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Systematic Review of Anorectal Fistula Classifications

(title)

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ABSTRACT

Background: Management of anorectal fistula is complex and requires an accurate preoperative assessment. The grade and complexity of the fistula should be considered in the classification and thus guide the modality of management and patient support. The objective of this systematic review is to examine and evaluate all existing classifications and viewpoints on anal fistula and to compare the findings of different researchers to address the considerable diversity in recurrence and success rates observed globally. Through this approach, the goal is to enhance knowledge and management of this condition.

Methods: The Scopus and PubMed databases were searched using specific keywords and medical subject headings in prospective and retrospective studies published during the period of 1936 and 2022, which present classifications of anorectal fistulas. The results were reported in the form of a table as well as in the form of a narrative synthesis. The qualitative assessment of the analysed classifications was evaluated using the Risk of Bias 2 (RoB 2) tool.

Results: Of 2,714 articles, eight papers were identified using the inclusion criteria. A further nine classifications were extracted from the identified articles. All 17 classifications were described and their advantages and disadvantages analysed based on their usefulness, current knowledge and validation.

Discussion: Various classifications of anal fistulas, starting with the oldest classification proposed in 1934 by Milligan and Morgan are discussed. A brief summary of each classification, its advantages, and disadvantages, along with its validation and management-oriented approach is provided. The classifications discussed include those proposed by Milligan and Morgan, Stelzner, Goligher, Thompson, Lilius, Sumikoshi, Parks, Eisenhammer, Hanley, Shafik, Morris et al., Schaefer et al., Whiteford et al., Abeysuriya et al., Garg, Rojanasakul and Tsang, and Emile et al. The most widely used and well-known classification, Parks' classification, is now considered less effective. The newer classifications integrate clinical experience, Magnetic Resonance Imaging (MRI), and surgical results and provide treatment recommendations, making them more clinically useful. However, they also have some drawbacks, such as the dependence on MRI, lack of extensive validation, and limited guidance for treatment decisions. The limitations of the review are also acknowledged, as some original articles of classifications were not accessible.

Keywords: Classification, Anorectal fistula, Fistula-in-ano

INTRODUCTION

Over the last few decades, there has been a significant improvement in our knowledge and understanding of the pathogenesis of cryptoglandular infections that lead to perianal abscesses and anal fistulas. [1] This improvement has been aided by new diagnostic possibilities and technical instruments, which have contributed to the development of numerous classifications and treatment options. [2] Currently, there is no universally accepted approach or gold standard for the classification and treatment of anal fistula. Perspectives, techniques, and approaches for assessing and treating this condition vary among institutions and regions, leading to a lack of consensus. [2] This systematic review aims to present and analyse all available classifications and perspectives on anal fistula. The goal is to compare the experiences of individual researchers to address the significant variability in recurrence and success rates seen worldwide. By doing so, we hope to improve understanding and treatment of this condition.

METHODS

Data sources and Search strategy: A detailed literature search was performed using electronic databases, including PubMed and Scopus. In the first phase, databases were filtered using the following keywords: [(anal OR anorectal OR in-ano OR rectal OR rectum) AND (fistula) AND (classification OR grading OR staging)]. The search included papers published during the period from January 1936 to November 2022. Two reviewers independently processed and sorted the list of selected articles.

Inclusion criteria: Based on the titles, abstracts, and full text of articles, the authors screened the literature to select the ones that met the inclusion criteria. They described the inclusion criteria as indicated in Table 1.

Table 1. Inclusion criteria

Subjects	Patients with diagnosed anorectal fistulas.
Study design	Meta-analysis, systematic reviews, randomised controlled trials, cohort studies, cross-sectional studies, case reports and series were considered.
Outcomes	Articles that present new classification methods for anorectal fistulas.

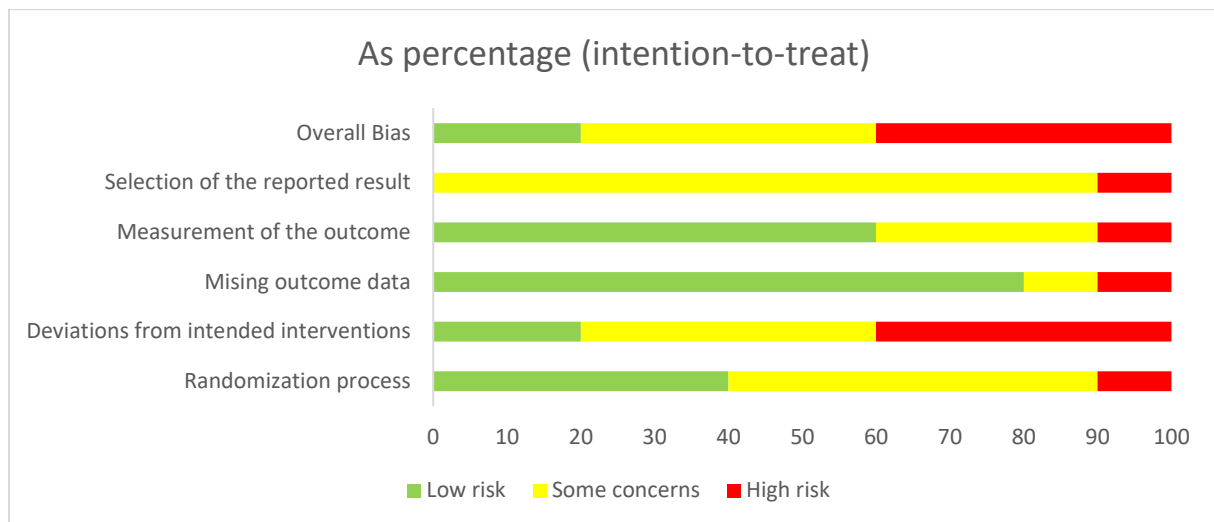
Language	Prospective and retrospective studies describing anorectal fistula classifications in English and German have been reviewed.
Exclusion criteria	The exclusion criteria included duplicate publications, studies that focused on anorectal fistulas in children and various malformations, as well as rectourethral, vaginal, and rectovaginal fistulas. Additionally, articles that could not be accessed in their entirety or were not available in English or German were excluded. Furthermore, fistulas arising from Crohn's disease or ulcerative colitis were excluded. Fissure-associated fistulas were also excluded due to their difference in entity.

Quality assessment: To assess the risk of bias of the analysed articles the Risk of Bias 2 (RoB 2) tool was used. The set list of questions was answered by two reviewers working independently of each other. The results can be seen in Table 2. Since no original papers were found for the classifications of Sumikoshi et al., Lilius, Thomson and Stelzner, no analysis could be performed for these. No risk of bias assessment could be carried out for the classification of Rojanasakul and Tsang, Whiteford et al. and Milligan and Morgan either, as they were not based on studies but on analysis of the anatomy.

