

Long term Outcomes of Surgical Treatment and Anatomical Characteristics of Acute and Chronic Cryptoglandular Anal Fistula Following Surgery

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Abstract

Background and Objective: Cryptoglandular anal fistula may recur after surgery, particularly when the fistula has complex anatomy. This study evaluated healing, recurrence, anatomical patterns, and factors associated with recurrence in patients treated during either the acute abscess or chronic fistula stage.

Materials and Methods: This retrospective cohort study included 320 adults who underwent surgery for cryptoglandular anal fistula at Rayong Hospital between 2012 and 2025. Patients were classified as having an acute anorectal abscess or a chronic anal fistula. The fistula anatomy was assessed using systematic anal fistula mapping, supplemented by magnetic resonance imaging in selected complex or recurrent cases. We tailored surgical treatment to fistula anatomy. We evaluated healing and recurrence-free survival using Kaplan–Meier analysis and assessed recurrence predictors using Cox proportional hazards regression.

Results: Among 320 patients, 142 had an acute abscess, and 178 had a chronic fistula. The median follow-up was 42 months (95% CI 33-50). Healing rates were higher in the acute group (97.2%) than in the chronic group (92.1%) (95% CI 1.0 - 11.2), $p < 0.017$. Recurrence occurred in 2.8% of the acute group and 7.9% of the chronic group (95% CI 0.2 - 9.9), $p < 0.041$. Estimated mean recurrence-free survival time was 145 months (95% CI 140.8 - 150) in acute and 127 months (95% CI 119.5 - 135.8) in chronic cases, $p < 0.01$. In the multivariable Cox model, high transsphincteric fistula was the only independent predictor of recurrence (adjusted HR 23.13, 95% CI 7.76-68.92; $p < 0.001$). No fecal incontinence was documented, although continence was assessed clinically rather than with a standardized score.

Conclusion: Anatomy-tailored surgical treatment was associated with high healing and relatively low recurrence rates in this cohort. High transsphincteric anatomy was strongly associated with recurrence. One-stage treatment during the acute abscess phase may be appropriate in carefully selected patients when the fistula anatomy can be clearly identified; however, these findings should be interpreted cautiously because of the retrospective, single-center study design.

Keywords: anal fistula, recurrence, healing, prognostic factors, anal fistula mapping

INTRODUCTION

Anal fistula (fistula-in-ano) is a common anorectal condition that results primarily from cryptoglandular infection, with an incidence of 5-12 per 100,000 population and a predominance in men^{1,2}. Acute anorectal abscess and chronic fistula are considered part of the same disease spectrum, with fistula formation reported in 15-60% of cases following abscess^{3,4}. Factors such as recurrent sepsis, secondary tracts, and

greater sphincter involvement are associated with increased risk of treatment failure^{3,5}. The principal aims of surgical management are to eradicate the fistula tract and preserve continence. Fistulotomy is generally recommended for simple fistulas, whereas sphincter-preserving techniques, including advancement flap and ligation of the intersphincteric fistula tract (LIFT), are preferred for complex cases^{2,6}. However, no single technique is universally effective, and recurrence

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remains a challenge, often related to missed secondary tracts or persistent infection³. Previous studies have reported a treatment failure rate of approximately 20%, particularly in patients with complex fistula anatomy⁷. Recent approaches have emphasized anatomical classification and fistula mapping to improve identification of the internal opening and secondary tracts^{3,8}. Fistula mapping defined tract anatomy and complexity, guided surgery, and provided variables for recurrence analysis. Although fistulotomy is effective for simple fistulas and sphincter-preserving procedures are used for complex disease, evidence regarding definitive one-stage treatment during the acute abscess phase remains limited. Long-term outcome data from Thailand are also scarce, and the clinical value of systematic anal fistula mapping for defining tract anatomy and predicting recurrence remains poorly established. Therefore, the primary objective was to determine the recurrence rate and predictors of recurrence after surgical treatment. The secondary objectives were to assess healing, compare outcomes between acute abscess and chronic fistula, and characterize fistula anatomy using systematic anal fistula mapping

MATERIALS AND METHODS

This retrospective cohort study followed STROBE recommendations and included patients who underwent surgery for anal abscess or cryptoglandular fistula-in-ano by a single colorectal surgeon at Rayong Hospital, a tertiary-care referral hospital in Thailand. The Human Research Ethics Committee of Rayong Hospital approved the study (E011/2568). We treated 320 patients between January 1, 2012, and December 31, 2025; the sample included all eligible patients during the study period, and we did not perform a formal sample size calculation. Inclusion criteria were adults (≥ 18 years) with acute anorectal abscess, chronic anal fistula, or recurrent fistula previously treated outside Rayong Hospital. Patients with fistulas secondary to Crohn's disease, tuberculosis, or malignancy were excluded. Patients were classified into two groups based on initial presentation: (1) acute anal abscess group, defined as patients presenting with anorectal abscess who underwent drainage, with fistula treatment performed in the same setting when identified; and (2) chronic anal fistula group, defined as patients with a draining fistula without active abscess who underwent elective surgery. For patients with multiple tracts, we used the most complex fistula for analysis. As shown in **Figure 1**

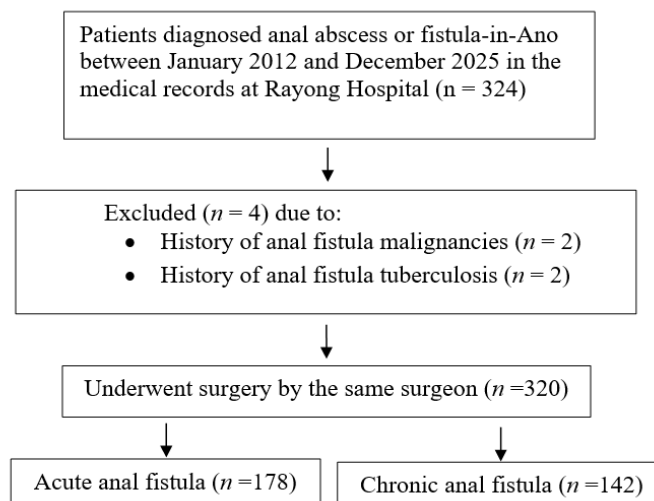


Figure 1 Flow diagram of patient selection

FISTULA CLASSIFICATION

Anal fistulas were classified according to their anatomical relationship to the anal sphincter complex, based on intraoperative findings supplemented by preoperative imaging. We selectively performed pelvic magnetic resonance imaging (MRI) in patients with recurrent or complex fistulas when tract delineation was uncertain on clinical examination. According to the American Society of Colon and Rectal Surgeons (ASCRS) guidelines, fistulas were categorized as simple (intersphincteric and low transsphincteric) or complex, which included high transsphincteric ($>30\%$ external sphincter involvement), suprasphincteric, extrasphincteric, and horseshoe fistulas⁹.

