Chapter

Understanding New Ideas in Cryptoglandular Fistula-in-Ano

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Abstract

Outcomes of surgical treatment for anorectal abscesses and chronic fistulas varies widely, as there is lack of unified classification and systematic surgical approach to address a wide range of disease pattern. Acute anorectal abscess and chronic fistula-in-ano should be considered the same disease at both end of a spectrum. This article describes in detail the pathogenesis and relevant anorectal anatomy to aid understanding of a new concept of classifying anorectal abscess and fistula based on natural patterns. A better understanding of patterns allows more accurate surgical treatment. Recent evidence shows that definitive surgical treatment for anal fistula during acute abscess stage is safe and feasible. An optimum surgical treatment should focus on eradication of intersphincteric infection, removal of secondary branches or abscesses, allow healing by secondary intention and preserve continence as best as possible. Common challenges faced by clinicians include confusion in classification, inaccurate delineation of fistula, challenging acute abscesses, unable to locate internal opening and facing complex features such as high fistula or multiple branches. Suggested solutions are discussed and a structured treatment strategy according to types and patterns is proposed. Surgical treatment should follow the principles above and combination of surgical techniques is beneficial compared to individual modality.

Keywords: anorectal abscess, fistula-in-ano, classification, natural patterns, combination surgical techniques

1. Introduction

Since the publications of Park and Eisenhammer in the 1960s to 1970s, we have gained better understanding on the pathogenesis of cryptoglandular infection leading to perianal abscesses and eventually fistula in ano. With this knowledge, we have moved in strides in producing numerous classifications and treatment options, ranging from minimally invasive techniques to surgical procedures that produces significant disruption to the anorectal anatomy.

Anorectal fistulous abscesses and chronic fistula-in-ano are the same disease. This view has been shared by both Parks and Eisenhammer [1, 2]. We tend to separate both topics and discuss the management separately. However, recent views suggest we should treat it as a same disease, both at different spectrum.

We have yet to achieve a gold standard as recurrence rates and success rates still varies widely across continent. I believe the reasons are:

- Lack of comprehensive classification of fistula-in-ano due to a lack of understanding of the natural pattern and progression of the disease.

- Lack of unified surgical approach to address different types of fistula-in-ano. Understanding and practices of surgical techniques varies according to institutions and regions.

Chapter Outline:

- Revisiting the pathogenesis of cryptoglandular infection.
- Relevant updates in anorectal anatomy.
- Understanding the natural patterns of cryptoglandular abscesses and fistulas.
- Review of practicality of classifications for fistula in ano.
- Using natural patterns to classify anorectal abscess and fistula.
- Definitive surgical treatment in acute abscess stage.
- Emerging concepts in managing cryptoglandular anal fistulas.

2. Revisiting the pathogenesis of cryptoglandular infection

In 1961, Park reported his study of 44 specimens of normal anorectal anatomy, and 30 resected specimens from fistula-in-ano surgery. Anal glands were racemose structure of widely ramifying ducts, opening internally via the anal crypts (at dentate line), and extended deep into internal sphincters or ends in the longitudinal layer. They never extend into external sphincter muscles. He concluded that, anal glands provided free channels for infection to pass from the anal lumen deep into the internal sphincter muscles [1]. This observation was echoed by Eisenhammer in 1966, who added that main concentration of large crypts was situated posteriorly, followed by the anterior commissure and last, laterally. Internal orifice of a fistula was always found at the crypt entrance in the pectinate line, at approximately the midlevel of the anal canal [2]. Another study in 1994 by Seow found that 1% of anal glands in fact do penetrate the external sphincter [3]. However, infection arising from external sphincter was never reported.

The term fistulous abscess was used by Eisenhammer; the acute stage represents the abscess, and the chronic stage represents the fistula [2]. Acute abscess progress to a recurrent acute abscess or a chronic infection within the anal glands [1]. Fistula is a granulation tissue tract, develops after abscesses spontaneously rupture or are surgically drainage, where it continues to discharge materials from infected anal gland/ducts. It is kept open by chronic granulomatous inflammation [1, 2].

Pyogenic infections constituting 90% of all cases [1, 2]. Parks noted that 73% of infections occurred at either anterior or posterior midline [1]. Eisenhammer postulated that this intermuscular infection is due to obstructive suppurative adenitis, where causative organism were intestinal bacilli, streptococcus or anaerobes [2].

The cryptoglandular infection pathogenesis remains relevant till present day. From the evidence of early studies, we can conclude that:

1. Anorectal abscess and fistula are essentially the same disease, both at different end of a spectrum, and therefore should always be treated as a single disease entity.

2. Origin of infection lies in deep to the internal anal sphincter and longitudinal layer, but not in the external sphincter based on clinical assessments. In the present-day practice, we understand this anatomical region as the intersphincteric space [4].

3. Majority of the origin of infection lies in either anterior or posterior aspect of anal canal.

4. Location of the internal opening should be predictable.

5. 90% are pyogenic infection, which can be dealt with appropriate surgery and antibiotics.

Why does complex fistula occur?

Of course, secondary causes of complex fistula-in-ano are not uncommon. It can be due to tuberculosis, Crohn's disease, perforated colonic diverticular disease or any form of pelvic sepsis [5, 6]. These are beyond the scope of this chapter.

Eisenhammer believes both spectrums of this disease have a pre-determined pattern and is predictable. He wrote: 'When faulty surgery is performed, natural anatomic barriers become disrupted, new planes of infections opened, leading to complex and complicated conditions' [6]. Recently, this concept is highlighted again. The pattern of spread should be predictable. Infection of the anorectal region should track in between the anogenital muscular and fascia layers rather than penetrating them, forming abscesses in various anorectal spaces. Anorectal musculature, fascias and spaces are constant. Therefore, the natural patterns of anal fistula should also follow a constant pattern [7].

To understand how cryptoglandular disease manifest as simple or complex disease, we should first discuss the natural patterns of cryptoglandular anorectal abscesses and fistulas.

3. Relevant updates in anorectal anatomy

Quoting Kurihara et al. in 2006, 'To be able to successfully treat cryptoglandular anorectal abscesses and fistulas, we need to understand the exact anatomy and extension course' [8]. Secondly, as mentioned before, we need to understand that infection will spread along the least resistant plane, along the planes of anorectal muscles and fascia to reach the respective anorectal spaces [7].

3.1 Review of relevant anorectal anatomy

Important anatomical structures are depicted in **Figure 1a** and **b**. The internal sphincter and the longitudinal muscle are continuation of the circular and longitudinal smooth muscles of rectum respectively in the anal canal. There are 3 components of external sphincters, subcutaneous, superficial and deep external sphincters, whereas puborectalis is a component of the levator ani [1, 2]. Recent publications suggest that puborectalis is also known to be the same entity as deep external sphincter [7, 9]. Perianal space and Ishio-rectal fossa were described by Parks as the 2 most common spaces for abscess formation [1]. However, his postulation that the source of infection was between internal sphincter and longitudinal muscle was later updated [1].