Table 2. Risk of bias domains

	D1	D2	D3	D4	D5	Overall		
Emile et al., 2021	+	+	+	+	!	+	+	Low risk
Garg, 2017	+	+	+	+	!	+	!	Some concerns
Abeyesuriya et al., 2010	+	!	+	+	!	!	-	High risk
Schaefer et al., 2004	!	!	+	+	!	!		
Morris et al., 2000	+	!	+	+	!	!	D1	Randomisation process
Hanley, 1978	!	-	-	!	-	-	D2	Deviations from the intended interventions
Shafik, 1979	!	-	+	-	!	-	D3	Missing outcome data
Eisenhammer, 1978	!	!	+	!	!	!	D4	Measurement of the outcome
Parks et al., 1976	-	-	!	+	!	-	D5	Selection of the reported result
Goligher et al., 1975	!	-	+	!	!	-		

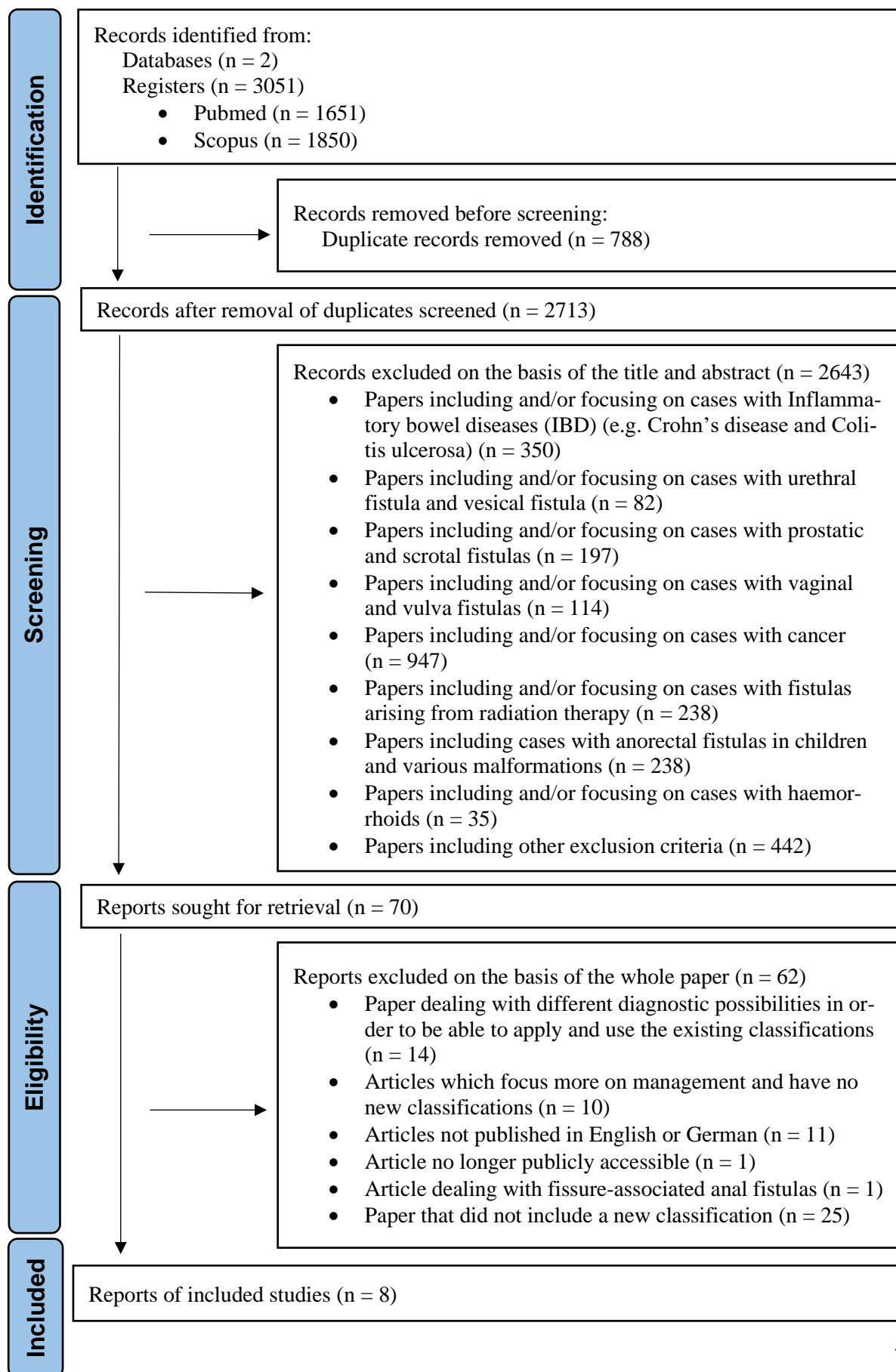
Figure 1. Risk of bias – Results as percentage



RESULTS

Study selection: The article followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement and provided an overview, depicted in Figure 2, of the process used to identify relevant articles for the review. Following a database search, a total of 3051 articles were identified. After removing duplicates, 2713 articles were deemed potentially relevant and were reviewed for relevance. Of these, 2643 papers were excluded based on their title and abstract, leaving 70 articles that underwent full-text searches for eligibility assessment. In total, eight papers that met the inclusion criteria were extracted and included in the review. Additionally, during the eligibility check, nine articles that did not appear in the original database search were identified and included because they also met all inclusion criteria. Finally, the review identified 17 articles that presented new classifications of anorectal fistula.

Figure 2. PRISMA Flow diagram



Study characteristics: The following section presents a description of all 17 identified classifications of anorectal fistulas, presented in chronological order from oldest to most recent, along with their characteristics.

Classification of Milligan and Morgan

Milligan and Morgan published in 1934 an article including their surgical experience and anatomical views of the anal canal. They presented a precise anatomical description of the sphincter and associated muscles, defined the 'anorectal ring' mainly as the puborectalis muscle, and pointed out its role in continence. Moreover, the classification presented by them, grouped fistulas and their tracks according to their location to the anorectal ring. [3]

Three main groups were the result, termed subcutaneous and submucous fistulae, anal fistula and anorectal fistula. [4] Anal fistulas were termed as those that “[...] have their main tracks entering the anal canal below the ano-rectal ring and may be “low” or “high” level fistulae.”[4] About the anorectal type of fistula Hughes wrote: “These possess a track extending above the level of the ano-rectal ring. Ano-rectal fistulae may communicate with the anal canal or with the rectum or may be incomplete.”[4] Hughes analysed and validated the classification suggested by Milligan and Morgan of St. Mark’s Hospital by the data of 111 patients with anal fistula. In his conclusion, he stated that the term "ano-rectal fistula" should encompass all types of fistulae in the region, and the classification system should be updated to reflect modern anatomical understanding. [4]

To conclude, the classification is based on knowledge that has been outdated and it does not provide support for the decision of which treatment should be carried out.

Classification of Stelzner

Stelzner presented in 1959 his classification of fistulas with three different types: inter-muscular, transsphincteric and extrasphincteric. They were classified according to the relationship of the fistula with the external anal sphincter. Intermuscular fistulas are located between the external and internal sphincters. A transsphincteric fistula is identified, as it extends beyond the external sphincter and into the ischioanal fossa. Fistulas are called extrasphincteric if they do not involve the sphincters and lead from the perianal skin via the levator ani muscles, the ischioanal fossa and the fatty tissue into the rectum. [5][6]

Due to lack of access to the original article, it was not possible to obtain any further information. Nevertheless, it can be concluded that this anatomically oriented classification has a good basic idea, but is difficult to implement in practice, because it is unspecific and does not give any indication of therapeutic measures.

Classification of Goligher et al.