SURGICAL TECHNIQUES

Colorectal surgeons at Rayong Hospital treated all patients using standard techniques. The two main procedures were fistulotomy and ligation of the intersphincteric fistula tract (LIFT). Fistulotomy was performed for simple, low fistulas, involving tract division, curettage, and marsupialization, with healing by secondary intention. LIFT was used for transsphincteric or complex fistulas to preserve sphincter integrity, involving ligation and division of the tract within the intersphincteric space. We selected the procedure based on intraoperative assessment. Simple fistulas were generally treated with fistulotomy, whereas complex or high tracts were managed with LIFT. In patients presenting with acute abscess, a one-stage fistulotomy was performed if the internal opening was identified; otherwise, abscess drainage with seton placement was undertaken, followed by definitive surgery (Fistulotomy with marsupialization) at a later stage.

The FIPS procedure involves identifying the fistula tract and openings, performing fistulotomy or fistulectomy with sphincter division, removing the tract and infected tissue, and immediately reconstructing the sphincter with end-to-end absorbable sutures while ensuring external drainage.

A draining seton is a loose seton placed through the fistula tract to maintain continuous drainage and control sepsis while preserving the sphincter.

POSTOPERATIVE FOLLOW-UP

Patients were followed up at 4 weeks postoperatively and then until clinical healing was achieved, with further visits every 6-12 months or as needed for recurrent symptoms. Fecal incontinence was assessed based on clinical records and patient reports and classified as mild, moderate, or severe¹⁰. Standardized continence scoring was not consistently recorded. We contacted patients who missed follow-up by telephone.

DATA COLLECTION

Acute anal fistula or abscess was defined as a fistulous tract identified during examination under anesthesia and surgical treatment of an acute anorectal abscess, with active local infection or inflammation at the time of presentation^{3,8}.

Chronic anal fistula was defined as an established fistulous tract presenting with persistent or recurrent perianal drainage after spontaneous or surgical drainage of a previous anorectal abscess, with or without recurrent secondary abscess formation^{3,8}.

Recurrence was defined as the re-appearance of an abscess or fistulous drainage at or near the site of the original fistula after an initial period of healing of more than 6 months. This included cases of treatment failure where the fistula never fully healed (persistent fistula at 12 weeks was considered a failure) as well as cases of fistula that healed and then re-developed later^{7,11}.

Persistent non-healing was defined as continued drainage, an unhealed external opening or wound, recurrent abscess, or need for additional fistula treatment within 12 weeks after definitive surgery, without documented complete healing.

True recurrence was defined as the reappearance of fistulous drainage or an abscess at or near the original site after documented complete healing.

Healing: defined as complete closure of the fistula tract with no further drainage. For patients who underwent fistulotomy, "healing" referred to full epithelialization of the fistulotomy wound. For LIFT patients, healing meant the external opening had closed and the intersphincteric incision healed without signs of persistent fistula.

Exposure variables were prespecified and included patient-related, clinical, and anatomical factors. Patient-related variables comprised age, sex, body mass index (BMI), history

of raw food consumption (Laap, bile, Koi Kung, Koi Pla, Pla Ra), American Society of Anesthesiologists (ASA) classification, operative time, operative technique, length of hospital stay (LOS), and fecal incontinence. Comorbidities of interest included diabetes mellitus, hypertension, dyslipidemia, and obesity. Anatomical characteristics were assessed using a standardized Anal Fistula Map based on clinical examination (Goodsall's rule)^{8,12}, intraoperative findings, and magnetic resonance imaging (MRI), when available.

THE ANAL FISTULA MAPPING PROCEDURE

The fistula tract was mapped starting from the internal opening (IO) through the intersphincteric space (ITS), with subsequent assessment of its relationship to the external sphincter at different levels, classified as intersphincteric (IT), low transsphincteric (LT), or high transsphincteric (HT). The tract was then followed through the relevant anal spaces, including the perianal (PRA), postanal (PRN), deep postanal (DPA), ischioanal (ISA), ischiorectal fossa (IFL), and supralelevator (SPL) spaces, until it terminated at the external opening (EO). The distance from the external opening (EO) to the anal verge (AV) was then measured, and the shape of the fistula tract was finally assessed as straight, curved, or horseshoe.

The same surgical team obtained all data from standardized medical records and operative reports and recorded them consistently.

STATISTICAL ANALYSIS

All analyses were conducted using SPSS Statistics for Windows (version 20.0; IBM Corp., Armonk, NY, USA). Categorical variables are presented as frequencies and percentages and were compared between groups using the chi-square test. Continuous variables are presented as medians with interquartile range (IQR) or means with standard deviation and were compared between groups using the independent samples t-test or Mann-Whitney U test, as appropriate based on distribution. We used the Kaplan–Meier method to analyze time-to-event data for two key endpoints: fistula healing and fistula recurrence. For time to healing, we censored patients who had not achieved healing by the last follow-up at their last visit. For time to recurrence, we censored patients without recurrence at the last follow-up (and censored those lost to follow-up before a certain time similarly). We handled missing data using complete-case analysis. We used the log-rank test to compare survival curves between groups. To identify prognostic factors associated with outcomes, we performed univariate and multivariate analyses: for recurrence or healing rate as the outcome, we used Cox proportional hazards regression to estimate hazard ratios (HR) for potential risk factors. Variables with $p < 0.10$ in univariate

Cox analysis were considered for inclusion in a multivariate Cox model by using forward stepwise selection. A two-tailed $p < 0.05$ was considered statistically significant in all analyses. Where appropriate, results are presented with 95% confidence intervals.

Results

Patient Characteristics

The study included 320 patients. **Table 1** summarizes baseline characteristics and the extent of missing data. Both groups showed male predominance, with 83.3% in the acute anal fistula group and 81.5% in the chronic group. The mean age was comparable between groups (34.58 ± 11.32 years in the acute group vs. 35.57 ± 10.09 years in the chronic group; $p = 0.41$; mean difference -0.99 years, 95% CI -3.35 to 1.37). Similarly, mean body weight did not differ significantly (74.07 ± 18.25 kg vs. 72.55 ± 15.12 kg; $p = 0.429$; mean difference 1.52 kg, 95% CI -2.26 to 5.30). The median body mass index (BMI) was 24 kg/m^2 (IQR 22-29) in the acute group and 25 kg/m^2 (IQR 22-28) in the chronic group, with no statistically significant difference ($p = 0.292$). Obesity (BMI $\geq 25 \text{ kg/m}^2$) was observed in 40.8% of patients in the acute group and 48.9% in the chronic group, while morbid obesity (BMI $\geq 30 \text{ kg/m}^2$)

was present in 21.1% and 20.2%, respectively. More than half of patients reported consuming raw food (54.2% in the acute group vs. 60.1% in the chronic group), with no significant difference between groups ($p = 0.402$). Most patients were classified as ASA physical status II (60.6% vs. 63.5%). Regarding comorbidities, HIV infection was present in 8.45% of the acute group and 6.17% of the chronic group, while diabetes mellitus was observed in 7.04% and 5.6%, respectively. The median operative time was shorter in the acute group (35 minutes [IQR 25-40]) compared with the chronic group (45 minutes [IQR 35-60]). Likewise, the median length of hospital stay was shorter in the acute group (2 days [IQR 2-3] vs. 3 days [IQR 2-4]). Loss to follow-up occurred in 16.9% of patients in the acute group and 9.6% in the chronic group.