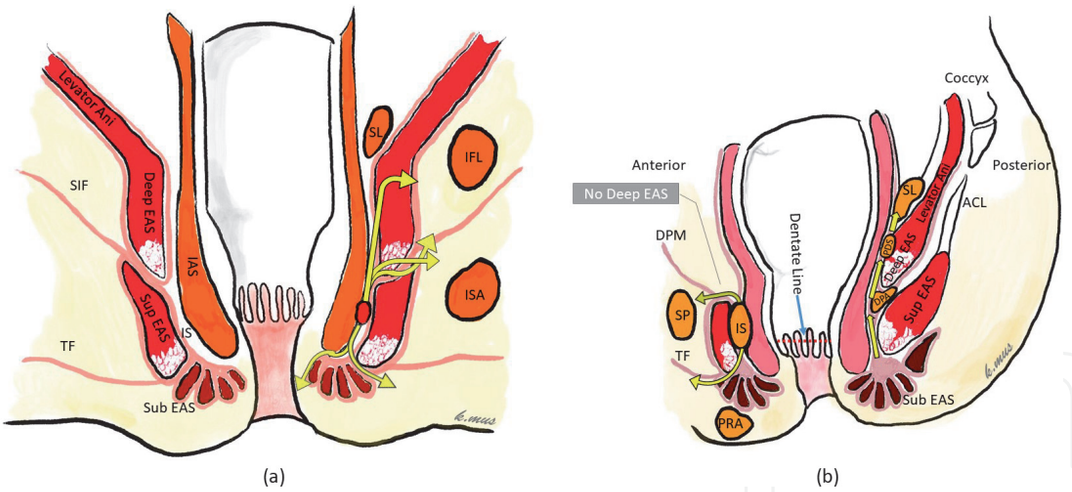

Figure 1.
Coronal view of the anorectal anatomy. Potential space for abscess to form; ISA: ischioanal space, IFL: Infralevator space, SL: Supralevator space, DPA: deep postanal space, PDS: posterior deep space (intersphincteric), IS: intersphincteric space, PRA: perianal space, SP: Superficial perineal space. SIF: septum of ischioanal fossa, TF: transversalis fascia, DPM: deep perineal membrane, ACL: anococcygeal ligament, IAS: internal anal sphincters. EAS: external anal sphincters, components: deep, sup (superficial) and sub (subcutaneous). Deep EAS is interchangeably termed puborectalis muscle. Sagittal view shows significant difference between anterior and posterior perineum. Deep perineal space lies above deep perineal membrane (DPM). Yellow lined arrows show postulated paths for intersphincteric sepsis to traverse the sphincter complex into respective anorectal spaces. Detailed explanation in segment 4.

3.2 Several updates in anorectal anatomy are summarized below

Internal sphincter circular muscles and longitudinal muscle layer are fused together, and the intersphincteric plane is a potential space between the longitudinal layer and the fascia of striated muscle external sphincters [4, 7] (see **Figure 1a** and **b**).

Deep external sphincter overlaps with puborectalis (part of levator ani), and superficial external sphincter overlaps with deep external sphincter, implicating that the external sphincter is not a continuous sheet of striated muscles. The author made a clear distinction between puborectalis and deep external anal sphincter as 2 separate entities, with weak connective tissue between each group [8].

However, other view states that the vertical portion of the levator ani's striated muscles around the anorectal ring is the puborectalis muscle, interchangeably known as the deep external sphincter [7]. This is supported by previous study by Shafik in 1975 confirming that puborectalis muscle and deep external sphincter are actually fused and functions as a single loop termed the top loop [9].

Both authors stipulate that there is a potential point of weakness between the vertical group and the horizontal group of striated muscles at the level of anorectal ring, allowing infection in the intersphincteric space to spread into the Infralevator space [7, 8].

The emerging terms of deep postanal space, posterior deep space and septum of ischiorectal fossa which will be explained next (refer to segments 4.2 & 4.5) [7, 8, 10, 11].

The anatomy of anterior perineum, especially superficial and deep perineal space are equally important to explain anterior patterns of abscesses and fistulas. Anterior perineum lacks puborectalis/deep external sphincter component. Posteriorly, there is a complex interconnection between intersphincteric space, supralevator space, posterior deep space and deep postanal space. (Shown in **Figure 1b**) Deep postanal space communicates with both ischioanal space and Infralevator space laterally and deep perineal space anteriorly (refer to segment 4.2) [7].

4. Understanding the natural patterns of cryptoglandular abscesses and fistulas

4.1 Simple and low abscesses and fistulas

The 2 most common fistulas described by Park in 1976 were intersphincteric fistula and transphincteric fistula, which accounts for 75% of his series. Eisenhammer in 1966 also reported that 80% in his series were low intermuscular type. Infection arising from anal gland forms suppuration in the intersphincteric space, forming an intersphincteric abscess. Alternatively, it can track along the potential intersphincteric space caudally to the intersphincteric groove or along the subcutaneous external sphincter fibers/septaes to form a perianal abscess. This forms an intersphincteric fistula once it ruptures outwards. However, if it spreads between subcutaneous and superficial external sphincter, it forms a low transphincteric fistula and results in a perianal or ischiorectal abscess. These 2 patterns are the most common findings reported and can occur anteriorly or posteriorly [1, 5–7, 12].

4.2 Depth of infection: depth of infections corresponds with the fascia layers

4.2.1 Posterior perineum

Posterior perineum divided into 2 compartments, infra-levator space and the clinical ischioanal space by a septum [8]. Abscess in the intra-levator space presents similarly as a clinical supralevator abscess and may not be apparent from external inspection. It can tract anteriorly to the deep perineal space. Infection/abscesses in the clinical ischioanal space is easily diagnosed by clinical examination externally due to inflamed, indurated or fluctuant ischioanal fossa.

4.2.2 Anterior perineum

There are 3 levels of soft tissue compartments [7].

- The lowest level consists of bulbus spongiosus and subcutaneous external sphincter, separated from the mid-level by transversalis fascia. Infection spreads radially in a linear fashion.

- The mid-level is termed superficial perineal space containing superficial transverse perineii muscles at the same level as the superficial external sphincter, separated from the deep level by perineal membrane. In males, infection in this space can extend to the scrotal area.

- The upper level is the deep perineal space, between the perineal membrane and the levator ani. It communicates posteriorly with the infra-levator space [7]. One should remember that in the deep perineal space, deep external sphincter or puborectalis is absent. Infection can spread between deep perineal space (anterior) and infra-levator space (laterally).

4.3 Transphincteric fistula

Low or high? This represents the level where infection extends through external sphincter into ischiorectal space. In clinical practice, we define low transphincteric

fistula as those involving <1/3 of external sphincter, and high transphincteric fistula if >1/3 involved [12, 13]. Intersphincteric infection can pass through the external sphincter [1, 2, 8, 11], at junctions of each external sphincter portions [8]. If the infection passes through junction between levator ani and deep external sphincter, abscess may present as a Infralevator abscess, and the resulting fistula is a Suprasphincteric type as described by Park [5]. This typically occurs posteriorly and leads to horseshoe pattern (described in 2.2.5). On the other hand, if infection spread at the junction between superficial and deep external sphincter, it will cause ischioanal abscess and a high transphincteric fistula. A low transphincteric fistula results from infection spreading between the junction of superficial and subcutaneous external sphincter.