As described by Parks et al. in their paper, Goligher published a new modified version of Milligan and Morgan's 1934 classification in 1961. He distinguished high anorectal fistulas into 'ischiorectal' and 'pelvirectal' fistulas. 'Ischiorectal' refers to fistulas that extends to the upper level of the ischiorectal fossa, and 'pelvirectal' fistulas are those which invade the levator ani muscles. Parks et al. criticize the interpretative scope offered by this classification, as a potential misapplication could result from it. [5]

Due to the lack of access to the original article of Goligher, the information is based on what is provided by Parks et al.

Classification of Thompson

In 1962 Thompson proposed his classification of anal fistula. He allocated fistulas into simple, and complex based on the ease of the management and the frequency. [6] Unfortunately, no precise information could be obtained on which criteria constitute a simple or a complex fistula, as the original article is not publicly available. Nevertheless, a strong point is that this clear, management-oriented classification is easy to apply and can help surgeons in their treatment decisions. Further elaboration and clear criteria are necessary for the application.

Classification of Lilius

Lilius used his experience from surgeries and classified anal fistulas in 1968 into six types, namely subcutaneous, low intermuscular, high intermuscular, low anal, high anal and pelvirectal type. [6] As Parks et al. described, Lilius extended the idea of intermuscular spread of anal fistulas. [5] The result is a classification with more specific subdivision, but no management support. A better assessment of the classification was not possible due to the lack of access to the article.

The Sumikoshi Classification System

M.D. Junichi Iwadare mentions in his paper “Sphincter-Preserving Techniques for Anal Fistulas in Japan” the classification system of Sumikoshi et al. from 1972 which includes four types of fistulas namely subcutaneous, intersphincteric, ischiorectal and pelvirectal. [7] The graph and classification from Iwadare's paper can be seen in Table 3. Since the original paper is in Japanese, this classification system would have been excluded, as it does not fulfil the inclusion criteria for this systematic review. The classification is worth mentioning, however, as it is widely used in Japan as it is recommended in the Japanese Guidelines [8] and thus interesting to compare. The “Japanese Practice Guidelines for Anal Disorders II. Anal fistula” published by Yamana in 2018 states that the Sumikoshi classification system defines also other factors besides the mentioned types: “The space above the dentate line is referred to as high: H; below the dentate line is called low: L. Multiple or curved tracts are complex: C; straight tracts are simple: S; tracts that extend on one side are unilateral: U, whereas tracts on both sides are bilateral: B. Each tract is specified using these alphanumeric indicators, for example, IILs or IIIB.” [8] Yamana concludes that this classification is specific and clinically beneficial. [8]

Table 3. The Sumikoshi Classification System – 1972

Type I	Subcutaneous fistulas	<p>Figure 3. The Sumikoshi Classification System</p> <p>Figure 1. The Sumikoshi classification system. Subcutaneous fistulas are called Type I, intersphincteric fistulas are called Type II, ischiorectal fistulas are called Type III, and pelvirectal fistulas are called Type IV. I = submucosal space; II = intersphincteric space; III = ischiorectal space; IV = pelvirectal space; L = below the dentate line; H = above the dentate line; IAS = internal anal sphincter; EAS = external anal sphincter; LV = levator ani.</p> <p>Iwadare J. Sphincter-preserving techniques for anal fistulas in Japan. <i>Dis Colon Rectum</i>. 2000 Oct;43(10):S69–77.</p>
Type II	Intersphincteric fistulas	
Type III	Ischiorectal fistulas	
Type IV	Pelvirectal fistulas	

Parks Classification

The classification of anorectal fistulas by Parks et al. [5] proposed in 1976, is well known and widely used. It is based on the analysis of 400 patients over 15 years, who suffered from fistula-in-ano. The classification system proposed in this paper is based on the pathogenesis of abscess and fistula and on the anatomy of the pelvic floor. The result are four main groups, namely the intersphincteric fistulas, also the most common one, the trans-sphincteric, suprasphincteric and extrasphincteric type. Those groups are further subdivided, which can be seen in Table 4 and in Figure 4, which is from the

original article. Parks et al., based on their understanding of the pathogenesis of anorectal fistula, stated that abscess and fistula are the same disease, with abscess representing the acute phase and fistula the chronic form. The authors emphasized the significance of anatomical structures such as the sphincters in terms of their involvement and impact on outcome, particularly stressing the importance of the external sphincter for continence and recommending that it remain untouched during surgery. [5]

The advantages of this classification are that it is easy to understand and useful for planning the most appropriate surgical procedure, and it helps to identify complex fistulas and possible complications at an early stage. However, it should be mentioned that fistulas with multiple tracts cannot be classified and that concomitant diseases such as inflammatory bowel diseases, which may be the cause of the fistula, are not included. As Garg writes in his paper, the understanding of the disease at that time was not as good as it is today, because tools such as Magnetic Resonance Imaging (MRI) were not available and therefore no three-dimensional understanding could be gained. [9] Professor Goligher criticised the fact that the classification does not seem to be focused on the clinical management of fistulas. [10]

Figure 4. Parks Classification

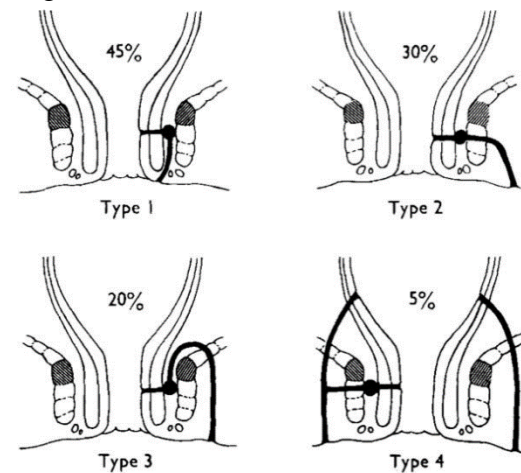


Fig. 9. The four main anatomical types of fistula. The external sphincter mass is regarded as the keystone and the terms 'trans-', 'supra-' and 'extra-' refer to it. Type 1, Intersphincteric; type 2, trans-sphincteric; type 3, suprasphincteric; type 4, extrasphincteric.

Parks AG, Gordon PH, Hardcastle JD. A classification of fistula-in-ano. Br J Surg. 2005 Dec 7;63(1):1–12.

Table 4. Parks Classification – 1976

Intersphincteric	<ul style="list-style-type: none"> a. Simple intersphincteric fistula b. Intersphincteric fistula with a high blind track c. Intersphincteric fistula with a high track opening into the lower rectum d. High intersphincteric fistula without a perineal opening e. High intersphincteric fistula with a pelvic extension f. Intersphincteric fistula from pelvic disease
Trans-sphincteric	<ul style="list-style-type: none"> a. Uncomplicated <ul style="list-style-type: none"> a. Low type b. Medium type c. High type b. Trans-sphincteric fistula with a high blind track
Suprasphincteric	
Extrasphincteric	<ul style="list-style-type: none"> a. Extrasphincteric fistula secondary to a transsphincteric fistula b. Extrasphincteric fistula due to trauma c. Extrasphincteric fistula due to specific anorectal disease d. Extrasphincteric fistula due to pelvic inflammation

Parks AG, Gordon PH, Hardcastle JD. A classification of fistula-in-ano. Br J Surg. 2005 Dec 7;63(1):1–12.