Natural Chronic Anal Fistula Patterns

For fistulas with an internal opening (IO) at 1 o'clock ($n=13$), all cases demonstrated the tract component in the intersphincteric space (ITS) (13, 100%). The fistula levels were intersphincteric (IT) in 3 cases (23.1%), low transsphincteric (LT) in 9 (69.2%), and high transsphincteric (HT) in 1 (7.7%). Extension into the perirectal/anogenital spaces was observed in

Table 1 Patients' demographic and clinical characteristics

Characteristic	Acute anal fistula (n = 142)	Anal fistula (n = 178)	Missing, n
Sex, n (%)			0
Male	119 (83.8)	145 (81.5)	
Female	23 (16.2)	33 (18.5)	
Age, years, mean $\pm$ SD	34.58 ± 11.32	35.57 ± 10.09	0
Weight, kg, mean $\pm$ SD	74.07 ± 18.25	72.55 ± 15.12	18
BMI, kg/m², median (IQR)	24 (22-29)	25 (22-28)	32
BMI category, n (%)			
<25 kg/m ²	66 (46.5)	77 (43.3)	
$\geq 25 \text{ kg/m}^2$	58 (40.8)	87 (48.9)	
Raw-food consumption, yes, n (%)	77 (54.2)	107 (60.1)	25
ASA physical status, n (%)			13
I	31 (21.8)	51 (28.7)	
II	86 (60.6)	113 (63.5)	
III	17 (12.0)	9 (5.1)	
Comorbidities, n (%)			7
Obesity (BMI $\geq 30 \text{ kg/m}^2$)	30 (21.1)	36 (20.2)	
HIV infection	12 (8.5)	11 (6.2)	
Diabetes mellitus	10 (7.0)	10 (5.6)	
Hypertension	4 (2.8)	15 (8.4)	
SLE	0	1 (0.6)	
Marfan syndrome	0	1 (0.6)	
Operative time, min, median (IQR)	35 (25-40)	45 (35-60)	24
Length of hospital stay, days, median (IQR)	2 (2-3)	3 (2-4)	4
Lost to follow-up, n (%)	24 (16.9)	17 (9.6)	0

Data are n (%), mean $\pm$ SD, or median (IQR), as indicated. Percentages use the total group denominator. Patients could have more than one comorbidity. Missing values are totals for both groups; group-specific missing BMI and ASA data are shown separately. No patient was classified as ASA IV. Raw food included Laap, bile, koi kung, koi pla, and pla ra. ASA, American Society of Anesthesiologists; BMI, body mass index; HIV, human immunodeficiency virus; IQR, interquartile range; SD, standard deviation; SLE, systemic lupus erythematosus.

Table 2 The anal fistula map pattern of chronic anal fistula

IO (O'clock)	N	ITS n (%)			Level n (%)			Anogenital spaces n (%)												External opening (o'clock) n (%)												Distance (EO to AV) (cm) mean ± SD	Tract shape n (%)					
								PRA			DPA			ISA			PRN																			I F L	S P L	
		a	c	t	IT	LT	HT	a	c	t	a	c	t	a	c	t	a	c	t	a	c	t	1	2	3	5	6	7	9	10	11		12	5,7	1,11	Straight	Curve	Horseshoe
1	13	0	0	13 (100)	3 (23.1)	9 (69.2)	1 (7.7)	0	0	9 (69.2)	0	0	0	0	0	0	0	0	6 (46.2)	0	0	10 (76.9)	2 (15.4)	0	0	0	0	0	0	0	1 (7.7)	0	0	0	1.92±0.6	13 (100)	0	0
2	9	0	0	9 (100)	0	9 (100)	0	0	0	9 (100)	0	0	0	0	0	0	0	0	6 (66.7)	0	0	1 (11.1)	8 (88.9)	0	0	0	0	0	0	0	0	0	0	0	2.77±0.8	8 (88.9)	1 (11.1)	0
5	9	0	0	9 (100)	0	8 (88.9)	1 (11.1)	0	0	8 (88.9)	0	0	0	0	0	4 (44.4)	0	0	1 (11.1)	0	0	0	1 (11.1)	0	8 (88.9)	0	0	0	0	0	0	0	0	0	2.22±0.6	7 (77.8)	2 (22.2)	0
6	80	0	2 (2.5)	78 (97.5)	6 (7.5)	54 (67.5)	20 (25)	0	0	49 (61.2)	0	0	20 (25)	0	0	35 (43.8)	0	0	8 (10)	0	0	0	3 (3.8)	6 (7.5)	23 (28.8)	8 (10)	24 (30)	5 (6.2)	1 (1.2)	5 (6.2)	0	5 (6.2)	0	2.66±1.2	41 (51.2)	34 (42.5)	5 (6.2)	
7	6	0	0	6 (100)	0	6 (100)	0	0	0	6 (100)	0	0	0	0	0	2 (33.3)	0	0	0	0	0	0	0	0	0	4 (66.7)	2 (33.3)	0	0	0	0	0	0	1.91±0.3	6 (100)	0	0	
11	13	0	0	13 (100)	0	10 (76.9)	3 (23.1)	0	0	9 (69.2)	0	0	0	0	0	0	0	0	10 (76.9)	0	0	0	0	0	0	0	0	0	1 (7.7)	12 (92.3)	0	0	0	0	3.00±1.0	13 (100)	0	0
12	48	0	0	48 (100)	5 (10.4)	36 (75)	7 (14.6)	0	0	36 (72)	0	0	0	0	0	0	0	0	33 (68.8)	0	0	17 (35.4)	6 (12.5)	2 (4.2)	0	0	0	0	0	0	18 (37.5)	4 (8.3)	0	1 (2.1)	2.85±1.8	44 (91.7)	3 (6.2)	1 (2.1)

Abbreviations: IO=Internal opening (1-12 o'clock), ITS=Intersphincteric space: abscess(a), cavity(c), tract(t), Level at anal sphincters: IT (intersphincteric), LT (low transsphincteric), HT (high transsphincteric). ITS = Intersphincteric space, PRA = Perianal space, PRN = Perineum space, DPA = Deep post-anal space, ISA = Ischioanal space, IFL = Infralelevator space, SPL = Supralelevator space, EO= external opening (1-12 O'clock), AV= anal verge, Distance = from EO to AV

the PRA in 9 cases (69.2%) and PRN in 6 (46.2%). The external opening (EO) was located at 1 o'clock in 10 cases (76.9%), 2 o'clock in 2 cases (15.4%), and 11 o'clock in 1 case (7.7%). The mean EO-to-anal verge (AV) distance was 1.92 $\pm$ 0.6 cm, and all tracts were straight (13, 100%).

For IO at 2 o'clock (n=9), all cases had the tract component in the ITS (9, 100%) and were classified as LT fistulas (9, 100%). PRA involvement was present in all 9 cases (100%), while PRN involvement was found in 6 (66.7%). The EO was located at 1 o'clock in 1 case (11.1%) and at 2 o'clock in 8 cases (88.9%). The mean EO-to-AV distance was 2.77 $\pm$ 0.8 cm. The tract was straight in 8 cases (88.9%) and curved in 1 (11.1%).

