Thesis

Evaluation of Perianal Abscess Management in Infants

submitted by

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Graz, 29.04.2026 *Sandro Schifferl m.p.*

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Zusammenfassung

Hintergrund

Perianale Abszesse stellen die häufigste erworbene anorektale Erkrankung im Säuglingsalter dar und treten überwiegend in den ersten Lebensmonaten auf. Sie gehen mit lokalen Entzündungszeichen, Schmerzen und in seltenen Fällen mit systemischen Symptomen einher. Ziel dieser Diplomarbeit war es, konservative und chirurgische Therapieansätze bei perianalen Abszessen im Säuglingsalter zu vergleichen und deren Einfluss auf Behandlungsdauer, Rezidivrate und Komplikationen zu evaluieren.

Methodik

Im Rahmen einer retrospektiven Single-Center-Studie wurden alle Säuglinge unter 12 Monaten analysiert, die zwischen 2005 und 2022 an der Universitätsklinik für Kinder- und Jugendchirurgie Graz wegen eines perianalen Abszesses behandelt wurden (n=145). Die Patient:innen wurden anhand der primären Therapieform in eine erfolgreich konservativ behandelte Gruppe, eine primär chirurgisch behandelte Gruppe und eine Gruppe mit konservativem Therapieversagen (sekundäre Operation) eingeteilt. Zusätzlich wurden Rezidive, Lokalisationen sowie der Einfluss lokaler und systemischer Antibiotikatherapien statistisch ausgewertet.

Ergebnisse

Das Studienkollektiv zeigte eine deutliche männliche Dominanz (n=139; 95,9%) bei einem mittleren Alter bei Erstvorstellung von 4,1 ± 2,8 Monaten. Die Ergebnisse belegen eine signifikant kürzere mediane Behandlungsdauer bei erfolgreicher konservativer Therapie (3 Tage) im Vergleich zur primär chirurgischen Gruppe (8 Tage; p=0,007). Ein Therapiewechsel von primär konservativ auf operativ (konservatives Therapieversagen) trat bei 29 Patient:innen (20%) auf, was mit einer deutlich verlängerten mittleren Behandlungsdauer von 97,1 ± 209,9 Tagen einherging.

Die Rezidivrate war in der Gruppe des konservativen Therapieversagens signifikant höher (31%) als im restlichen Kollektiv (9,5%, p=0,029). Innerhalb der operierten Patient:innen erwies sich die Fistulotomie als überlegen: Eine frühzeitige Fistelsanierung (≤ 14 Tage nach Erstvorstellung) verhinderte Rezidive vollständig

(0%), während einfache Inzisionen in diesem Zeitraum eine Rezidivrate von 27,3% aufwiesen (p=0,042). Weder die Art der Antibiotikagabe (lokal vs. systemisch; p=0,225) noch die Dauer der Antibiose (p=0,083) hatten einen signifikanten Einfluss auf die Rezidivrate oder die Heilungsdauer.

Schlussfolgerung

Zusammenfassend zeigt die Studie, dass eine primär konservative Therapie eine effektive und sichere Option darstellt, sofern ein rasches Ansprechen erfolgt. Bei ausbleibender Besserung innerhalb von 7–10 Tagen sollte jedoch die frühzeitige Eskalation zur chirurgischen Fistelsanierung innerhalb eines „Window of Opportunity“ von 14 Tagen angestrebt werden, um Rezidive und Chronifizierungen zu vermeiden. Die routinemäßige Antibiotikagabe bietet keinen messbaren Vorteil gegenüber der gezielten chirurgischen Sanierung.

Abstract

Background

Perianal abscesses represent the most frequent acquired anorectal pathology in infancy, predominantly occurring during the first months of life. They typically present with local signs of inflammation, pain, and rarely, systemic symptoms. The aim of this diploma thesis was to compare conservative and surgical management strategies for infantile perianal abscesses and to evaluate their impact on overall treatment duration, recurrence rates, and clinical complications.

Methods

This retrospective single-center study analyzed all infants under 12 months of age treated for perianal abscesses at the Department of Paediatric and Adolescent Surgery, Medical University of Graz, between 2005 and 2022 (n=145). Patients were stratified based on their definitive clinical trajectory into a successful conservative group, a primary surgical group, and a conservative treatment failure group (requiring secondary surgical escalation). Additionally, recurrence rates, anatomical localizations, and the impact of local versus systemic antibiotic therapy were evaluated utilizing robust statistical analyses.