Classification of Eisenhammer

S. Eisenhammer published a paper in 1978 which discusses “the primary group of anorectal cryptoglandular intermuscular acute fistulous abscesses and their corresponding chronic lesions, the anal fistulas” [11]. The author proposes a classification system, shown in Table 5, for these lesions based on the observations and experience of nearly 800 cases collected over a period of 25 years. A renewed presentation of the etiology, pathology and anatomy, and thus the classification of fistulae, is provided to improve that of Parks et al. Correct surgical treatment by an anorectal surgeon or proctologist is crucial, as emphasized by the author Eisenhammer, particularly in the case of the fistulous abscess, which stands for an acute situation. He advised that the primary acute abscess stage of the fistula should be the focus of the classification, as this stage provides the best conditions for good healing. [11]

It is positively noted that Eisenhammer's classification focuses on the patterns of fistulas and includes the complexity of the fistulas. The usage of intricate terminology makes it challenging to utilize this classification widely, resulting in its limited adoption. [2]

Table 5. Classification of Eisenhammer – 1978

Group I. The intermuscular fistulous abscess and fistula	Low	Posterior low intermuscular fistulous abscess and fistula
		Posterior low intermuscular superficial ischioirectal, unilateral horseshoe, fistulous abscess and fistula
		Anterior low intermuscular fistulous abscess and fistula
		Anterior low intermuscular superficial ischioirectal-bilateral horseshoe fistulous abscess and fistula
	High	
Group II. The intermuscular transsphincteric ischioirectal fistulous abscess and fistula		Posterior ischioirectal horseshoe fistulous abscess and fistula
		Anterior ischioirectal fistulous abscess and fistula
Group III. The acute anorectal non-cryptoglandular, non-fistulous abscess		

Eisenhammer S. The final evaluation and classification of the surgical treatment of the primary anorectal cryptoglandular intermuscular (Intersphincteric) fistulous abscess and fistula. Dis Colon Rectum. 1978 May;21(4):237–54.

Classification of Anorectal Abscess and Fistula-in-ano by Hanley

Patrick H. Hanley's article, "Anorectal Abscess Fistula," published in the Symposium on Colon and Anorectal Surgery in 1978, provides a detailed explanation of the principles of anorectal anatomy and discusses the routes and causes of infection of the anal glands. [12] Additionally, Hanley establishes a “new classification for anorectal space abscess and fistula-in-ano based on the precise anatomic site of origin of the initial anorectal infection and the pathway of spread if not treated as a surgical emergency” [12] which can be seen in Table 6. Hanley highlighted how important it is to identify the site of abscess formation, as it helps to predict the process of spread. This information could prevent chronification and thus fistula development, especially if the patient has received antibiotics or has not undergone surgery. Furthermore, Hanley discusses the therapeutic possibilities of the individual groups in the classification. [12]

Advantages of the classification system proposed by Patrick H. Hanley are the integration of precise anatomical site integration and the revised treatment recommendations. However, it should be noted that there was no extensive validation.

Table 6. Hanley's Classification – 1978

I. Low Intermuscular Abscess	A. Infralelevator-Transsphincteric	1. Perianal space 2. Superficial postanal space 3. Superficial anterior anal space 4. Deep postanal space (horseshoe) 5. Deep anterior anal space (horseshoe) 6. Ischiorectal fossae
II. High Intermuscular Abscess	A. Supralelevator	1. Retrorectal space 2. Rectovesical space 3. Pelvirectal space
III. Intermuscular abscess with combined supralelevator and infralelevator abscess		
IV. Subcutaneous anal canal space		
V. Submucosal rectal space		

Hanley PH. Anorectal Abscess Fistula. Surg Clin North Am. 1978 Jun;58(3):487–503.

A Simplified Classification by Shafik

Ahmed Shafik M.D. presented in 1979 a new classification of anal fistulae in his paper "A new Concept of the Anatomy of the Anal Sphincter Mechanism and the Physiology of Defecation". [13] This study was based on data from 300 patients with anorectal fistulas. After the patients were first clinically examined for the location of the openings of the fistulas and the depth of the track, a surgical examination of the fistulas was performed. The relation between the fistula tract and the external sphincter and the levator plate was examined, as well as the relation of the fistula tract to the intersphincteric and central spaces. Concluded from the research and data, Shafik developed a classification based on two types: intrasphincteric and extrasphincteric. Table 7 demonstrates the differentiation between high and low types, including the further sub-categorization of intrasphincteric fistulas. The aim was to classify the relation of the fistulae to the external sphincter, as this is the muscle that has the main responsibility for continence. [13] The hypothesis Shafik puts forward is: "All fistulas start as a central space infection which may

remain confined to the intrasphincteric compartment or spread extrasphincterically. The low and high types are variations of the depth as related to the levator plate.” [13] Shafik generally refers to the pathology of anorectal fistulas and only briefly mentions how he treated the fistulas of the patients who participated in the study. The classification is simple and therefore easy to understand and apply. However, it does not cover all types of anorectal fistula and does not include an understanding of the extent of the fistula. Accordingly, other clinical factors and surgical considerations would have to be considered to ensure the best possible treatment for patients.

Table 7. A Simplified Classification – 1979

Intrasphincteric Fistula	Low	Non-loop type	
		Loop type	Low loop
			High loop
	High	Intrarectal	
		Extrarectal (Pelvirectal)	Primary
			Secondary
Extrasphincteric Fistula	Low		
	High		

Shafik A. A new concept of the anatomy of the anal sphincter mechanism and the physiology of defecation. The external anal sphincter: a triple-loop system. Invest Urol. 1975 Mar;12(5):412-9. PMID: 1112669.

St. James’s University Hospital MR Imaging Classification

Morris et al. provided in their paper “MR Imaging Classification of Perianal Fistulas and Its Implications for Patient Management” in 2000 a new classification for anal fistulas based on MR Imaging. [14] This is particularly interesting as it was the first classification based on the results of the MRI. [15] The five grades proposed in this classification relate Park's surgical classification to anatomy seen on axial and coronal MR imaging. The key is that the classification involves not only the detection of primary fistula tracts, but also secondary branching and associated abscesses. The classification, which is presented in Table 8, was clinically investigated in a prospective double-blind study with 300 patients. The MRI images, obtained unseen by the surgeons preoperatively, allowed the results of the imaging analysis to be compared with those of the surgical exploration interventions. The results of the MRI examinations showed that they were able to detect fistulas that had not been identified during the initial surgical

procedures and were more accurate when there was inflammatory swelling or fibrosis present. In addition, occult sepsis in the intersphincteric space can be detected on imaging and "high fistulae" (grades 3-5) can be analysed by imaging alone, thus avoiding the need for unsafe surgery. Their conclusion is that the classification can be used for preoperative analysis and thus better outcomes can be achieved in treatment by early detection of complex fistulas. Morris et al. recommend simple surgical treatment for intersphincteric fistulas and complex surgery for grade 3 or 4 fistulas, which may threaten continence or require colostomy to allow healing. In the case of a fistula that crosses the levator plate and is thus described as translevatoric, i.e. grade 5, the cause of pelvic sepsis should be searched. [14]

Pankaj Garg's comments in his papers that the classification is a rearrangement of Park's classification with little change in clinical implications. He also criticises the lack of assistance to operating surgeons for managing the fistula. [15]

Recent publications have revealed that the simplicity of intersphincteric fistulas and the complexity of transphincteric fistulas are not universal, and some may not fit the typical classification. [9]

Table 8. St James's University Hospital MR Imaging Classification – 2000

Grade	Description
Grade 0	Normal appearance
Grade 1	Simple linear intersphincteric fistula
Grade 2	Intersphincteric fistula with intersphincteric abscess or secondary fistulous track
Grade 3	Trans-sphincteric fistula
Grade 4	Trans-sphincteric fistula with abscess or secondary track within the ischioanal or ischiorectal fossa
Grade 5	Suprlevator and translevator disease

Morris J, Spencer JA, Ambrose NS. MR Imaging Classification of Perianal Fistulas and Its Implications for Patient Management. *Radiographics*. 2000 May;20(3):623–35.