For IO at 5 o'clock (n=9), all cases demonstrated the tract component in the ITS (9, 100%). Eight fistulas (88.9%) were LT, and 1 (11.1%) was HT. Extension involved the PRA in 8 cases (88.9%), ISA in 4 (44.4%), and PRN in 1 (11.1%). The EO was located at 5 o'clock in 8 cases (88.9%) and at 2 o'clock in 1 (11.1%). The mean EO-to-AV distance was 2.22 $\pm$ 0.6 cm. Seven tracts (77.8%) were straight, and 2 (22.2%) were curved.

For IO at 6 o'clock (n=80), the ITS showed the tract component in 78 cases (97.5%) and the c component in 2 cases (2.5%). Regarding fistula level, 6 cases (7.5%) were IT, 54 (67.5%) were LT, and 20 (25.0%) were HT. Extension into the anogenital spaces involved the PRA in 49 cases (61.2%), DPA in 20 (25.0%), ISA in 35 (43.8%), and PRN in 8 (10.0%). The EOs were widely distributed, most commonly at 7 o'clock

in 24 cases (30.0%) and 5 o'clock in 23 (28.8%), followed by 6 o'clock in 8 (10.0%), 3 o'clock in 6 (7.5%), 9 o'clock in 5 (6.2%), 11 o'clock in 5 (6.2%), combined 5 and 7 o'clock openings in 5 (6.2%), 2 o'clock in 3 (3.8%), and 10 o'clock in 1 (1.2%). The mean EO-to-AV distance was 2.66 $\pm$ 1.2 cm. The tract was straight in 41 cases (51.2%), curved in 34 (42.5%), and horseshoe-shaped in 5 (6.2%).

For IO at 7 o'clock (n=6), all cases demonstrated the tract component in the ITS (6, 100%), and all were LT fistulas (6, 100%). PRA involvement was present in all cases (6, 100%), and ISA involvement was present in 2 cases (33.3%). The EO was located at 7 o'clock in 4 cases (66.7%) and at 9 o'clock in 2 cases (33.3%). The mean EO-to-AV distance was 1.91 $\pm$ 0.3 cm, and all tracts were straight (6, 100%).

For IO at 11 o'clock (n=13), all cases demonstrated the tract component in the ITS (13, 100%). Ten fistulas (76.9%) were LT, and 3 (23.1%) were HT. PRA involvement occurred in 9 cases (69.2%) and PRN involvement in 10 (76.9%). The EO was located at 11 o'clock in 12 cases (92.3%) and at 10 o'clock in 1 case (7.7%). The mean EO-to-AV distance was 3.00 $\pm$ 1.0 cm, and all tracts were straight (13, 100%).

For IO at 12 o'clock (n=48), all cases demonstrated the tract component in the ITS (48, 100%). The fistula levels were IT in 5 cases (10.4%), LT in 36 (75.0%), and HT in 7 (14.6%). Extension involved the PRA in 36 cases (72.0%) and PRN in 33 (68.8%). The EO was located at 11 o'clock in 18 cases (37.5%),

1 o'clock in 17 (35.4%), 2 o'clock in 6 (12.5%), 12 o'clock in 4 (8.3%), 3 o'clock in 2 (4.2%), and combined 1 and 11 o'clock openings in 1 (2.1%). The mean EO-to-AV distance was 2.85 ± 1.8 cm. Most tracts were straight (44, 91.7%), while 3 (6.2%) were curved and 1 (2.1%) was horseshoe shaped.

Overall, tract patterns varied by the location of the internal opening. IOs at 1, 2, 5, 7, and 11 o'clock were predominantly associated with straight tracts and external openings near the corresponding IO position, whereas the 6 o'clock IO demonstrated the greatest anatomical variability, including a broader distribution of external openings and higher proportions of curved and horseshoe tracts. In contrast, fistulas originating from the 12 o'clock IO were predominantly straight but frequently terminated at anterior external openings, particularly at the 11 and 1 o'clock positions.

Natural Anal Abscess Patterns

For IO at 1 o'clock (n=11), ITS consisted of abscess in 72.7% and tract in 27.3%. Fistula levels were IT 36.4%, LT 54.5%, and HT 9.1%, with PRA and PRN abscesses in 54.5% and 27.3%, respectively. All EOs were located at 1 o'clock, with a mean EO–AV distance of 2.18 ± 1.8 cm, and all tracts were straight.

For IO at 2 o'clock (n=7), all cases had ITS abscesses. Fistula levels were IT 57.1% and LT 42.9%, with PRA abscesses in 42.9%. All EOs were at 2 o'clock; the mean EO–AV distance was 1.21 ± 0.2 cm, and all tracts were straight.

For IO at 5 o'clock (n=17), ITS abscess and tract were

found in 94.1% and 5.9%, respectively. Fistula levels were IT (41.2%) and LT (58.8%), with PRA and ISA abscesses at 58.8% and 5.9%, respectively. EOs were located at 5 o'clock in 94.1% and at 3 o'clock in 5.9%. The mean EO–AV distance was 1.52 ± 0.9 cm; 94.1% of tracts were straight, and 5.9% were curved.

For IO at 6 o'clock (n=55), ITS abscesses and tracts were present in 96.4% and 3.6%, respectively. Fistula levels were IT 56.4%, LT 40.0%, and HT 3.6%, with PRA, DPA, and ISA abscesses in 41.8%, 3.6%, and 10.9%, respectively. EOs were most common at 6 o'clock (36.4%), followed by 5 and 7 o'clock (25.5% each), with less frequent openings at 9 o'clock (1.8%), 10 o'clock (1.8%), paired 3/9 o'clock (3.6%), and paired 5/7 o'clock (5.5%). The mean EO–AV distance was 1.40 ± 0.6 cm; tract shapes were straight 87.3%, curved 5.5%, and horseshoe 7.3%.

For IO at 7 o'clock (n=10), all cases had ITS abscesses. IT and LT fistulas were equally distributed at 50.0%, with PRA and ISA abscesses at 50.0% and 20.0%, respectively. All EOs were at 7 o'clock, with a mean EO–AV distance of 1.50 ± 0.7 cm, and all tracts were straight.

For IO at 11 o'clock (n=10), ITS abscess and tract were found in 90.0% and 10.0%. Fistula levels were IT 30.0% and LT 70.0%, with PRA and PRN abscesses at 40.0% and 10.0%, respectively. All EOs were located at 11 o'clock; the mean EO–AV distance was 1.30 ± 0.4 cm, and all tracts were straight.