4.4 Anterior glands or posterior glands

Infection originating from anterior glands or posterior glands will results in typical patterns. Various authors reported internal openings found mainly at the anterior or posterior anal canal, which corresponds well with infected anal gland/crypt [1, 6].

Anterior gland infection that spreads via transphincteric route have predictable patterns. A low transphincteric pattern will tract along the subcutaneous tissue and below transversalis fascia in a linear fashion. A high transphincteric pattern will tract along the perineal space, in male, it extends into the scrotum. In female, it may result in ano-vaginal fistula or opens around the labia majora or causes perineal abscesses. Anterior horseshoe pattern has also been reported. It extends into the ischioanal space at 11 and 1 o'clock position [2, 6, 7].

Posterior gland infections are as described in 4.3 and 4.5.

4.5 Anatomy of the posterior perineum and deep posterior anal space

Hanley described the horseshoe pattern in detail; Infected anal glands originated from posterior midline of the anal canal, spreading along the longitudinal muscle cranially, passing superior or inferior to deep external sphincter (transphincteric extension) into the space known as deep postanal space. Deep postanal space communicates with both ischiorectal spaces above the surface of the superficial external sphincter. Pus will extend through the plane of least resistance into one or both ischiorectal spaces [10, 11].

In 2006, Kurihara made further anatomical discovery regarding posterior horseshoe pattern. Ischiorectal space is divided into 2 compartments by the septum of ischiorectal space, which starts at the Alcock's canal to border between puborectalis (part of levator ani) and deep external anal sphincter. This septum is important as the inferior rectal vessels and nerve runs along this fascia layer to penetrate the upper anal canal wall at the deep external sphincter level. At the point where inferior rectal vessels and nerve enters the external sphincter, tissue is loose. Infection spreads upwards along the intersphincteric plane, forms a nidus at the level of deep external sphincter within the intersphincteric space, which is termed as posterior deep space. It can extend via the weak points into either above or below the septum of ischiorectal space, spread either unilaterally or bilaterally to form horseshoe abscesses/fistulas [8]. Both authors however agreed that the internal opening is usually situated at the mid-anal canal posteriorly [8, 10]. Rojanasakul reports that the posterior high transphincteric fistula can occurs at 5 and 7 o'clock position of the anal canal [7].

4.6 Supralevator extension

In rare cases, intersphincteric sepsis tracks cranially, reaching the supralevator space via intersphincteric plane, limited only by the fascia of levator ani (extension of pelvic fascia) [2, 5]. It is unlikely that these collections spread across the levator ani. However, it is possible for the collection to enter the deep postanal space (posteriorly) or infra-levator space via a high transphincteric path or a suprasphincteric path as described above, forming an infra-levator abscess. These 2 are difficult to differentiate clinically, and erroneous drainage of these abscesses may lead to more complex iatrogenic fistulas such as extra-sphincteric fistula or a translevator fistula. Therefore, MRI imaging is advocated if such pattern is suspected [14, 15].

5. Review of practicality of various classifications for fistula in ano

There are numerous classifications of fistula in ano published over the last 4 decades. This chapter will focus on some of the most commonly used classifications to discuss the practicality in clinical scenario.

5.1 Park's classification

Park's classification of fistula-in ano remains popular as the standard terminology used by surgeons. It was published in 1976, based on operative findings of 400 patients over a span of 15 years [5]. The 4 main types are commonly used and reproduced in literatures. However, minimal attention was actually paid to the 14 sub-types in his original report (refer to **Figure 2**). Park's classification relied on intra-operative findings as it presented, and focused on the position or configuration of the fistula tract in relation to the external sphincter [5]. There were several disadvantages of this classification.

a. It does not stratify the complexity of each type of fistula, e.g. low or high fistula, single or multiple tracts.

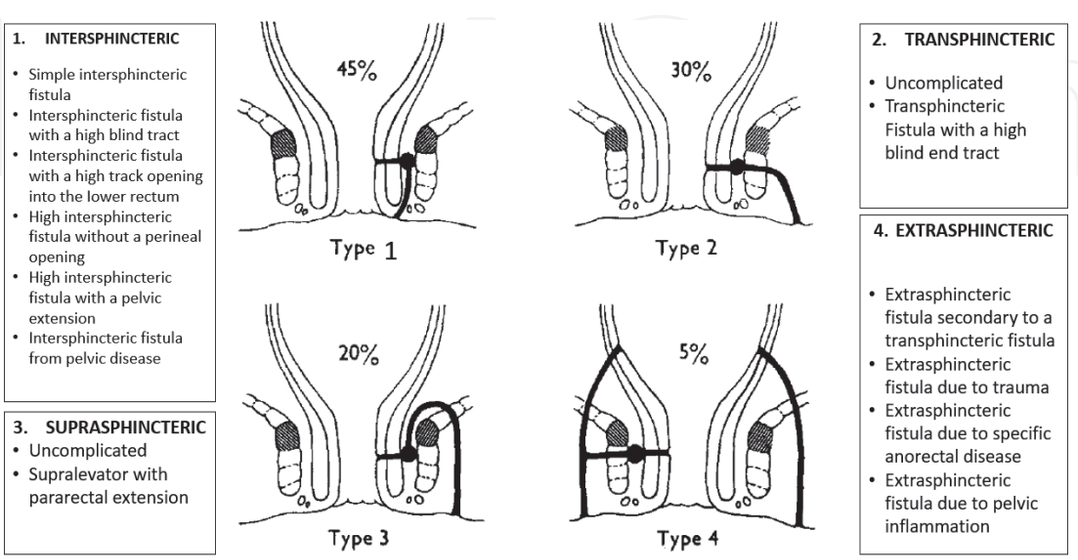

Figure 2.
Park's Classification in 1976. 4 main types with its sub-types (diagrams obtained from Park et al, 1976. A classification of fistula-in-ano. Br J Surg. 1976;63[1]:1–12). [5]

b. It does not guide clinicians in locating the source of intersphincteric sepsis and in selecting appropriate surgical treatment.

c. His clinical findings are recently disputed by several studies using modern imaging, especially the suprasphincteric and extrasphincteric type [8, 14, 16]. Even in 1976, Park described that some cases had difficult anatomy due to fibrosis (recurrence and previous surgery), thus exact anatomy was not entirely ascertained. There was no imaging to guide the findings back then.

5.2 Eisenhammer's classification

Eisenhammer published his final evaluation (refer to **Table 4**) based on low or high fistula, location of infection and pattern of spread. It was a useful guide for surgeons to predict the location of internal opening (intersphincteric infection) and course of fistula tract [6]. Eisenhammer stated that his series was mainly from private practice where all the patients presented to him were new cases, thus reporting the actual natural progression and patterns [6]. It is by far the most complete set of classification and focused on patterns of fistula, while stratifying each type by complexity. However, it did not gain popularity due to its' complex terminologies.