Freiburg University Hospital MR Imaging Classification

Schaefer, Lohrmann, and Langer developed a new MR-imaging protocol to identify anorectal fistulas in 2004 and called it "subtraction MR-fistulography". They evaluated this protocol in a study of 36 participants who had a clinical diagnosis of anal fistulae or abscesses. Patients with diagnosed Crohn's disease were not excluded. In the study, the patients were examined based

on the new MR protocol and then underwent surgery to explore the fistulas. The surgeons evaluated the fistulas during surgery without prior access to the MR images, and later, the imaging and surgical results were compared. The authors' classification, comprising six categories for fistulas and four for abscesses, is presented in Table 9 of the article. Schaefer et al. also stated that the proposed classification refers to the known classifications of Parks and the St. James' University hospital. Furthermore, the authors used the tool of the 'anal clock' to describe the anatomic location of fistulas and abscesses. Moreover, complex anal sepsis was defined as the presence of more than two fistulous tracks in combination with abscess formation. In addition, independent risk factors were identified that predict a poor post-operative outcome. [16]

According to Schaefer et al. these factors are: "[p]revious fistula surgery, complexity, lack of identification of the internal fistulous opening, wrongly diagnosed primary tracks, and missed secondary tracks [...]". [16] The authors stated that conducting a statistical analysis comparing MRI and surgical examination, two competing modalities, was not feasible for the collection of statistical data. The absence of data on sensitivity, specificity and prognostic information highlights the limitation of the study. According to the study's conclusion, high-resolution subtraction MR fistulography is not only a new diagnostic tool for detecting anal fistulas, but also an important adjunct to surgical investigation. [16]

Due to the non-invasiveness of MRI imaging, which is well-tolerated by patients [16], and the provision of detailed information, the protocol represents a standardized approach that offers several advantages. The disadvantages of the classification include its limited applicability, as an MRI is required, and its operator dependence, as the results are based on the radiologist's evaluation, and it does not result in a precise treatment plan. Further validation would be desirable, especially as the number of participants in the study was relatively small with 36 patients.

Table 9. Freiburg University Hospital MR-Classification – 2004

Fistula (F)	F I	Linear intersphincteric
	F II	Intersphincteric with horseshoeing
	F III	Linear trans-sphincteric
	F IV	Trans-sphincteric with horseshoeing
	F V	Translevatoric
	F VI	Other (recto/ano-vaginal, perineum, scrotum, labia, subcutaneous, blind sinus, urinary bladder, tumor)

Abscess (A)	A I	Perianal
	A II	Ischiorectal fossa
	A III	Suprlevatoric
	A IV	Other (intramuscular, labia, scrotum)

Schaefer O, Lohrmann C, Langer M. Assessment of anal fistulas with high-resolution subtraction MR-fistulography: comparison with surgical findings. *J Magn Reson Imaging*. 2004 Jan;19(1):91-8. doi: 10.1002/jmri.10436. PMID: 14696225.

Standard Practice Task Force (SPTF) Classification

Whiteford et al. published guidelines for the treatment of anorectal fistulas in "The American Society of Colon and Rectal Surgeons" in 2005. These guidelines are based on articles retrieved from selected databases using key words. A new classification of anorectal fistulae was established, dividing fistulas into simple and complex forms. [17]

He thereby adopts Thomson's idea of classification from 1962. Whiteford et al. defines fistula-in-ano as complex "[...] when the track crosses >30 to 50 percent of the external sphincter (high-transsphincteric, suprasphincteric, and extrasphincteric), is anterior in a female, has multiple tracks, is recurrent, or the patient has preexisting incontinence, local irradiation, or Crohn's disease." [17]

Accordingly, complex fistulas are those that have an increased risk of affecting continence with a fistulotomy. The Authors state that the exact anatomy and thus the differentiation of the fistulas is determined in the operating theatre. Additional supportive imaging measures such as MRI and endorectal ultrasound can be useful but are not explicitly recommended here. The classification including the treatment guidelines can be seen in Table 10. [17]

The positive aspect of this classification is its simplicity and clarity and the resulting ease of application and also the idea of having a classification based on treatment. Nevertheless, this classification may not be applicable to all fistulas, as it does not include complex fistulas such as those with multiple openings and horseshoe shapes. Thus, the potential complexity and extent of the fistula has not been adequately considered and may not clearly help in the choice regarding the treatment for the surgeon concerned. Garg also notes in his paper of 2018 that the classification is oversimplified and according to his data one third of the fistulas classified as complex by Whiteford et al are actually simple and can be treated with a fistulotomy. [15] Moreover, the article is based on clinical experience and is thus limited by its evidence and feasibility.

Table 10. Standard Practice Task Force (SPTF) Classification – 2005

Simple anal fistulas	Treatment recommendations according to Whiteford et al.: <ol style="list-style-type: none"> 1. Fistulotomy 2. Track debridement and fibrin glue injection
Complex anal fistulas	Treatment recommendations according to Whiteford et al.: <ol style="list-style-type: none"> 1. Debridement and fibrin glue injection 2. Endorectal advancement flap closure 3. Seton and/or staged fistulotomy

Whiteford MH, Kilkenny J, Hyman N, Buie DW, Cohen J, Orsay C, et al. Practice Parameters for the Treatment of Perianal Abscess and Fistula-in-Ano (Revised). *Dis Colon Rectum*. 2005 Jul;48(7):1337–42.