For IO at 12 o'clock (n=32), ITS abscess and tract were present in 87.5% and 12.5%. Fistula levels were IT 21.9% and

Table 3 The anal fistula map pattern of anal abscess

IO (O'clock)	N	ITS n (%)		Level n (%)			Anogenital spaces n (%)															External opening (o'clock) n (%)															Distance (EO to AV) (cm) mean ± SD	Tract shape n (%)		
							PRA			DPA			ISA			PRN			I F L	S P L																				
		a	t	IT	LT	HT	a	c	t	a	c	t	a	c	t	a	c	t	a	c	t	1	2	3	5	6	7	9	10	11	12	3,9	5,7	Straight	Curve	Horseshoe				
1	11	8 (72.7)	3 (27.3)	4 (36.4)	6 (54.5)	1 (9.1)	6 (54.5)	0	0	0	0	0	0	0	0	3 (27.3)	0	0	0	0	11 (100)	0	0	0	0	0	0	0	0	0	0	0	0	2.18±1.8	11 (100)	0	0			
2	7	7 (100)	0	4 (57.1)	3 (42.9)	0	3 (42.9)	0	0	0	0	0	0	0	0	0	0	0	0	0	7 (100)	0	0	0	0	0	0	0	0	0	0	0	0	1.21±0.2	7 (100)	0	0			
5	17	16 (94.1)	1 (5.9)	7 (41.2)	10 (58.8)	0	10 (58.8)	0	0	0	0	0	1 (5.9)	0	0	0	0	0	0	0	0	0	1 (5.9)	16 (94.1)	0	0	0	0	0	0	0	0	0	1.52±0.9	16 (94.1)	1 (5.9)	0			
6	55	53 (96.4)	2 (3.6)	31 (56.4)	22 (40)	2 (3.6)	23 (41.8)	0	0	2 (3.6)	0	0	6 (10.9)	0	0	0	0	0	0	0	0	0	0	14 (25.5)	20 (36.4)	14 (25.5)	1 (1.8)	1 (1.8)	0	0	2 (3.6)	3 (5.5)	1.40±0.6	48 (87.3)	3 (5.5)	4 (7.3)				
7	10	10 (100)	0	5 (50)	5 (50)	0	5 (50)	0	0	0	0	0	2 (20)	0	0	0	0	0	0	0	0	0	0	0	10 (100)	0	0	0	0	0	0	0	1.50±0.7	10 (100)	0	0				
11	10	9 (90)	1 (10)	3 (30)	7 (70)	0	4 (40)	0	0	0	0	0	0	0	0	1 (10)	0	0	0	0	0	0	0	0	0	0	0	10 (100)	0	0	0	0	1.30±0.4	10 (100)	0	0				
12	32	28 (87.5)	4 (12.5)	7 (21.9)	25 (78.1)	0	22 (68.8)	0	0	0	0	0	0	0	0	7 (21.9)	0	0	0	0	7 (21.9)	7 (21.9)	0	0	0	0	0	0	11 (34.4)	6 (18.8)	1 (3.1)	0	1.79±0.7	31 (96.9)	1 (3.1)	0				

Abbreviations: IO=Internal opening (1-12 O'clock), EO = External opening (1-12 o'clock), ITS=Intersphincteric space: abscess(a), cavity(c), tract(t), Level at anal sphincters: IT (intersphincteric), LT (low transsphincteric), HT (high transsphincteric). ITS = Intersphincteric space, PRA = Perianal space, PRN = Perineum space, DPA = Deep post-anal space, ISA = Ischioanal space, IFL = Infralevator space, SPL = Supralevator space, AV= anal verge, Distance = from EO to AV

LT 78.1%, with PRA and PRN abscesses at 68.8% and 21.9%, respectively. EOs were distributed at 11 o'clock (34.4%), 1 and 2 o'clock (21.9% each), 12 o'clock (18.8%), and paired 3/9 o'clock (3.1%). The mean EO–AV distance was 1.79 ± 0.7 cm; 96.9% of tracts were straight, and 3.1% were curved.

Overall, anal fistula tracts were predominantly associated with intersphincteric abscesses and low fistula levels, with most tracts demonstrating a straight morphology. Internal openings at 1, 2, 5, 7, and 11 o'clock showed strong concordance with the corresponding external opening, whereas IO at 6 and 12 o'clock showed greater variation in tract direction and EO location. The 6 o'clock IO demonstrated the greatest anatomical complexity, including high transsphincteric fistulas, multiple external openings, and horseshoe tracts. The mean EO-to-anal verge distance was approximately 1-2 cm across all IO locations.

Fistula types differ between groups (Table 4). In the acute group (n=142), low-level fistulas predominated, mainly low transsphincteric (54.9%) and low intersphincteric (43.0%), with very few high transsphincteric cases (2.1%) and no high intersphincteric fistulas. In the chronic group (n=178), low transsphincteric fistulas were more common (74.2%), while low intersphincteric fistulas decreased (7.9%). High transsphincteric fistulas were more frequent (17.9%), and no high intersphincteric fistulas were observed.

Table 4 Anal fistula classification

Type	Acute anal fistula n= 142	Anal fistula n= 178
Low intersphincteric	61 (43%)	14 (7.9%)
Low transsphincteric	78 (54.9%)	132 (74.2%)
Anterior high transsphincteric	1 (0.7%)	11 (6.1%)
Posterior high transsphincteric	2 (1.4%)	21 (11.7%)
High intersphincteric	0	0

Operative Procedures According to Clinical Presentation and Fistula Complexity

We stratified patients by presentation and complexity (Figure 2). In acute simple fistula, fistulotomy with marsupialization predominated (94.3%), with minimal use of drainage seton (3.5%). In acute complex fistula, procedures were limited, mainly LIFT (0.7%) and drainage seton (1.4%). In the chronic group, fistulotomy with marsupialization remained common in simple cases (80.3%), while complex fistulas were more often managed with sphincter-preserving techniques, particularly LIFT (14.6%) and drainage seton (3.4%). Overall, fistulotomy with marsupialization was the main approach for simple fistulas in both groups, without a statistically significant difference ($p = 0.089$; 95% CI – 0.015 to 0.205).