5.3 St James University Hospital classification

In year 2000, St James University Hospital improved Park's classification using Magnetic Resonant Imaging (MRI) studies. They analyzed 300 cases and classified fistula to five grades [16]. Essentially an anatomical classification, this classification refined the findings of Parks based on MRI (as shown in **Table 1**), splitting each of Park's type I (intersphincteric fistulas) & II (transphincteric fistulas) in two further grades (grade I into I & II and grade II into III & IV) and fused grade III & IV into one grade (grade V) [16]. This classification attempts to stratify fistula into simple or complex, allowing clinicians to judge the use of simple fistulotomy or more complex strategies/expert referrals. However, like Park's classification, it does not guide clinicians on the location of intersphincteric sepsis nor if the fistula is low or high. Furthermore, recent publications showed that not all intersphincteric fistulas are simple, and not all transphincteric fistulas are complex [7, 12].

St James's Classification	Description	Park's Classification
Grade 1	Simple Linear Intersphincteric Fistula	Type 1 – Intersphincteric
Grade 2	Intersphincteric Fistula with intersphincteric abscess and secondary fistulous tract	
Grade 3	Trans-sphincteric Fistula	Type 2 - Transphincteric
Grade 4	Trans-sphincteric Fistula with abscess or secondary track within the ischioanal or ischiorectal fossa	
Grade 5	Supralevator & Translevator Disease	Type 3 – Suprasphincteric
		Type 4 - Extrasphincteric

Table 1.
Comparison of St James Classification and Park's Classification. The former recognizes the need to stratify Park's Type 1 and 2 into simple and complex (information extracted from Morris et al, 2000. MR imaging classification of perianal fistulas and its implications for patient management, Radiographics 20 [2000] 623-635 discussion 635-7) [16].

5.4 Standard Practice Task Force

A practical and simple solution was created by Standard Practice Task Force in 2005, classified fistula-in-ano in just two categories-simple and complex [17]. The treatment of complex fistulas posed a high risk to anal continence and in simple fistulas, fistulotomy could be done safely without any risk of incontinence. The latter usually involved less than one-third of sphincter complex. Fistulotomy is not recommended in complex fistulas.

However, a study in 2017 showed that 32.1% (93/290) of complex fistulas were amenable to fistulotomy [12]. Simple and complex classification was shown to overestimate complexity of fistula. Furthermore, it was not particularly useful for clinicians in differentiating different types or patterns of complexity and determining the specific management.

5.5 Garg's classification

The most recent classification was introduced in 2017 and validated in 2020 with over 848 patients using combination of MRI study and intra-operative findings [12, 18]. This classification provided comprehensive and detailed grouping of anal fistula into 5 grades, from simple to complex grading (**Table 2**). In general, complexity was determined by low or high fistula, presence of multiple secondary tracts or collections. Intersphincteric and transphincteric fistulas were both recognized as simple if the fistula is low and safe for fistulotomy. This classification allows stratification of fistula-in-ano in a practical manner to guide their management strategies. Grade 1 and 2 fistulas were reported as safe to be treated with fistulotomy, whereas grade 3 to 5 requires more complex surgical strategy or expert referral (refer to **Table 2**) [12]. This method of stratification was validated to be safe. Following the Garg's new classification, patients underwent fistulotomy did not show significant changes in continence score post operatively [18]. However, this grading method relies heavily on MRI, which is not readily available in all

Grade 1	Low* Fistula with single branch	SIMPLE ¥
	Intersphincteric or Transphincteric	
Grade 2	Low* Fistula with multiple tracts, abscess or horseshoe.	
	Intersphincteric or Transphincteric	
Grade 3	High* Transphincteric with single branch	
	Anterior fistula in female	
	May have: Impaired continence, Crohn's disease or Previous radiation	
Grade 4	High* Transphincteric with	
	Multiple tracts, Abscess, Horseshoe.	
Grade 5	High* Transphincteric with Supralevator tract	
	Or Suprasphincteric	
	Or Extrasphincteric	

**Low transphincteric: <1/3 of external sphincter involved. High transphincteric: > 1/3 of external sphincter involved.*
¥Grade 1: Fistulotomy should be possible in almost all these fistulas (>95%). Grade 2: Fistulotomy should be possible in majority of these fistulas (>90%)

Table 2.
Garg's New Classification of Anal Fistulas (information extracted from Garg [18]).

institutions. Furthermore, there are many subclassifications to remember and challenging complex type such as suprasphincteric, supralevator and extrasphincteric types, were group into a single category even though each have unique patterns.

A useful classification allows clinicians:

- To categorize various subsets or presentations of a disease for better understanding.
- Stratification of a disease according to severity or complexity.
- To guide clinicians in treatment strategy and prognostication.

In general, most of the classifications above do not fulfill all 3 criteria above. Garg's classification was a significant improvement in categorizing, stratification and suggested treatment options for each grade. However, when faced with complex fistulas, there is still a general lack of understanding of its pathogenesis and optimal surgical treatment. This author believes, the step forward is to provide a more comprehensive treatment algorithm/guideline based on knowledge of natural patterns and progressions. To achieve this, the author believes classification based on natural patterns of cryptoglandular abscess and fistula will provide further insight.

6. Using natural patterns to classify anorectal abscess and fistula

6.1 Classifications that focuses on natural patterns

The new idea. Most classifications focus on anatomical configurations of fistula. It is possible to classify anorectal abscesses and fistula-in-ano based on natural patterns. This type of classification is beneficial as:

1. It helps clinician to understand the pathogenesis better, leading to a better understanding of different types and patterns of complex fistulas.
2. It helps clinician to predict the source of infected anal glands and intersphincteric sepsis, and the same time identify secondary extensions and external tracts.
3. This author postulate that it may reduce clinicians' reliance on imaging modalities.

Eisenhammer produced a classification method and later modified it in 1978 on his final evaluation of 800 patients over a span of 25 years. In general, the basis of his classification lied on low or high fistula/abscess, the position of the infected anal crypt (anterior or posterior), confined to intermuscular space (intersphincteric space) or spread to ischiorectal space [6]. However, it was not commonly utilized over the next few decades.

Rojanasakul proposed to classify the Natural Pattern of Anal Abscess and Fistula. It is effectively summarized into 5 main patterns and each pattern predicts the location of internal opening (refer to **Table 3**). This is paramount for surgeons to locate the offending anal gland/crypt for optimal treatment. Almost all patterns can be summarized by a simple classification of 5 patterns (refer to **Figure 3**) [7].

Type 4 and 5 can occur in combination. This is often complex and confusing to clinicians as it may present with a supralevator abscess concurrently with bilateral horseshoe or ischioanal abscesses (Shown in **Figure 3**). The key to managing this combination type is to address both the high intersphincteric tract and the high transphincteric tract with combination of surgical techniques (will be described in segment 8). When we compare both Eisenhammer's finding to this new classification of natural patterns, we find that all of the previously described types can be simplified into these 5 main patterns (refer to **Table 4**). Clinicians should be mindful that it is possible for 2 patterns to occur concurrently [7].