Four Quadrant Classification

Abeyasuriya et al. [18] published an anatomical classification of anorectal fistulas in their article “The distribution of the anal glands and the variable regional occurrence of fistula-in-ano: is there a relationship?” in 2010. The proposed classification of fistulas is based on the location of the external and internal opening and on the location of the fistula with its primary and accessory tracts. The location was considered in relation to the quadrant. The result was the classification into left upper (LU), right upper (RU), left lower (LL) and right lower (RL) quadrant and fistulas with multi-quadrant distribution, which is presented in Figure 5. The study conducted to develop this classification had two phases consisting of 39 and 10 participants. [18]

The low number of subjects suggests insufficient verification of the classification, and furthermore, no therapy recommendation results from the proposed classification. It merely offers an anatomical positional relationship. Consequently, the classification is not useful in everyday clinical practice. [18]

Figure 5. Four Quadrant Classification

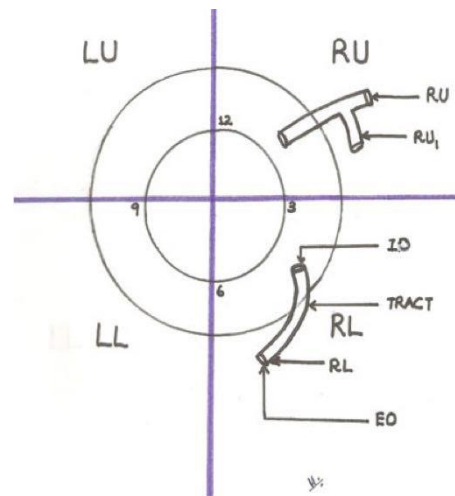


Fig. 1 Four quadrants and new fistulous tract nomenclature in the perineum. The perineum was divided into right upper and lower and left upper and lower quadrants (RUQ, RLQ, LUQ, LLQ) in the lithotomy position. The site of the external (EO) and internal openings (IO) and the tract pathway were considered as a single entity, and the fistulae were classified based on what quadrants they were in. Any additional tracts were called RU1, RLI etc. The clockwise position of the fistulae is described in relation to the dentate line

Abeyasuriya V, Salgado LSS, Samarasekera DN. The distribution of the anal glands and the variable regional occurrence of fistula-in-ano: is there a relationship? *Tech Coloproctology*. 2010

New Classification (NC)

Dr. Pankaj Garg's study from 2017 compared three existing classifications, namely those of Parks, St. James Hospital University (SJHU) and the Standard Practice Task Force (SPTF), based on their effectiveness in 440 cases of patients with anorectal fistula. In response to the lack of correlation between the grade and complexity of the fistula in these classifications, he provided a new classification. The aim of the 'New Classification (NC)', as with the other three, was to guide surgeons in deciding if a fistulotomy could be performed without jeopardizing the patient's continence. The difference that comes with his classification is, firstly, that Garg used the possibility of MRI and he did not group together all fistulas that were complex and could not be treated by fistulotomy, but subclassified them. The NC gives a recommendation for treatment and can therefore support the treatment decision. Table 11 presents the classification from the original paper. Garg also recommends the preoperative use of an MRI or endoanal ultrasound, as more than a third of fistulas that can apparently be classified as simple are in fact complex. [9]

In 2018 and 2020, two supporting articles by Garg were published, providing a further assessment of the NC. [15,19] From the Cohort Study of 2020 with renewed comparisons between the four classifications mentioned above, it emerged that the NC shows above mentioned advances and thus a recommendation can be made. [19]

On the other hand, the requirement of an MRI for the evaluation is simultaneously a disadvantage, as it is only available to a limited extent in institutions. Nevertheless, Garg states that the use of MRI is more cost-effective over the long term, as the recurrence rate is reduced and the correct treatment can be assessed. [9]

In conclusion, although NC may not yet be the standard due to reduced clinical utility, it is effective as a decision-making tool for the treatment of anorectal fistulae.

Table 11. New Classification – 2017

Grade	Description	Treatment guidelines
I	LOW LINEAR Intersphincteric and Transsphincteric Fistula- (less than 1/3 of external sphincter involvement) I-A: Low linear Intersphincteric I-B: Low linear Transsphincteric	Fistulotomy should be possible in almost all these fistulas (>95%)

II	<p>LOW Intersphincteric and Transsphincteric Fistula- (less than 1/3 of external sphincter involvement)</p> <p>II-A- Abscess</p> <p>II-B-Multiple tracts</p> <p>II-C -Horseshoe</p> <p>II-D. Supralelevator: Complete Intersphincteric supralelevator fistula.</p> <p>II-E- Supralelevator: Low Transsphincteric (<1/3 sphincter involvement) with intersphincteric supralelevator extension</p>	<p>Fistulotomy should be possible in majority of these fistulas (>90%)</p>
III	<p>III-A: High linear Transsphincteric fistula (>1/3 sphincter involvement)</p> <p>III-B: Fistula with associated Crohn's disease, sphincter injury, post radiation exposure or anterior fistula in a female</p>	<p>Fistulotomy should not be attempted. FPR or sphincter saving procedures – LIFT, VAAFT, AFP, TROPIS, OTSC clip or FiLac laser - should be done.</p>
IV	<p>Complex High (>1/3 sphincter involvement) Transsphincteric fistula with either</p> <p>IV-A- Abscess</p> <p>IV-B-Multiple tracts</p> <p>IV-C -Horseshoe</p>	<p>Fistulotomy should not be attempted. FPR or sphincter saving procedures – LIFT, VAAFT, AFP, TROPIS, OTSC clip FiLac laser - should be done. FPR and AFP should be avoided in an abscess (IVA). Preferably refer these fistulas to a fistula expert</p>
V	<p>V-A: Transsphincteric (>1/3 sphincter involvement) with intersphincteric supralelevator extension</p> <p>V-B: Suprasphincteric fistula</p> <p>V-C: Extrasphincteric fistula</p>	<p>Fistulotomy should not be attempted. Sphincter saving procedures – LIFT, VAAFT, AFP, TROPIS, OTSC clip- should be done. Preferably refer these fistulas to a fistula expert</p>

FPR- Fistulectomy with primary sphincter reconstruction, LIFT- Ligation of Intersphincteric fistula tract, VAAFT- Video assisted anal fistula treatment, AFP- Anal fistula plug,

TROPIS- Transanal opening of intersphincteric space OTSC- Over-the-scope-clip proctology.

Garg P. Comparing existing classifications of fistula-in-ano in 440 operated patients: Is it time for a new classification? A Retrospective Cohort Study. Int J Surg. 2017 Jun;42:34–40.

Anal Fistula Classification based on Natural Patterns

A. Rojanasakul and C.B. Tsang [20] tried to reappraise and understand the problems of anal fistulas and their previous classifications and developed a classification using a different perspective and a new template for documenting and reporting anal fistulas. The authors argue that anorectal sepsis spreads through the anogenital muscles rather than invading them to reach the anorectal spaces. This means that the patterns of anal fistula should follow a constant pattern, since the anatomy of the muscles and spaces remains the same. The newly established classification is based on the five natural patterns of anal fistulae, which are illustrated in Figure 6. The first pattern is low intersphincteric and can appear in all directions around the anus. The second pattern is low transphincteric and occurs frequently in the posterior and anterior directions. The third and fourth patterns are high transphincteric and have internal openings located at the 11, 12, or 1 o'clock position (anterior) and 6 o'clock position (posterior) respectively. The fifth pattern is defined as posterior high intersphincteric pattern of anal fistula and is caused by an infection in the intersphincteric region. There are three possible pathways for the fistula to spread: upwards to form a supralevator abscess without external opening, laterally above the superficial external sphincter towards the ischioanal space, or posteriorly to the deep post-anal space and ischioanal fossa. These patterns can occur in combination and lead to complex fistulas. Almost all cases of this pattern have an internal opening at 6 o'clock. According to the authors, the new classification of anal fistula has the following positive features: it focuses only on fistulas of cryptoglandular origin, refers to both anal fistulas and anal abscesses, and includes only the basic natural patterns of anal fistula. This classification serves as a basis for understanding

Figure 6. Natural Anal Fistula Patterns

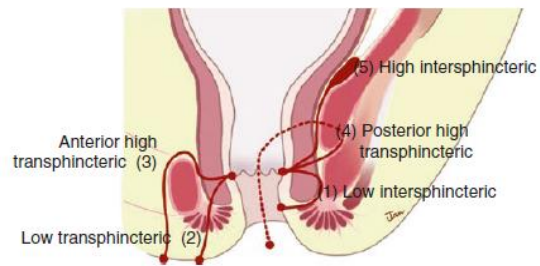


Fig. 80.6 Natural anal fistula patterns (see text)

Rojanasakul A, Tsang CB. Emerging Concepts in Classification of Anal Fistulae. In: San-toro GA, Wieczorek AP, Sultan AH, editors. Pelvic Floor Disorders [Internet]. Cham: Springer International Publishing; 2021 [cited 2023 May 2]. p. 995–1002.