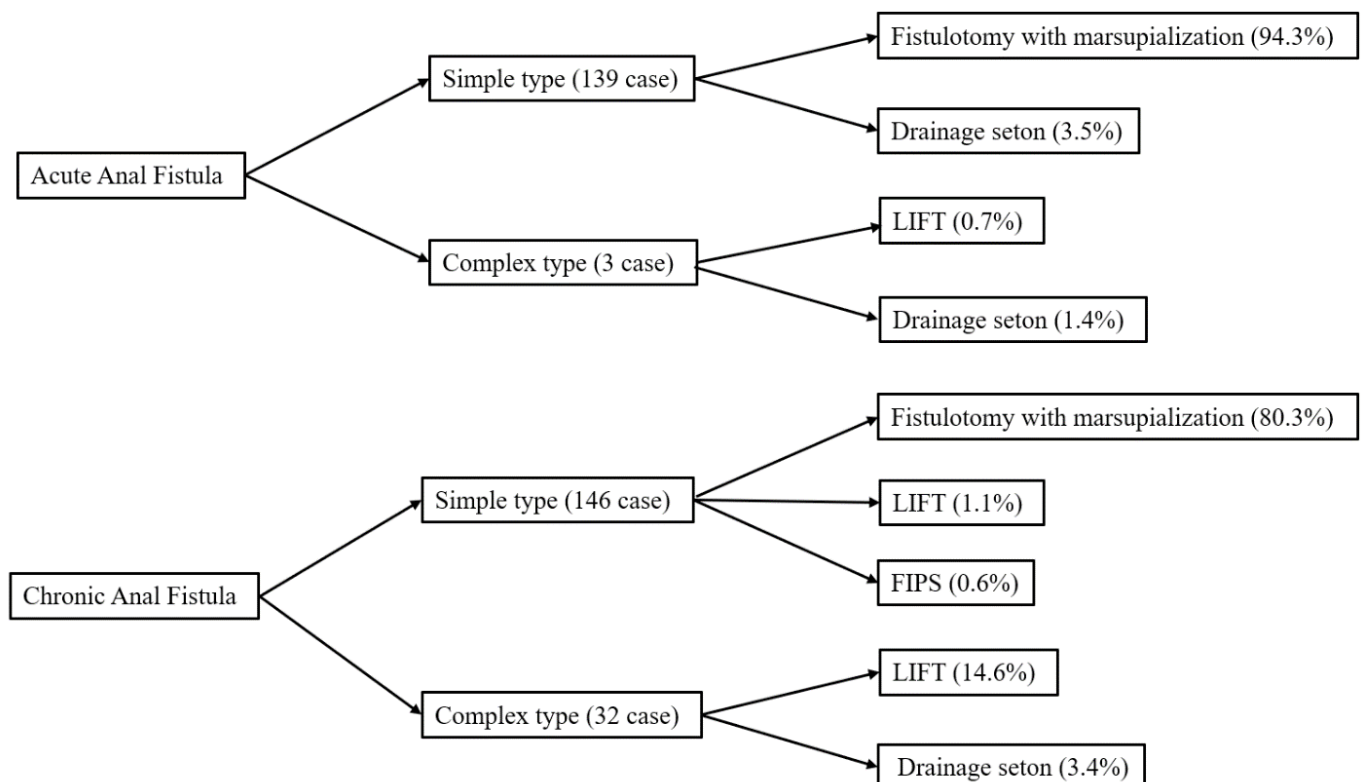


Figure 2 Operative procedures for anal fistula

Functional outcome

No major intraoperative complications occurred. Minor issues (urinary retention, minor bleeding) were managed conservatively, with no pelvic sepsis. We observed no fecal incontinence; only a few patients reported slight perianal dampness.

Healing Outcomes

We followed all patients until healing or the end of the study. Median follow-up was 42 months (95% CI 33-50 months). Median follow-up was 48 months (95% CI 30 - 65 months) in the acute group and 40 months (95% CI 29 - 50 months) in the chronic group. Healing rates were higher in the acute group (97.2%) than in the chronic group (92.1%) (95% CI 1.0 - 11.2), $p < 0.017$. As shown in **Table 5**

Recurrence Outcomes

Recurrence occurred in 2.8% of the acute group and 7.9% of the chronic group (95% CI 0.2-9.9), $p < 0.041$, and recurrence - free survival was significantly higher in the acute group ($p = 0.043$, log - rank), as shown in **Figure 3**. Estimated mean recurrence-free survival time was 145 months (95% CI 140.8 - 150) in the acute group and 127 months (95% CI 119.5 - 135.8) in the chronic group, $p < 0.01$. In recurrent cases, the acute group received curettage (1), fistulotomy (2), and fistulotomy with seton (1), while the chronic group underwent curettage (8), re-LIFT (2), fistulotomy (3), and fistulotomy with sphincteroplasty (1). All recurrent cases achieved complete healing after reoperation (100%), with no further recurrence.

Table 5 Healing and recurrence outcomes in acute and chronic anal fistula

Outcome	Acute anal fistula	Anal fistula	Between-group comparison	p-value
Median follow-up, months (95% CI)	48 (30-65)	40 (29-50)	-	-
Healing rate, %	97.2	92.1	Difference: 6.2 percentage points (95% CI 1.0 - 11.2)	0.017
Recurrence rate, %	2.8	7.9	Difference: 5.0 percentage points (95% CI 0.2 - 9.9)	0.041
Estimated means recurrence-free survival, months (95% CI)	145 (140.8 - 150.0)	127 (119.5 - 135.8)	18 months longer in the acute group	<0.01

Prognostic Factor Analysis

In univariate analysis, recurrence was significantly associated with high transsphincteric fistula (HR 23.37, 95% CI 8.41- 64.92, $p < 0.001$), deep post-anal space involvement (HR 15.05, 95% CI 5.59 - 40.55, $p < 0.001$), ischioanal extension (HR 4.86, 95% CI 1.91 - 12.32, $p = 0.001$), and curved tracts (HR 6.30, 95% CI 2.49 - 15.91, $p = 0.001$). Chronic fistula showed borderline significance (HR 2.98, 95% CI 0.98-9.06, $p = 0.054$), while age, sex, BMI >25, and raw food consumption were not significant.

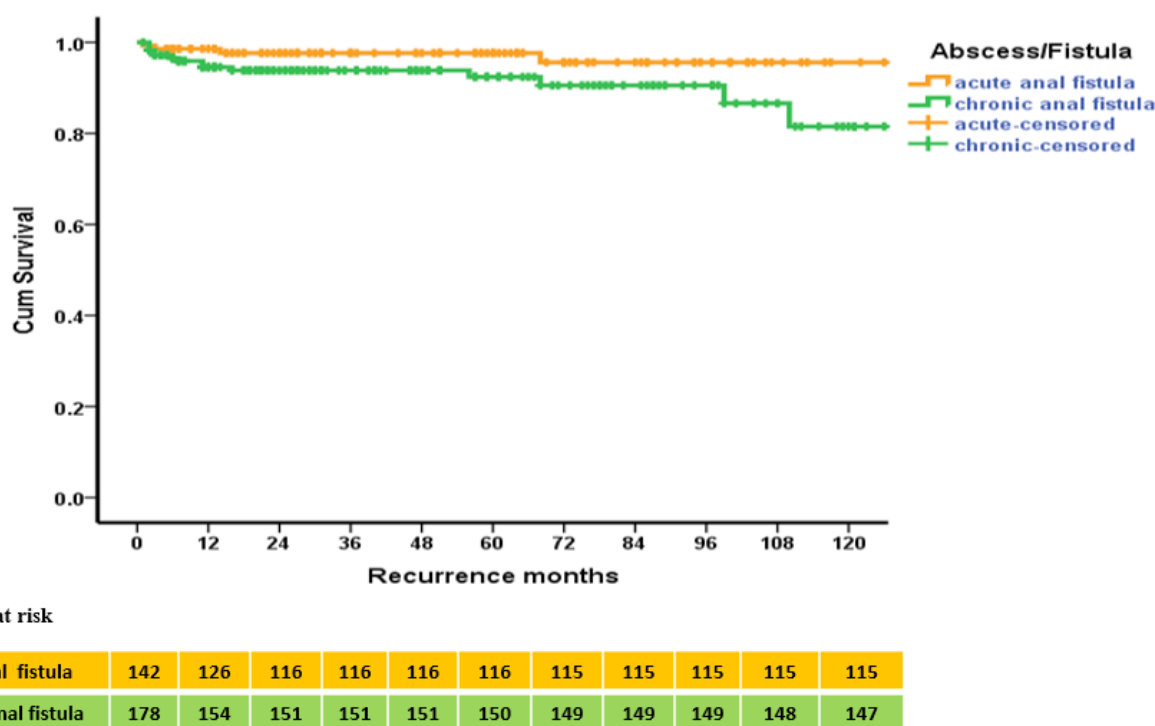


Figure 3 The Kaplan-Meier estimate of recurrence-free survival

In multivariate analysis, only high transsphincteric fistula remained an independent predictor of recurrence (adjusted HR 23.13, 95% CI 7.76 - 68.92, $p < 0.001$). As shown in **Table 6**. The high HR likely reflects greater anatomical complexity. However, the wide 95% CI and small number of recurrence events indicate limited precision, so the finding should be interpreted cautiously and confirmed in larger studies