Pattern	Internal opening (& Intersphincteric tract)	Proportion
1. Intersphincteric pattern	Internal opening: any direction	3.8%
2. Low transphincteric pattern	Internal opening: any direction, most common anterior and posterior	26.9%
3. Anterior high transphincteric pattern	Internal opening: anterior. 11, 12 or 1 o'clock position	27.9%
4. Posterior high transphincteric pattern	Internal opening: posterior Common: posterior midline Less common: 5 and 7 o'clock position	31.7%
5. High intersphincteric pattern	Internal opening: posterior Common to occur concurrently with posterior high transphincteric fistula (horseshoe fistula)	9.6%

Table 3.
Summary of natural patterns of anorectal abscesses and fistulas with predicted internal opening, intersphincteric tract and proportion (information extracted with permission from Rojanasakul & Tsang, 2021. Emerging Concepts in Classification of Anal Fistulae. Pelvic Floor Disorders, Springer) [7].

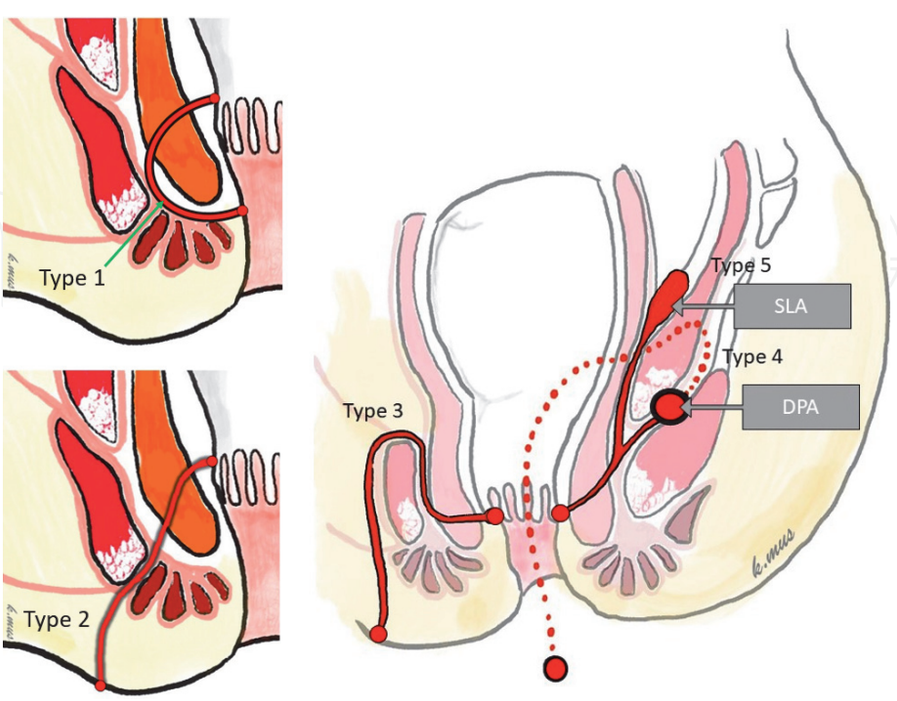

Figure 3.
Diagrammatic illustration of 5 types of natural patterns. SLA: Supralevator abscess. DPA: Deep post-anal abscess. Red dotted line represents the course of horseshoe pattern due to connection between deep post-anal space and ischioanal space/Infralevator space.

6.2 Controversies surrounding extra-sphincteric fistula

Park attributes extrasphincteric fistula to the following causes: secondary to a transphincteric fistula, trauma, specific anorectal disease and pelvic inflammation [5]. Eisenhammer's stated in both his initial series and final evaluation that extrasphincteric fistula was due to either iatrogenic probing or secondary causes such as pelvic sepsis, colonic diverticular diseases or inflammatory bowel disease [2, 6]. Garg's evaluation of more than 400 patients with anal fistula using MRI reported that there were no cases of extrasphincteric fistula in his series [12]. The most probable cause of extrasphincteric fistula: It is a combination of posterior high transphincteric fistula and high intersphincteric fistula situated posteriorly, resulting in both supra-levator collection and Infralevator collection. Incorrect drainage or probing of either can lead to a communication between the two collections across the levator ani [7]. Therefore, it is reasonable to conclude that extrasphincteric fistula does not fit into the natural pattern of cryptoglandular

	Eisenhammer's Classification	**Rojanasakul's Natural Patterns**
Group 1 – Intermuscular fistulous abscess and fistula		
Low:		
1	Posterior low intermuscular fistulous abscess and fistula	Intersphincteric and Low Transphincteric
2	Anterior low intermuscular fistulous abscess and fistula.	
3	Posterior low intermusculAr superficial ischiorectal, unilateral horseshoe, fistulous abscess and fistula. *	Posterior High Transphincteric
4	Anterior low intermusculAr superficial ischiorectal, bilateral horseshoe, fistulous abscess and fistula. Ω	Anterior High Transphincteric
High:		
1	High intermuscular fistulous abscess and fistula – mostly posterior	High Intersphincteric
2	High anovulvar intermuscular fistulous abscess and fistula – anterior. π	Anterior High Transphincteric
Group 2 – Intermuscular Transphincteric Ischiorectal fistulous abscess and fistula		
1	The Posterior Ischiorectal Horseshoe Fistulous Abscess and Fistula – bilateral Σ	Posterior High Transphincteric
2	The Anterior Ischiorectal Fistulous Abscess and Fistula – unilateral μ	Anterior High Transphincteric
Group 3 – Acute, non-cryptoglandular, non-fistulous abscess		Non-cryptoglandular diseases

Ω π μAnterior high transphincteric pattern can present as bilateral horseshoe, anovulvar tract or unilateral horseshoe. Bilateral anterior horseshoe pattern tends to have a lower internal opening compared to unilateral anterior horseshoe pattern [2, 6]. However, no other studies reported similar findings.
**Infection occurs in the clinical ischiorectal space.*
ΣInfection occurs in the infra-levator space.

Table 4.
Comparing current classification of natural patterns with Eisenhammer's updated description and classification in 1978 [6, 7].

infection. Its finding should alert surgeons of possibility of previous erroneous surgery or secondary sepsis originating from pelvis/abdomen [6].

6.3 Clinical application of the natural pattern and the role of adjunct imaging modalities

Understanding the pathogenesis and natural pattern helps in management of fistula-in-ano. Lessons from early publications showed that successful treatment of fistula-in-ano lies on the ability of surgeons to eradicate the source of infection, which is the infected anal crypt/gland and the intersphincteric abscess/tract [1, 2, 10, 19]. Recent publications further emphasized on eradicating secondary tracts or abscesses to prevent recurrences [15, 20, 21]. Therefore, objective clinical assessment should assist clinicians to:

a. Identify the internal opening & intersphincteric tract/abscess.

b. Identify the location of anorectal space involved.

c. Identify the external tract and secondary branches.

d. Ascertain the level of sphincter involved.

