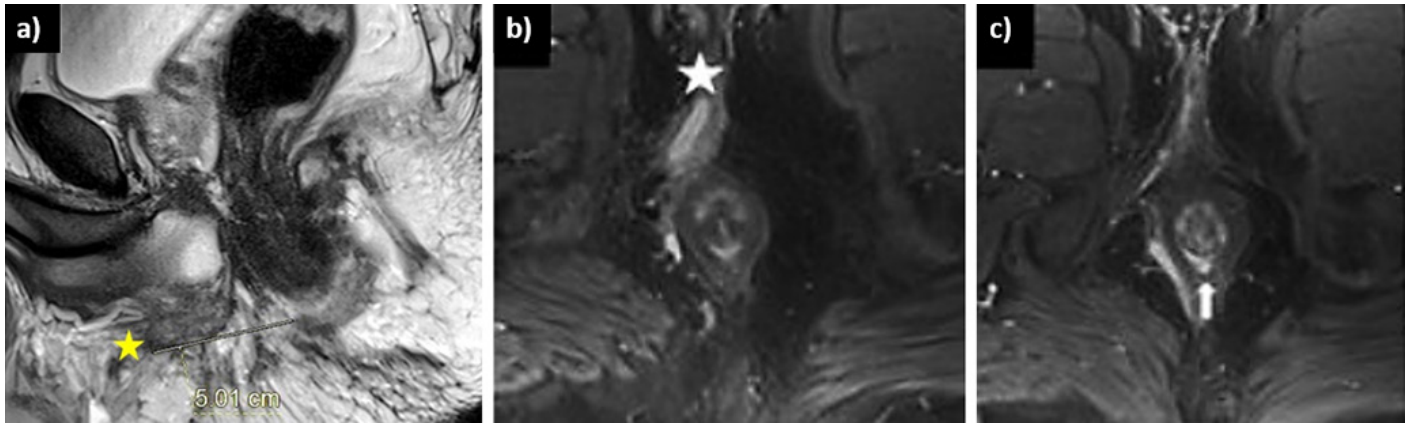


Figure 3. A 48-year-old man. The external orifice (star) is located anteriorly, 5 cm from the anal verge. The internal orifice is located at the posterior midline in the mid-portion of the anal canal (thick arrow), forming a fistula

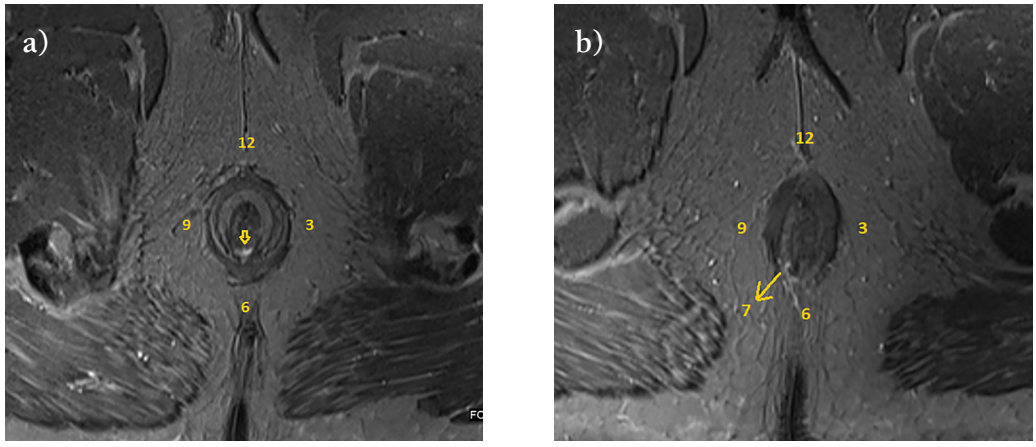


Figure 4. A 54-year-old man. The internal orifice (short thick arrow) is located at the 6 o'clock position. The fistula extends caudally and posteriorly through the transsphincteric space, with the external orifice located at the 7 o'clock position (long thick arrow), forming a transsphincteric fistula

Among patients with a posterior external orifice, 175 (93.6%) had a posterior internal orifice, 7 (3.7%) had an anterior internal orifice, and 5 (2.7%) had an internal orifice on the transverse line (at the 3 or 9 o'clock positions). Of the 187 patients with posterior fistulas, 74 had an internal orifice at the posterior midline consistent with Goodsall's rule, yielding an accuracy rate of 39.6% (Figure 5).