Figure 7. Algorithm of Anal Fistula Map

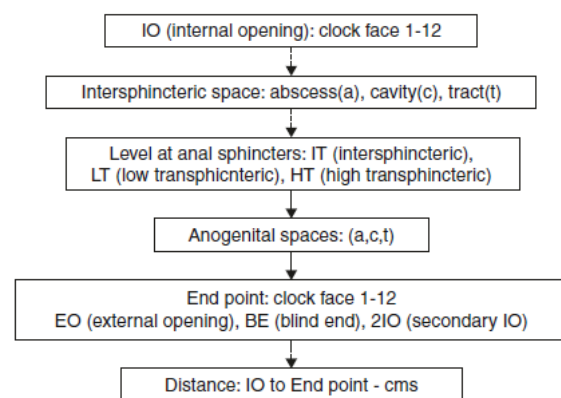


Diagram 80.1 Algorithm of Anal Fistula Map

Rojanasakul A, Tsang CB. Emerging Concepts in Classification of Anal Fistulae. In: San-toro GA, Wieczorek AP, Sultan AH, editors. Pelvic Floor Disorders [Internet]. Cham: Springer International Publishing; 2021 [cited 2023 May 2]. p. 995–1002.

more complex forms of fistulas. Unlike previous classifications, conversion to other classifications is possible, but not vice versa. The new classification serves as a guide for surgical options and decisions and may reflect different outcomes depending on fistula type, technique and surgeon. Parks' supra- and extrasphincteric types are not included in this classification but may be recognised as type 4 and type 5. In addition, the authors developed a standardized template for documenting and reporting anal sepsis called the 'Anal Fistula Map' (shown in Figure 7), which addresses the lack of a common language between surgeons and radiologists and facilitates communication. It provides a clear description of the route of any fistula and considers any associated abscess, cavity, or tract in each location. The map is not intended to replace any classification system, but it can be used to extract any anal fistula classification. The advantages of the Anal Fistula Map include guiding surgeons in surgical decision-making, facilitating communication between surgeons and radiologists, and allowing for clear recording of intra-operative findings. [20]

This new classification still needs to be validated to be significant in terms of clinical usefulness and feasibility.

Emile Modification of Parks Classification

The most recent classification of anorectal fistulae was published in 2021 by Emile et al. [21] Their classification proposed is a modification of the widely used Parks classification, which was based on the anatomical relation of the fistula with the anal sphincter. The amendment of Emile includes the incorporation of predictors of recovery failure and postoperative continence disorders. These modifications are organised in three parts. First, the "transsphincteric" type of the former Parks classification has been further subdivided based on the extent of involvement of the external anal sphincter by the fistula tract, into two stages: Stage II "low transsphincteric" and Stage III "high transsphincteric". Secondly, they recommended subdividing the I, II and III stage into two groups, namely A and B or simple and complex respectively. They defined complex fistulas as those with risk factors that could complicate complete healing after surgery. These risk factors, which they identified from prior literature, include secondary tracts and associated abscess cavities, horseshoe fistula, anterior fistula in female patients and former surgical procedures for anal fistulae. The third point is that suprasphincteric and extrasphincteric anal fistulas have been grouped together and described as unusual due to their infrequent occurrence. "The Modified Parks Classification" is presented in the table below (Table 12).[21]

Besides the advantage of including risk factors for poor outcomes, there are a few points to consider. Limitations of this study, as described by the authors themselves, include the missing external validation in clinical studies to provide its accuracy in predicting management outcomes. Further research will be needed to approve the practicality and utility of this modified classification. Furthermore, the clinicians' subjective assessment of the anatomy of the fistula, on which the classification is based, could not be improved, so that the assessment still depends on the responsible physician. Probably the most decisive disadvantage is that the classification does not give specific information on which treatment options are recommended based on the staging. Therefore, its role in guidance for treatment decisions may be limited.

Table 12. Emile Modification of Parks Classification – 2021

Stage of fistula		Description
Stage I: Intersphincteric fistula not involving the EAS fibers	A	Simple linear, nonbranching intersphincteric tract
	B	Intersphincteric tract with at least one of the following: <ul style="list-style-type: none"> • Horseshoe tract • Secondary extensions and associated abscess cavities • Anterior fistula in female patients • History of previous surgery for anal fistula
Stage II: Low transsphincteric fistula involving less than 30% of EAS fibers	A	Simple linear, nonbranching low transsphincteric tract
	B	Low transsphincteric tract with at least one of the following: <ul style="list-style-type: none"> • Horseshoe tract • Secondary extensions and associated abscess cavities • Anterior fistula in female patients • History of previous surgery for anal fistula
Stage III: High transsphincteric fistula involving more than 30% of EAS fibers	A	Simple linear, nonbranching high transsphincteric tract
	B	High transsphincteric tract with at least one of the following: <ul style="list-style-type: none"> • Horseshoe tract • Secondary extensions and associated abscess cavities • Anterior fistula in female patients • History of previous surgery for anal fistula
Stage IV: Unusual types of fistula		Suprasphincteric fistula Extrasphincteric fistula

Emile SH, Elfeki H, El-Said M, Khafagy W, Shalaby M. Modification of Parks Classification of Cryptoglandular Anal Fistula. Dis Colon Rectum. 2021 Apr;64(4):446–58.

Table 13. Comparison Table of all 17 Classifications

Classification	Year	Based on	Management guidance	Advantages / Disadvantages
Milligan and Morgan	1943	Clinical experience	No	+ Detailed anatomical analysis and description, the first attempt of a classification - Based on "old" anatomical understanding, not sufficiently validated before publication and not indicative of therapeutic strategies
Stelzner	1959	Not known	No	- Unspecific, no guidance for management
Goligher	1961	Not known	No	- Wide scope for interpretation, no guidance for management
Thompson	1962	Not known	Yes	+ Clear, easy to understand, management orientated - Unspecific
Lilius	1968	Clinical experience, Operative results	No	- No guidance for management
The Sumikoshi Classification system	1972	Not known	No	+ Specific - No guidance for management
Parks Classification	1976	Clinical experience	No	+ Widely used and accepted - Not accurate, no guidance for management
Eisenhammer	1978	Clinical experience, Operative results	No	+ Detailed, focus on fistula patterns - Complex
Hanley	1978	Clinical experience	Yes	+ Treatment recommendations - Missing validation
A Simplified Classification	1979	Clinical experience, Operative results	No	+ Simple - Does not categorize all types of fistula, not management orientated
St. James's University Hospital Classification	2000	MRI	No	+ MRI based - Not management orientated, not much change compared to Parks Classification