In the author's view, using the knowledge and classification of the Natural Patterns of Anal Abscess and Fistula [7], the above information can be actively sought after using a combination of clinical assessment and imaging modalities.

6.3.1 Clinical examination or examination under anesthesia

In cases of acute abscess, clinical examination generally elicits tenderness and fluctuation around perianal or ischioanal fossa. However, detailed assessment is usually informative with sedation, local or regional anesthesia. In high intersphincteric abscesses or Infralevator abscesses, tenderness is elicited on digital rectal examination at the anorectal ring. Examination under anesthesia may reveal pus discharge from internal opening upon insertion of anoscope. Perianal abscess is typical of type 1 (Intersphincteric) and type 2 (Low Transphincteric) patterns, and internal opening usually corresponds with the location of abscess. Ischioanal fossa abscess is the usual presentation of type 3 and 4 (high transphincteric) patterns. However, it should also be remembered that type 4 pattern produces Infralevator abscess, where internal opening is almost always posterior. Type 5 pattern produces high intersphincteric abscess and internal opening is usually posterior [6, 7].

In cases of chronic fistula, location of external opening and course of fistula tract should direct clinicians to the possible patterns. Low fistulas are clinically palpable as thickened fibrous cord extending from the external opening towards the infected anal crypt (internal opening). In high fistulas, tracts are usually not palpable subcutaneously. Digital examination may reveal chronic induration over the anorectal ring adjacent to lateral wall of rectum. External tracts usually runs deep and parallel with the anal canal on probing [6].

In cases where internal opening is not apparent, there are several techniques described to facilitate the identification of internal openings [6, 15].

a. Hard, board like changes to the deep surface of the internal sphincter usually represents the location of infected anal crypt.

b. Offending anal crypt retracts into a funnel on pulling the external tract.

c. Palpation of cord-like fibrous tract.

d. Internal opening probing: using hook or right-angled blunt tip forceps.

e. Gentle probing from external sinus: using small sized urethral catheter. Lacrimal probe is not advisable as it may cause false tracts.

f. Injection of dye (methylene blue solution) or water via external sinus.

g. Sensitivity of clinical examination in detecting the primary fistula tract is 68.7%, followed by 62.1% for secondary extension, and 59.7% for localizing internal opening [22]. Therefore, imaging is required as adjunct.

6.3.2 Imaging modalities as adjunct to classify the abscess/fistula pattern

Magnetic resonant imaging (MRI) and Endoanal ultrasound (EAUS) are the 2 most reliable imaging modality to delineate anorectal abscess and fistula. Conventionally, both modalities are equally sensitive in detecting anal fistula, but MRI has slightly superior specificity compared to EAUS [23]. MRI is not readily available in all institutions, whereas EAUS is operator dependant and requires significant learning curve.

Kim et al. in 2009 reported that 3 dimensional endoanal ultrasound is the preferred method, and use of hydrogen peroxide contrast may increase the detection rate of anal fistula. Sensitivity in detecting primary fistula tract is 84.4%, 81.8% for secondary extension and 84.2% for localizing the internal opening [22].

Recently, the interest in MRI has surged, in line with renewed efforts from various institutions to produce new classifications [16, 18]. With the availability of MRI scan, the fistula could be assessed in all three dimensions (axial, coronal and sagittal) [14]. The sensitivity and specificity of MRI in diagnosing fistula tracts were 98.8 and 99.7%, and in identifying internal opening were 97.7 and 98.6% respectively [14]. In addition, MRI is able to reclassify simple fistula based on clinical assessment to complex fistula, as it has the extra benefit of detecting additional secondary tracts, horseshoe tracts and supralevator extensions [18].

Clinical assessment and imaging adjunct helps clinicians to identify internal opening and intersphincteric tract/abscess, location of abscess, external tracts and secondary tracts. It also helps to define low and high fistula. This information will assist clinicians to recognize the type of anal fistula/abscess, thus allowing stratification and planning for appropriate surgical treatment. Surgical treatment will be discussed in the next segments.

7. Definitive surgical treatment in acute abscess stage

Eisenhammer wrote: '*single stage definitive surgery during the acute abscess phase is the correct timing to provide definite treatment and is associated with remarkably high healing rate, as long as the offending anal crypt is correctly identified and dealt with*.' [6] The idea of definitive surgery for fistulous anorectal abscess is not a recent concept, but one which never took off for the past few decades due to concerns of incontinence [24].

7.1 Benefits and disadvantages

Major guidelines recommend that immediate fistulotomy should be undertaken only by experienced surgeons, and a more conservative practice of simple abscess drainage in most circumstances is safest. Fistulotomy should only be done in low or simple fistulas [13, 25, 26]. This approach is known to be beneficial for 2 reasons: 1) Simple incision and drainage procedure, especially as an office procedure, allows quick return of function and daily living, thus avoiding prolong wound healing and hospital stay [2, 27]. 2) Less experienced surgeons may be confused with the exact anatomy of the fistula, or may cause iatrogenic injury and incorrect fistulotomy [6].

However, in the author's view, definitive surgery during the acute abscess stage has its advantage. Sharing Eisenhammer's view, the ideal management should be during the acute abscess stage [6]. Treating the fistula during acute abscess stage will reduce the number of chronic fistula formation [19]. A meta-analysis showed that definitive treatment leads to a risk reduction of 83% in recurrent fistula [24]. Furthermore, this is cost effective for health care facilities in general as the burden of treating chronic fistula is greatly reduced by reducing the need for re-operations.

7.2 Challenges

7.2.1 No standardized approach

Conventionally, several techniques were described in treating fistula during acute abscess stage. For perianal and ischioanal abscesses with identifiable fistula tract, fistulotomy, fistulectomy and cutting seton were used [19, 24–26]. Internal sphincterotomy was reported for intersphincteric abscess [6, 13]. Oliver reports performing immediate fistulotomy only for low transphincteric, intersphincteric and subcutaneous type, with recurrence rate of 5% [28].

7.2.2 Difficulty in localizing internal opening

A meta-analysis in 2006 analyzed 5 studies with a total of 405 patients showed that internal opening is not found in 10–17% of cases [24]. Inability to locate internal opening leads to higher recurrence rate as the source of infected anal crypt is not dealt with. Recurrence rate increased from 5–29% when internal opening was not found [28]. Imaging modalities are not readily available in cases of acute abscess.

7.2.3 Risk of incontinence

The same meta-analysis reported that sphincter-cutting procedures like fistulotomy and cutting seton during acute abscess is associated with 2-fold increase of risk of fecal incontinence to flatus and soiling. Severe incontinence rate was reported up ranging from 0 to 40%, although sample sizes for most studies were small [24].