Complete case analysis

Complete-case analysis retained 16 recurrence events, including 288 patients for BMI and 295 for raw-food consumption. Missing data affected only the univariable analyses because these variables were not included in the multivariable model. The log-minus-log plot showed that the curves for low and high transsphincteric fistulas were approximately parallel and did not clearly intersect, suggesting that the proportional hazards assumption was reasonably satisfied. High transsphincteric fistula remained the only significant predictor of recurrence (HR 43.95, 95% CI 11.84-163.16; $p < 0.001$), confirming a consistent direction of effect.

DISCUSSION

This study summarizes surgical outcomes for acute and chronic anal fistulas at Rayong Hospital, demonstrating success rates and risk factors consistent with both international literature and prior Thai tertiary-care studies.

Healing and recurrence

In this study, acute anal fistula showed a healing rate of 97.2% and recurrence of 2.8%, outperforming prior reports (healing 66.3-79.7%, recurrence 20.9-33.7%)¹³⁻¹⁷, likely due to the predominant use of fistulotomy with marsupialization rather than incision and drainage. Chronic fistula demonstrated a healing rate of 92.1% and recurrence of 7.9%, compared with previous studies (healing 79.4-87.5%, recurrence 12.5-20.6%)^{2,7,18,19}. Median time to recurrence was 8.5 months (IQR 1.5-54.5) in acute cases and 9 months (IQR 2.75-59) in chronic cases, longer than some international reports 3.2 months (IQR, 2.1-4.6)^{13,15,16}, with most recurrences occurring within 6-24 months^{2,7,17-19}, supporting at least 2-year follow-up⁷.

ACUTE ABSCESS VS CHRONIC FISTULA MANAGEMENT

Historically, acute anorectal abscess has been treated with incision and drainage (I&D) alone, with delayed fistula surgery due to concerns about operating in infected tissue. However, increasing evidence supports definitive treatment during the acute stage when feasible³. In this study, 97.7% of acute cases underwent fistulotomy with marsupialization, achieving a low recurrence rate of 2.8% and a high healing rate of 97.2%. These outcomes are consistent with a meta-analysis reporting a recurrence rate of 3.7% for fistulotomy with drainage (RR 0.13, 95% CI

Table 6 Prognostic factors associated with fistula recurrence

Variables	Univariate HR (95% CI)	p-value	Adjusted HR (95% CI)	p-value
Age, years	1.009 (0.965-1.054)	0.703	-	-
BMI, kg/m²				
<25	Reference	-	-	-
≥25	1.950 (0.718-5.297)	0.190	-	-
Sex				
Male	Reference	-	-	-
Female	1.440 (0.470-4.416)	0.523	-	-
Raw food consumption				
No	Reference	-	-	-
Yes	1.387 (0.502-3.832)	0.529	-	-
Anal fistula type				
Acute	Reference	-	-	-
Chronic	2.980 (0.980-9.060)	0.054	-	-
Transsphincteric level				
Low	Reference	-	Reference	-
High	23.373 (8.414-64.924)	<0.001	23.126 (7.760-68.921)	<0.001
Deep postanal space involvement				
No	Reference	-	-	-
Yes	15.050 (5.589-40.549)	<0.001	-	-
Ischioanal space involvement				
No	Reference	-	-	-
Yes	4.857 (1.914-12.322)	<0.001	-	-
Tract shape				
Straight	Reference	-	-	-
Curved	6.297 (2.493-15.907)	<0.001	-	-

0.07-0.24)²⁰. Importantly, outcomes were not inferior to delayed surgery, and many patients were successfully treated in a single procedure, avoiding reoperation. This approach is consistent with the concept that anal abscess and anal fistula represent different stages of the same disease process³. In this cohort, one-stage treatment during the acute abscess phase was associated with high healing and low recurrence. However, because this was a retrospective observational study, these findings do not establish that one-stage treatment is superior to delayed surgery. Treatment selection depended on intraoperative anatomy: patients with clearly identified, low-risk tracts were more likely to undergo immediate fistulotomy, whereas unclear or complex fistulas were managed with drainage, seton placement, and delayed definitive surgery. This confounding by indication may partly explain the favorable outcomes in the one-stage group. Therefore, one-stage treatment may be considered in carefully selected patients when the tract and internal opening are clearly defined, but prospective comparative studies are needed before broader recommendations can be made. Regarding functional outcomes, previous studies have reported low incontinence rates of 2.8% in acute cases¹⁶, with no significant difference in long-term incontinence (RR 3.06, 95% CI 0.7 - 13.45)²⁰. In chronic fistula, mean Wexner scores range from 0-3^{2,7,19}. In the present study, no patients developed fecal incontinence in either group; only occasional mild perianal dampness was reported, indicating favorable functional results alongside high healing rates.

The anal fistula map pattern

Rojanasakul's classification was applied for its practical role in guiding surgical decision-making and facilitating communication among clinicians, surgeons, and radiologists⁸. In this study, fistula mapping using operative findings and imaging was performed in all patients, with successful identification of the internal opening in 100%, a key factor associated with healing and prevention of recurrence^{3,18}. Acute anal fistulas were predominantly low-level (low intersphincteric and low transsphincteric), whereas chronic fistulas showed a higher proportion of high transsphincteric tracts, indicating greater complexity. This pattern is consistent with prior studies showing progression from intersphincteric origin to more complex transsphincteric disease over time²¹. High transsphincteric fistulas are considered complex and often require sphincter-preserving techniques to reduce incontinence risk²². Overall, these findings support that increasing chronicity is associated with greater anatomical complexity, impacting surgical planning and outcomes. At Rayong Hospital, MRI for anal fistula mapping was introduced in 2022 and utilized in 36 patients (20.2%), primarily in chronic or complex cases. MRI is particularly valuable in suspected high transsphincteric or recurrent fistulas, with reported accuracy

of 92.5% and sensitivity of 93.8%²³, and has been associated with reduced recurrence rates⁵. In this study, recurrence was lower in patients who underwent MRI (42.8%) compared with those who did not (57.1%). Goodsall's rule was applied during preoperative and intraoperative assessment, with an accuracy of approximately 71.6-72%²³, while MRI served as an adjunct tool in selected cases. Nevertheless, MRI showed a missed diagnosis rate of 19.44% and an inconclusive-interpretation rate of 25% in the present study. This relatively high proportion may reflect the early phase of MRI implementation at our institution and variations in radiological interpretation during the initial adoption period. Overall, comprehensive fistula mapping - combining clinical assessment, Goodsall's rule, and selective MRI - enhances anatomical delineation, improves surgical planning, increases cure rates, reduces recurrence, and facilitates sphincter preservation. This approach contributes to better functional outcomes, reduced morbidity, and improved patient counseling and surgical confidence.