Of the 118 patients with an anterior external orifice, 100 had fistulas located within 2.5 cm of the anal verge, of which 71 exhibited radial tracts consistent with Goodsall's rule. Among the 18 anterior fistulas located more than 2.5 cm from the anal verge, 5 had internal orifices at the posterior midline, also consistent with the rule. In total, 76 anterior fistulas were found to align with Goodsall's rule, resulting in an accuracy rate of 64.4% (Figure 5). Adherence to Goodsall's rule in anterior and posterior fistulas is summarized in Table 2.

Fistulas with a radial course were more common than those with curvilinear tracts (57.7% vs. 42.3%, respectively).

The accuracy of Goodsall's rule was observed in 52.7% of women and 47.7% of men, with no statistically significant difference between genders (p=0.416). No significant difference in adherence to the rule was observed between patients with and without associated abscesses (p=0.464). Similarly, there was no significant difference in adherence among different fistula types based on the Parks classification (p=0.588).

However, comorbid diseases significantly affected the accuracy of the rule (p=0.017). In the Bonferroni-adjusted subgroup analysis, no significant difference was observed between the cryptoglandular group and patients with Crohn's disease (p>0.05). Among the 11 patients with malignancy, only 1 (9.1%) adhered to the rule, distinguishing this group in terms of reduced accuracy.

Discussion

Perianal fistulas are a major cause of morbidity, and their complex anatomy and close relationship with the anal sphincters highlight the importance of precise preoperative diagnosis to prevent recurrence and preserve continence.[1] Identifying the correct location of the internal orifice is critical for successful intervention, as it is the primary source of sepsis. Accurate localization minimizes the risk of incomplete excision, reduces recurrence rates, and improves patient

Table 1. Demographic data of the study population

Demographic data	**Mean ± SD**
Age (year)	45.94±14.15
	n (%)
Gender	
Men	214 (70.2%)
Women	91 (29.8%)
Fistula type (Parks Classification)	
Intersphincteric	162 (53.1%)
Transsphincteric	138 (45.2%)
Suprasphincteric	3 (1.0%)
Extrasphincteric	2 (0.7%)
Etiology	
Idiopathic	254 (83.3%)
Crohn's disease	29 (9.5%)
Malignancy	11 (3.6%)
Hematological disorders	5 (1.6%)
Ulcerative colitis	3 (1.0%)
Perianal sepsis	3 (1.0%)

SD: Standart deviation

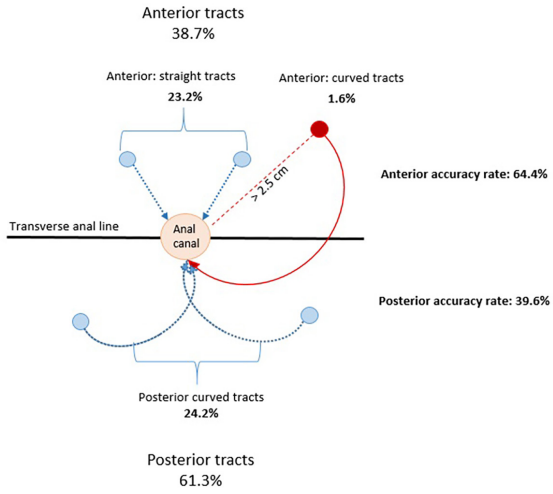


Figure 5. Schematic representation of fistula distribution

outcomes. In this study, we evaluated the validity of Goodsall's rule in predicting the internal orifice of perianal fistulas based on MRI findings. Our results revealed an overall accuracy of 49.2%, with the rule being more applicable to anterior fistulas, showing an accuracy of 64.4% compared with 39.6% for posterior fistulas.