7.3 Feasibility

The principles of treating acute fistulous abscess were laid down by McElwain:

1. Identification and excision of offending anal crypt [19] – position of infected gland and internal opening

2. Laying open the intermuscular abscess cavity [19] – drainage of intersphincteric space

3. Create a superficial external drainage for abscess beyond the external sphincter [19] – drainage of extrasphincteric abscesses

This author adds another 2 important principles:

1. Keeping wound open for drainage and to allow secondary healing.

2. Preservation of continence as best as possible.

In line with sphincter preservation as an important principle, a recent prospective study showed promising results utilizing sphincter preserving techniques for drainage and definitive treatment of fistulous anorectal abscess [29]. 86 patients with anorectal abscesses were operated by a single surgeon with intention of definitive single stage surgery and preservation of sphincter muscles. Using Rojanasakul's Natural Patterns of Anorectal Abscess and Fistula classification as guide, this study proposes 2 important steps: 1) Drainage of the perianal abscess at its most bulging point, 2) Exploration of the intersphincteric space to locate internal opening and intersphincteric tract/abscess. Internal opening was found in 95% of cases and intersphincteric tract was found in 77% of cases. Intersphincteric tract is treated with ligation as per LIFT procedure [4], whereas intersphincteric abscess were drained with suture closure of internal opening. Intersphincteric exploration wound is loosely closed with tube drains to promote drainage and secondary healing. This method reported overall healing rate of 83%, where the best results is obtained if intersphincteric tract is well formed. There were no cases of post-op incontinence. The remaining 17% non-healing group went on to elective surgery for definitive surgery of chronic fistula [29].

It is well known that in patients with anorectal abscesses undergoing simple drainage, 2/3 will progress to chronic fistula [27]. Definitive treatment of fistula may reduce the incidence of chronic fistula to an estimated below 30% based on recent evidence [28, 29]. With emerging sphincter preserving approaches, guided by our understanding of patterns of infection spread and imaging modalities, we are better equipped to approach acute fistulous abscesses with intention of single stage surgery.

8. Emerging concepts in managing cryptoglandular anal fistulas

Principle of surgical treatment of chronic fistula-in-ano should include the following:

1. Identification and removal of the source of sepsis in the intersphincteric space [1, 4, 6, 30].

2. Eradication of external and secondary tracts or abscesses [15, 20].

3. Maintaining the intersphincteric space open to heal by secondary intention [15].

4. Preservation of continence as best as possible [13, 25, 26].

5. An ideal surgical procedure should fulfill all 4 criteria above. Various surgical techniques have been described in literatures, ranging from sphincter cutting procedures to minimally disruptive biomaterials or novel techniques. In this segment, the author attempts to classify various surgical procedures into

categories, thereby assessing its suitability for specific fistula types and adherence to the above principles.

8.1 Sphincter cutting procedures for low fistula

Fistulotomy is the oldest, simplest, and most widely used procedure for anal fistulae. Most major guidelines recommend fistulotomy as a suitable and safe procedure for simple or low fistula [13, 25, 26]. This procedure involves laying open the entire fistula tract, together with the sphincter muscles it traverses, with adequate curettage to remove all granulation tissue tract [13, 31]. Marsupialization of the edges appears to speed up wound healing and reduces post-op pain and bleeding, but reported benefits were not significant [13]. Success rate is more than 90%, but incontinence rate is reported as high as 28% in elective setting [31]. According to Garg et al. in 2020, fistulotomy performed on low intersphincteric and low transphincteric fistulas (Garg's Classification grade 1 & 2) is safe. Post-operative mean continence score increased from 0.044 to 0.135, without reaching statistical significance. Low fistula is defined as involvement of less than 1/3 of external sphincter [18]. Failure of treatment or recurrence is associated with inappropriate selection of patients with high fistula or multiple tracts [31].

Internal sphincterotomy was first reported by Eisenhammer in 1966 to treat low intermuscular fistula (low intersphincteric type) which accounted for majority of cases in his series [2]. The principle is similar to fistulotomy, where the only difference is only lower half of internal sphincter muscles were laid open to eradicate intersphincteric sepsis. This technique gradually became synonymous with fistulotomy in various literatures as later studies showed that low intersphincteric type is far less common than low transphincteric type [7, 12]. In recent decade, ASCRS Practice Parameters introduced it as a treatment for intersphincteric fistulous abscess [13]. This technique is suitable for low intersphincteric type and does not cause incontinence [6].

8.2 Sphincter preservation or sphincter reconstruction procedures for both low and high fistula

Surgeons generally try to avoid sphincter cutting techniques. Ligation of Intersphincteric Tract (LIFT) procedure avoids sphincter cutting, using a small incision to explore the intersphincteric space to ligate and excise the intersphincteric tract [4] or to drain intersphincteric abscess [29]. Additional procedure in combination with LIFT such as closure of internal opening, excision of external tract and bioprosthetic mesh have been reported to improve outcomes [32]. A recent report from the original birthplace of LIFT procedure reported 10 year overall primary healing rate of 87.65%, and overall healing rate after re-operation was 99.2%. True recurrences were due to recanalization as a result of incorrect identification of intersphincteric tract. However, majority of recurrences were due to infection in the intersphincteric wound, leading to intersphincteric fistula which was easily treated by fistulotomy [20]. Other reports cited Crohn's disease, complex multiple fistulas and horseshoe pattern as a common cause of recurrences [33], stressing the importance of identification of secondary tracts and abscesses. In the author's view, LIFT procedure is best combined with additional curettage, drainage or excision of external fistula tracts/abscess. Recently, the original author reported slight modification where LIFT incision was loosely approximated and tube drain inserted to reduce intersphincteric space infection and promote secondary healing [29]. A recent meta-analysis and systematic review reported overall pooled success rate of 76.5% and incontinence rate of 1.4% [21].

Excision of fistula with immediate sphincter reconstruction is an alternative to reduce the risk of incontinence, at the same time completely eradicate intersphincteric and secondary tracts. It is suitable for both low and high transphincteric fistula. Procedure is similar as described in 8.1, with additional sphincter repair to restore continuity. Term as Fistulotomy or fistulectomy with primary sphincteroplasty (FIPS), Ratto reports 93.2% overall success rate, with a low morbidity rate [33]. Overall postoperative worsening continence rate was 12.4% mainly post-defecation soiling, without significant changes in anorectal manometry parameters [33]. In general, this technique produces higher success rate compared to LIFT procedure, albeit variations of techniques and terms used across institutions [34]. Incontinence is still a major concern, despite being much lower than fistulotomy alone. It is recommended in the German's S3 guideline but not in other major guidelines [26]. In the author's recent experience, this procedure produces excellent outcome in both low and high transphincteric chronic fistula, and extrasphincteric secondary (branching) tracts can be excised or curetted concurrently. However, in acute abscess stage, initial seton drainage is preferred prior to FIPS to reduce the risk of breakdown of sphincter repair [34].

8.3 Role of seton in complex fistula

Loose draining seton allows initial control of sepsis prior to definitive surgery to improves success rate. German S3 guideline used the term fibrosing seton [26]. It allows drainage of abscess and forms a thick fibrous fistula tract, which can be dealt with easily on the next elective surgery. Draining seton before LIFT shows no added benefits [32]. However, seton before fistulotomy and sphincter reconstruction showed benefits in downstaging high transphincteric to low transphincteric type [34]. From personal experiences, seton drainage can also be utilized to drain ischioanal/Infralevator collections with multiple external openings after debridement or curettage to prevent extensive wounds in the perineum.