Freiburg University Hospital MR-Classification	2004	Clinical examination, imaging, surgical exploration	No	+ Non-invasive method for classification, standardized approach of protocol - MRI required, not management orientated
Standard Practice Task Force (SPTF) Classification	2005	Clinical experience	No	+ Simple, attempted to be management orientated - Not all types of fistulas included, oversimplified
Four Quadrant Classification	2010	Clinical examination, imaging, examination under anaesthesia	No	+ New possible description of the anatomical relationship of fistulas - Not management orientated, no validation
Garg / New Classification	2017	Clinical experience, MRI, Operative results	Yes	+ Provides a Guideline for management, validated by patient's data - MRI necessary
Anal Fistula Classification based on Natural Patterns	2021	Clinical experience	No	+ Based on natural anal sepsis patterns - Not sufficiently validated
Emile Modification of Parks Classification	2021	Clinical experience, MRI, Operative results	No	+ Includes risk factors of poor outcome - No external validation, physician dependent, not management orientated

DISCUSSION

As Rojanasakul and Tsang described in their paper, a good classification system for anal fistulae should have the following characteristics: It should accurately describe the different patterns of anal fistulas based on knowledge of anatomy, imaging studies, and surgical findings. It should be easy to understand and used by different types of healthcare professionals. The system should cover common variants of anal fistulas but not include extremely rare cases. It should also guide treatment options and predict outcomes, while allowing for comparison of outcomes and complications between different techniques, surgeons, and institutions. [20]

The aim is to perform an optimal surgical treatment with the assistance of a well-graded classification in order to eradicate the infection, remove the tracts and secondary branches and preserve continence in addition to healing. [2]

The oldest classification, proposed by Milligan and Morgan in 1934, was based on a good anatomical analysis, but the validation of Huges showed that the former information is outdated. In addition, this classification does not support any surgeon in the choice of treatment. [4]

Stelzner then published his classification with the subdivision into inter-muscular, transsphincteric and extrasphincteric fistulas. [5] Due to lack of access to the original article, it has not been possible to obtain more information, therefore it is considered unspecific and not management oriented. Goligher's modified classification of Milligan and Morgan unfortunately did not show any improvement because of the interpretative scope offered by the classification leads to misapplication, according to Parks. [5] The first management-oriented classification was published by Thompson in 1962, which is simple and clearly understandable due to the division into simple and complex fistulas. [6] Being unspecific, it should be further developed in order to find practical applications. Lilius divided fistulas into six groups [6] in 1968, which was a more specific classification. However, this categorization is not management oriented. The classification of Sumikoshi, recommended in the Japanese guidelines [8], is difficult to evaluate due to the language barrier. Nevertheless, it is evident from other referenced articles that the proposed subdivisions of subcutaneous, intersphincteric, ischiorectal, and pelvirectal fistulas are specific and clinically beneficial. [8] There is no indication of specific treatment based on this classification. Parks et al. published what is now probably the most widely used and best-known classification of anal fistulae in 1976. [9] As our understanding of the pathology and issues related to anal fistulae has advanced, this classification has become less effective. [9] Additionally, since it is not treatment-oriented, it is not particularly informative. The classification suggested by Eisenhammer is detailed and focuses on fistula patterns, but it is intricate and difficult to apply in practice, which may explain why it has not gained widespread acceptance. [2] Hanley analysed the pathways and causes of infections in the anal glands and proposed his classification in 1978. This has the advantage that it included precise anatomical site integration and updated treatment recommendations. [12] But, it lacks extensive validation. In 1979, Shafik introduced "A Simplified Classification" based on his clinical experience with 300 patients and the resulting surgical outcomes. The classification's simple division into intra-

and extrasphincteric makes it easy to comprehend and apply, but it does not categorize all types of fistulas and is not management-oriented. [13]

With the St. James's University Hospital classification, the first MRI-based classification was published in 2000. However, it is not management-oriented and does not deviate significantly from the Parks classification. [15]

The Freiburg University Hospital MR-Classification published in 2004, is based on clinical examination, imaging, and surgical exploration. The standardized protocol and non-invasive classification method are advantages, but the classification's reliance on MRI and lack of associated management guidance are drawbacks. Additionally, the study had a relatively small sample size of 36 patients. [16]

In 2005, Whiteford et al. published the 'Standard Practice Task Force (SPTF) Classification', which was developed based on clinical experience. The classification is simple and aims to be management-oriented, but it is oversimplified as not all types of fistulas were included. Subsequent validations by Garg showed the need for improvement and re-evaluation of this classification. [15]

A new perspective on fistula classification was presented by Abeysuriya et al. in 2010 with their 'Four quadrant classification', which reviewed the anatomical relationships of fistulas. However, the classification's validation is weak with only 49 patients, and no therapeutic recommendations were provided, thereby limiting its usefulness in clinical practice. [18]

Garg's 'New Classification' of anal fistulas in 2017 significantly improved their categorization and stratification by integrating clinical experience, MRI imaging, and surgical results. Each grade is accompanied by a treatment recommendation, making it clinically useful. [9] Furthermore, the classification has been validated several times, with 440 patients in 2017 [9] and 848 fistula-in-ano patients in 2020 [19]. The classification's dependence on MRI is a drawback. Rojanasakul and Tsang introduced a new classification in 2021, which is based on the natural patterns of anal fistulae and an 'anal fistula map' that provides a standardized template for documenting anal sepsis. The classification focuses on fistulas of cryptoglandular origin and includes both anal fistulas and anal abscesses. It may reflect different outcomes depending on the fistula type, technique, and surgeon but needs further validation. [20]

The Emile modification of Parks classification, published in 2021, is based on clinical experience, MRI, and surgical results. The inclusion of risk factors for poor outcomes is a positive

aspect. The lack of external validation and the dependence on physician assessment are disadvantages. The most significant drawback is the lack of guidance for treatment decisions.

The review has some limitations that should be acknowledged. Firstly, some original articles of classifications were not accessible, which could potentially have an impact on the findings of the review. Additionally, the review did not include a comparison of classification using patient data or any validation, which may raise questions about the accuracy and reliability of the conclusions drawn. Therefore, these limitations should be considered when interpreting the results of the review.

In conclusion, the use of MRI in the evaluation of anal fistula has significantly improved our understanding and decision making in the management of this condition. Among the various classifications discussed, the Garg classification and the classification proposed by Rojanasakul and Tsang appear to be the most up-to-date in terms of knowledge about anal fistula. While the Garg classification is treatment-oriented, the classification based on natural patterns provides new insights into the pathogenesis of anorectal sepsis spread. Overall, these classifications provide valuable guidance for clinicians in managing patients with anal fistula, and future studies should continue to validate and refine these classifications.

OTHER INFORMATION

Two unsuccessful attempts were made to register the review protocol with PROSPERO, as it was rejected twice due to PROSPERO's prioritization of topics relevant to the COVID-19 pandemic. Consequently, the protocol was not successfully registered with PROSPERO. The authors received no financial support, neither for the research nor for the publication of this paper. There were no competing interests of the review authors.

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