The lower accuracy of Goodsall's rule in posterior fistulas may be attributed to several factors. First, the posterior perianal region presents more complex anatomical spaces, containing intricate fascial planes and potential spaces such as the deep postanal space and ischiorectal fossa, which are less prominent anteriorly. This anatomical complexity increases the likelihood of fistula tracts following atypical paths. Second, lateral posterior external openings are typically farther from the posterior midline than anterior external openings are from their usual internal counterparts, allowing more anatomical structures to potentially influence tract development. Third, studies indicate a higher prevalence of complex fistulas posteriorly, with branching or high transsphincteric fistulas occurring more frequently in the posterior quadrants, inherently limiting the predictive value of simplified anatomical rules. Finally, the influence of previous anorectal disease, including hemorrhoids, fissures, and prior surgical interventions, may distort normal anatomy, particularly in the posterior region, thereby affecting the development and course of fistula tracts.

In addition to Goodsall's rule, attempts to identify the internal orifice include preoperative MRI, clinical examination with palpation and gentle probing at the expected site, EAUS, and injection of hydrogen peroxide or methylene blue into the external orifice.[14,15] Several studies comparing the sensitivity of these modalities in detecting the internal orifice have reported comparable results.[16,17] In one such study by Buchanan et al.[18], EAUS was nearly as accurate as MRI, identifying the internal opening in 91% of cases compared with 97% with MRI. In another study comparing hydrogen peroxide-enhanced EAUS and MRI, both modalities demonstrated equal sensitivity, identifying the internal orifice in 86% of cases.[19] A meta-analysis by Li et al.[20] demonstrated that EAUS may have a sensitivity as high as 97% for detecting the internal opening. These findings support the use of all these methods as reliable tools for the preoperative assessment of fistulous disease and the safe and accurate localization of the internal orifice.

In perianal fistulas, surgical findings and MRI results show a high degree of correlation, further highlighting the role of MRI in preoperative planning by providing superior anatomical detail and enabling the precise localization of fistulous tracts and associated complications.[21,22] As stated in the European Society of Coloproctology's anal fistula guideline, early imaging (MRI or EAUS) should be used to differentiate simple fistulas from complex fistulas. In suspected complex cases or when EAUS is insufficient, preoperative MRI is recommended as moderate-level evidence.[17]

Goodsall's rule, although widely used, demonstrates varying accuracy depending on the clinical context and the modality used for evaluation. In our study, the rule was more accurate for anterior fistulas (64.4%) than for posterior ones (39.6%). These findings are consistent with several previous studies. For example, using hydrogen peroxide injection as a reference, Gunawardhana et al.[23] reported an accuracy of 72% for anterior fistulas and 41% for posterior fistulas; Devi et al.[24] also demonstrated lower adherence in posterior fistulas (69.1% vs. 84.6%). Similarly, Alexander et al.[7] reported adherence rates of 66% for anterior fistulas and 29% for posterior ones,

Table 2. Adherence to Goodsall's rule in anterior and posterior fistulas

	Consistent with the rule n (%)	Inconsistent with the rule n (%)	Total (n)
Anterior fistulas	76 (64.4%)	42 (35.6%)	118
Distance from anal verge ≤2.5cm	71 (71%)	29 (%29)	100
Distance from anal verge >2.5cm	5 (27.8%)	13 (72.2%)	18
Posterior fistulas	74 (39.6%)	113 (60.4%)	187
Total	150 (49.2%)	155 (50.8%)	305

reinforcing the limitations of the rule in posterior cases. A recent study by Kumar et al.[12] found that Goodsall's rule was more accurate for anterior fistulas than for posterior ones based on MRI fistulogram findings (80% vs. 57.2%, respectively).