Comparison of Surgical Techniques

In this study, fistulotomy was predominantly performed for simple fistulas (intersphincteric and low transsphincteric) and achieved high primary cure rates of 97.7% in the acute group and 97.2% in the chronic group. These outcomes are comparable to LIFT results reported by Songphol Malakorn (91%)¹¹. Additionally, fistulotomy required significantly shorter operative time (17.8 ± 11.38 min vs 40.9 ± 16.75 min for LIFT; $p < 0.01$)^{24,25}, reflecting its technical simplicity in appropriately selected cases. In this study, LIFT was mainly reserved for high transsphincteric fistulas, with a healing rate of 68.8%, within the reported range of 57-83%^{6,7}. Staged fistulotomy with seton achieved 83.3% healing, comparable to 85% in previous studies⁷. The relatively higher recurrence observed after LIFT likely reflects greater anatomical complexity and technical factors, including accurate tract identification and secure ligation^{3,6}. Importantly, repeat surgery resulted in 100% healing in all patients in this study, consistent with prior Thai studies reporting 99.2-100%^{6,11}, highlighting the importance of careful reassessment and tailored surgical management in recurrent disease.

Prognostic factors

Fistula complexity was the strongest predictor of recurrence, with high transsphincteric fistulas associated with a markedly increased risk (adjusted HR 23.13, 95% CI 7.76 - 68.92; $p < 0.01$), consistent with previous studies reporting HR 4.74 - 4.81^{7,18}. This emphasizes that patients with complex fistulas require careful counseling regarding recurrence risk and closer postoperative follow-up. The median time to recurrence was 8.5-9 months in both groups, longer than prior reports in

acute fistula (3.2-7 months)^{16,17}, while most chronic recurrences occurred within 24 months^{2,7}. These findings support a follow-up period of at least 2 years to ensure adequate detection of recurrence. Patient-related factors were not significant in multivariate analysis, likely due to the small sample size and low event rate. However, univariate analysis suggested possible associations with sex, BMI >25, and raw food consumption. Notably, comorbidities were common, including obesity (60%), raw food consumption (57.5%), HIV infection (20.9%), and diabetes (18%). Previous studies have identified BMI >30 and diabetes as significant risk factors for recurrence^{6,19}, while broader evidence also highlights obesity (BMI >25), high salt intake, spicy or greasy food consumption, diabetes, smoking, and heavy alcohol use as contributors to fistula development¹. These findings suggest the need for further investigation in larger case – control studies or prospective studies.

Clinical and practical implications

This study's findings have several key clinical implications. Accurate fistula mapping is essential at both initial and intraoperative assessment, using Goodsall's rule and adjunct imaging (MRI, endoanal ultrasound, EUA) in complex cases to improve identification of the tract and internal opening²³. A one-stage approach in selected anorectal abscess patients may shorten disease duration and reduce recurrence without increasing complications³. However, when inflammation obscures anatomy, simple drainage with delayed definitive surgery or seton placement for 8-12 weeks is recommended to allow tract maturation and prevent false tract formation⁶. Tailor surgical management to fistula complexity. Fistulotomy remains the gold standard for simple fistulas, with healing rates of approximately 95-98%^{2,7,20}, whereas sphincter-preserving techniques such as LIFT are preferred for complex fistulas, achieving success rates of around 70-90% with low morbidity^{6,7}. Even after failure, repeat or alternative procedures can still provide favorable outcomes^{6,11}. Modifiable risk factors - including obesity, diabetes, HIV infection, and raw food consumption - should be addressed. Because most recurrences occur within the first 2 years (approximately 80-90%)^{2,7,17-19}, regular follow-up every 4-6 months is recommended for early detection and optimal management.

Generalizability (external validity): The findings may be generalizable to patients with cryptoglandular anal fistula treated in similar tertiary-care settings, particularly where experienced colorectal surgeons perform management guided by anatomical fistula mapping. The favorable outcomes observed likely reflect consistent surgical decision-making within a specialized setting. However, caution is warranted when extrapolating these results to other healthcare environments, such as primary or secondary care centers, where differences in surgical expertise, resources,

and access to imaging (e.g., MRI) may affect outcomes. Additionally, as this was a single-center study conducted in Thailand, variations in patient characteristics and healthcare systems may limit broader applicability. Further multicenter or prospective studies are needed to confirm these findings.

Limitations: Potential sources of bias include selection bias due to retrospective design and surgeon-based decision-making, as well as information bias from incomplete medical records. This study also had a moderate sample size and low event rate. MRI was unavailable in the early phase; therefore, fistula assessment relied on Goodsall's rule and examination under anesthesia using lacrimal probes and water injection. Anal manometry was not performed, and continence was evaluated clinically¹⁰.

Future perspectives: Emerging techniques such as video-assisted anal fistula treatment (VAAFT)²⁶, fistula laser closure (FiLaC)²⁷, and more recently, intra-anal fistulotomy with fistula opening closure (IFOC)²⁸ aim to achieve high cure rates with minimal risk of incontinence. Although this study did not evaluate these approaches, they should be critically compared with established procedures such as fistulotomy and LIFT. This study indicates that, even without advanced technologies, meticulous application of conventional techniques can still provide satisfactory outcomes in most patients. Anal fistula mapping remains a key concept in modern management. Rojanasakul's classification offers a practical framework for identifying the internal opening and guiding appropriate surgical strategies for different fistula patterns⁸. Incorporating this approach into routine practice may help standardize treatment and improve outcomes. Looking forward, advances in imaging and the integration of artificial intelligence and machine learning may further enhance diagnostic accuracy, risk prediction, and support increasingly precise and personalized treatment strategies.

CONCLUSION

Anatomy-tailored surgery was associated with high healing and low recurrence rates in both acute and chronic cryptoglandular anal fistula. High transsphincteric anatomy was strongly associated with recurrence, while one-stage acute management appeared feasible in carefully selected patients. However, these findings should be interpreted cautiously because of the retrospective single-center design, low number of recurrence events, possible treatment-selection bias, and variable MRI availability during the study period. Larger prospective multicentre studies are needed to confirm these findings. A follow-up period of at least two years is recommended to adequately assess long-term outcomes.

What is already known on this topic

Implications based on external evidence: Previous literature supports careful anatomical assessment, selective MRI or endoanal ultrasound for complex or recurrent fistulas, and longer follow-up because some recurrences occur late. These recommendations are consistent with, but were not directly tested by, the present study.

What this study adds

Anatomy-tailored surgery was associated with high healing and low recurrence rates. High transsphincteric fistula was the only independent predictor of recurrence, although the estimate was imprecise because of the small number of recurrence events. One-stage acute management appeared feasible in selected patients, but this observational study cannot establish superiority over delayed treatment.

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