8.4 Sphincter saving biomaterials and novel techniques

Many sphincter saving biomaterials and novel techniques surfaced in the last 4 decades to deal with complex fistula with wide variation of success rates across continents. Among those are anal fistula plug [35, 36], fibrin glue [26], laser procedures [37], Video Assisted Anal Fistula Tract Treatment (VAAFT) [38] and endoscopic clips (OTSC) [39]. Across the board, none of these procedures have reported very high success rate. This is likely due to the fact that most procedures, in their attempt to avoid cutting sphincters, only focus on the closure of internal opening and/or the fistula tract, but do not eradicate the intersphincteric sepsis and its secondary tracts. The author's opinion is that these procedures are highly specialized and are often based on selected specialized institutions. Therefore, usage of these techniques should be reserved to experts of the respective fields.

8.5 Approach for high intersphincteric fistula and extensions

Garg described an improved procedure in 2017 for high fistulas termed Transanal Opening of the Intersphincteric Space (TROPIS) [30]. High intersphincteric tracts and abscesses are typically difficult to reach via intersphincteric approach or conventional probing from external opening, and usually branching. TROPIS procedure allows lay open and drainage of these tracts into the anal canal, thus eradicating septic nidus at the high intersphincteric plane, which is usually posterior and was termed as the posterior deep space in the

previous segment 4.5. This is done through the internal opening and external sphincter is not cut. The external branching tracts in the ischiorectal fossa were curetted. The space is left open for secondary healing. In the initial prospective cohort of 61 patients, success rate was 84.6% with no significant changes in continence score. The series consist of a mixture of high transphincteric type (anterior and posterior) and high intersphincteric type [30]. Incision on the internal

Type of pattern	Suitable procedure	Intersphincteric sepsis eradication	Eradication of external and secondary tracts/ abscesses	Healing by secondary intention	Preservation of continence
1. Low Intersphincteric	Fistulotomy or Internal Sphincterotomy	Yes	NA	Yes	Yes
	FIPS	Yes	NA	NA	Yes
2. Low Transphincteric	Fistulotomy	Yes	Yes	Yes	Unpredictable
	FIPS	Yes	Yes	NA	Yes
	LIFT	Yes	Yes	**Mod**	Yes
3. Anterior High Transphincteric	FIPS*	Yes	Yes	NA	Yes
	LIFT	Yes	**Add**	**Mod**	Yes
4. Posterior High Transphincteric	FIPS	Yes	Yes	NA	Yes
	LIFT	Yes	**Add**	**Mod**	Yes
	TROPIS	Yes	**Add**	Yes	Yes
5. High Intersphincteric	TROPIS	Yes	Yes	Yes	Yes
6. Combination type 4 & 5	Combination: TROPIS + **CED**	Yes	**Add**	Yes	Yes
	Staged approach. TROPIS, draining seton and delayed LIFT or FIPS	Yes	Yes	Yes	Yes

CED: Short for closure of external sphincter defect. After lay open of intersphincteric tracts and abscesses, an attempt is made to close the defect where transphincteric tract traverses the external sphincter. This can be done transanally or via external opening wound.
Mod: Modification by loosely approximate incision with tube drains to allow drainage and secondary healing of intersphincteric wound [29].
Add: Additional procedures includes drainage of ischioanal/Infralevator abscess, curettage or excision of external tracts, insertion of drains to the ischiorectal space [15, 29, 30].
Seton: Use of loose draining seton for drainage, induce fibrosis to form thickened tract and allows downgrading of high to low transphincteric fistula [34].
NA: Not applicable.
**Caution in performing FIPS in anterior transphincteric fistula, especially in female patients where external sphincter is thin, lack of support anteriorly and risk injuring perineal body.*

Table 5.
Summary of appropriate surgical treatment for different types of fistula pattern based on the principles of surgical treatment. No single procedure is 100% successful, therefore our clinical judgment is important in deciding on additional procedures, combination, staged approaches or modification to achieve our goal.

sphincter is shown to be safe without worsening incontinence [2, 30, 40]. In author's personal experience, TROPIS procedure is an excellent approach for high intersphincteric type and posterior high transphincteric type, especially if transphincteric fistula is located at the puborectalis level. However, like LIFT procedure, combination with drainage, curettage or excision of external tracts is necessary to reduce recurrences.

8.6 Deciding on the best surgical approach

To achieve good outcomes for anal fistula surgery, the author concludes that; 1) Understanding of type and natural patterns of fistula is extremely important, 2) The 4 principles of surgical treatment should be adhered to as closely as possible, and 3) No one surgical technique is suitable for all types of fistula. Therefore, selecting the appropriate procedure is important and to our best knowledge, no guidelines or classifications so far outlines a complete treatment algorithm especially on complex fistulas. Based on this review of evidence and best clinical judgment of the author, **Table 5** below attempts to summarize reasonable treatment options available for different fistula types to guide surgeons, where combination of procedures, additional procedures or modification of procedures is preferred over single modality (refer to **Table 5**).

9. Conclusions

Revisiting the anatomy and pathogenesis facilitates us to understand the natural patterns of anorectal abscess and fistula. With this new idea, we are able to classify and stratify this disease according to level of complexity and sphincter involvement, thus selecting the appropriate tool to manage it. Definitive treatment in acute abscess stage is feasible if the principles are followed. Surgical options and strategies should be carefully selected to suite each pattern, while adhering to the principles of surgical treatment. Challenges in managing cryptoglandular fistula-in-ano are summarized in Appendix (**Table 6**). The proposed solution is carefully selected from the current review of evidence and the experience of a high-volume tertiary centre.

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Conflict of interest

The author declares no conflict of interest.

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Appendix

Challenges	Complications	Proposed solution
i. Confusion in classification	• Wrong diagnosis	Adapting classifications that allows clear delineation of patterns, stratification of severity and guides management [7, 12]
	• Wrong stratification into simple or complex	
ii. Incorrect delineation of pattern	• Wrong procedure	Combination of clinical assessment and imaging modalities: MRI, EAUS
	• Risk of recurrence and incontinence	
iii. Acute abscess	• Develop chronic fistula	McElwain's principle [19]
		Consider intersphincteric exploration [29]
iv. High fistula	• Difficult to delineate	Role of MRI [15]
	• High risk of incontinence if treated with sphincter cutting surgery	TROPIS procedure [30]
v. Multiple secondary tracts and abscesses	• Risk of recurrence if not completely treated	Role of MRI and natural patterns classification [7, 14]
	• Technically more demanding	Additional procedures: drainage, curettage, excision.
vi. Internal opening not found	• Risk of recurrence	Combination of clinical assessment and imaging modalities: MRI, EAUS
		Attempt closure of internal opening at its predicted site [29].

Table 6.
Challenges in managing fistula-in-ano, with summary of its complications and proposed solutions.

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