However, some studies have reported higher accuracy of Goodsall's rule in posterior fistulas, in contrast to our findings. For instance, Barwood et al.[25], using intraoperative data, reported 91% accuracy for posterior fistulas and 69% for anterior ones. Bakir et al.[26], in a study incorporating MRI, EAUS, and surgical findings, reported accuracy rates of 73% for posterior fistulas and 52.4% for anterior fistulas, which conflicts with our results. Likewise, Cirocco and Reilly[27] reported 90% accuracy for posterior fistulas and noted that the rule was particularly unreliable for identifying anterior internal orifices, especially in women (31%). The study by Coremans et al.[28] supported these findings, demonstrating lower consistency with the rule in women and anterior fistulas. That study also reported no significant difference in adherence to Goodsall's rule between patients with Crohn's disease and those without.

In our study, although patients with Crohn's disease did not significantly differ from the cryptoglandular group, patients with malignancy-a smaller subgroup-exhibited notable inconsistency with the rule. This finding highlights the need for caution when applying Goodsall's rule in malignancy-related fistulas.

The variability in results across studies likely stems from differences in the inclusion criteria for complex fistulas and different methods employed to assess adherence to the rule, such as imaging modalities, hydrogen peroxide injection, or intraoperative observations. This discrepancy in the literature suggests that although Goodsall's rule remains a useful guideline, its accuracy may be substantially affected by underlying conditions and the anatomical complexity of the fistula. Its limitations in complex cases underscore the importance of incorporating advanced imaging techniques to complement traditional anatomical rules.

Study Limitations

The main limitation of our study is that adherence to the rule was investigated in relatively simple fistulas due to the exclusion of multiple fistulas and those complicated by secondary tracts. It is challenging to assess the validity of the rule using a fistula-based approach in cases involving a single internal orifice with secondary branches leading to different external orifices. Therefore, applying the rule to relatively simple fistulas appears to be a more reasonable approach in preoperative evaluation.

Another limitation is the small sample size in subgroups with underlying conditions. Additionally, because of the retrospective design, the results could not be correlated with intraoperative observations.

Nevertheless, our findings emphasize the need for greater caution when applying Goodsall's rule in the preoperative assessment of fistulas and highlight the importance of employing additional imaging modalities for the detection of the internal orifice, particularly in posterior fistulas, to ensure precise surgical planning and achieve better surgical outcomes.

Multidisciplinary prospective studies with larger populations, focusing on the comparative accuracy of the rule across simple and complex fistulas and incorporating both MRI and intraoperative findings, are needed to clarify conflicting results.

Conclusion

In conclusion, the traditional Goodsall principle, while demonstrating relative strength in predicting anterior fistula pathways, exhibits substantial limitations when applied to posterior fistulas. The inconsistent reliability observed across our patient cohort indicates that this historical rule should not serve as the sole basis for surgical planning.

Instead, our findings support the integration of advanced radiological assessment, particularly MRI, into standard preoperative protocols. We recommend that clinicians incorporate MRI evaluation whenever institutional resources allow to maximize diagnostic precision and guide appropriate surgical strategies, potentially reducing recurrence rates and associated morbidity.

Ethics

Ethics Committee Approval: This study was approved by the Ankara University Human Research Ethics Committee (approval number: I5-370-21, dated: 25.06.2021).

Informed Consent: All participants provided written informed consent prior to the examination.

Footnotes

Authorship Contributions

Surgical and Medical Practices: C.A., İ.E.G., Concept: D.K.Ö., A.E., Design: D.K.Ö., A.E., Data Collection or Processing: D.K.Ö., S.N.Y.Z., Z.E., Analysis or Interpretation: S.N.Y.Z., Z.E., F.S.Ö.A., Literature Search: D.K.Ö., S.N.Y.Z., Z.E., Writing: D.K.Ö., S.N.Y.Z., Z.E.

Conflict of Interest: No conflict of interest was declared by the authors.

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