Results

The study cohort exhibited a pronounced male predominance (n=139; 95.9%) with a mean age at initial presentation of 4.1 ± 2.8 months. The clinical outcomes demonstrated a significantly shorter median treatment duration following successful conservative management (3 days) compared to the primary surgical group (8 days; p=0.007). A shift from initial conservative to surgical therapy (conservative failure) was necessary in 29 patients (20%), resulting in a prolonged mean treatment duration of 97.1 ± 209.9 days.

Furthermore, the recurrence rate was significantly higher in the conservative failure cohort (31%) compared to the rest of the study population (9.5%, p=0.029). Among the surgically managed patients, early definitive fistulotomy (performed ≤ 14 days post-presentation) completely prevented recurrent disease (0%), whereas simple incision and drainage during the same early timeframe yielded a 27.3% recurrence rate (p=0.042). Neither the route of antibiotic administration (local vs. systemic;

p=0.225) nor the duration of the antibiotic therapy (p=0.083) significantly influenced the recurrence risk or the total healing time.

Conclusion

In summary, this study demonstrates that primary conservative management is an effective and safe first-line option, provided there is a rapid clinical response. However, in the absence of significant improvement within 7 to 10 days, early surgical escalation utilizing definitive fistulotomy within a 14-day "window of opportunity" should be strictly pursued to eradicate the cryptoglandular source, thereby preventing chronification and recurrent disease. Routine antibiotic administration offers no measurable clinical benefit over targeted surgical source control.

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1. Introduction

1.1. Background

Of all acquired anorectal diseases in children, perianal abscesses occur most frequently in infancy and can also affect infants after only a few weeks of life. It is a very unpleasant disease that can be accompanied by pain and inflammation, depending on the duration of the disease.

1.2. Scope of the Guide

Medicine is increasingly striving to adopt minimally invasive approaches, a development that likewise extends to the management of perianal abscesses in neonates, infants and children. The primary objective of this study is to determine whether a difference in clinical outcome exists between surgical and conservative treatment modalities.

The secondary objectives are to assess the median age at initial presentation, the anatomical location of the abscess according to the lithotomy position, recurrence rates associated with both therapeutic strategies, the necessity to modify treatment following failure of conservative management, and the incidence of postoperative complications. Furthermore, the study aims to compare the effectiveness of different conservative measures (e.g., sitz baths, topical antibiotic therapy) as well as various surgical interventions (e.g., incision and drainage, fistulotomy). The data analysis included all patients treated between 2005 and 2022 at the Department of Paediatric and Adolescent Surgery at the Medical University of Graz.

1.3. Importance of Perianal Abscess Management in Infants

The appropriate management of perianal abscesses is of considerable clinical importance, as it frequently determines both the duration of symptoms and the severity of the disease course in affected infants.

The foremost objective is to prevent complications. Inadequate or delayed treatment may result in fistula formation, local extension of the infection or systemic dissemination. Equally important is the provision of sufficient analgesia and alleviation of discomfort, as abscesses in the perianal region are often associated

with significant pain, while infants are unable to verbalize their distress adequately. The prevention of long-term sequelae is as crucial as the management of the acute condition, since timely and appropriate intervention may reduce the risk of chronic disease.

Particular emphasis should be placed on preventing recurrent or chronic abscess formation and minimizing scar tissue in order to preserve normal tissue integrity and function. Finally, prompt and effective treatment not only benefits the patient clinically but also provides reassurance to parents and helps to alleviate stress and anxiety regarding their child's health.

1.4. Definition

A perianal abscess is defined as a superficial purulent inflammatory process located in the perianal region, typically presenting as an erythematous, raised and often painful swelling adjacent to the anus. It may be situated subcutaneously, within the sphincter musculature or in the perirectal adipose tissue. Perianal abscesses occur in adults and children alike and, as addressed in the present thesis, are also observed in infants (1,2).

In simplified terms, a perianal abscess represents a localized collection of pus within a newly formed tissue cavity that develops due to various etiological factors, most notably cryptoglandular infection (3). Owing to its anatomical proximity to the anus, even a superficially located abscess may rapidly lead to significant discomfort and pain (4). In contrast, deep-seated abscesses are uncommon in this age group and generally necessitate more advanced and intensive therapeutic management (5).

1.5. Causes and Risk Factors

Several factors may contribute to the development of a perianal abscess in infants. The principal etiological mechanism is infection of the anal crypt glands, which are small mucus-secreting glands situated within the anal canal. These glands drain into small invaginations of the mucosa, referred to as anal crypts (6). These crypts are small, cup-shaped recesses located within the anal canal. The associated glands

extend distally below the dentate line and traverse the internal anal sphincter muscle (**Figure 1**).

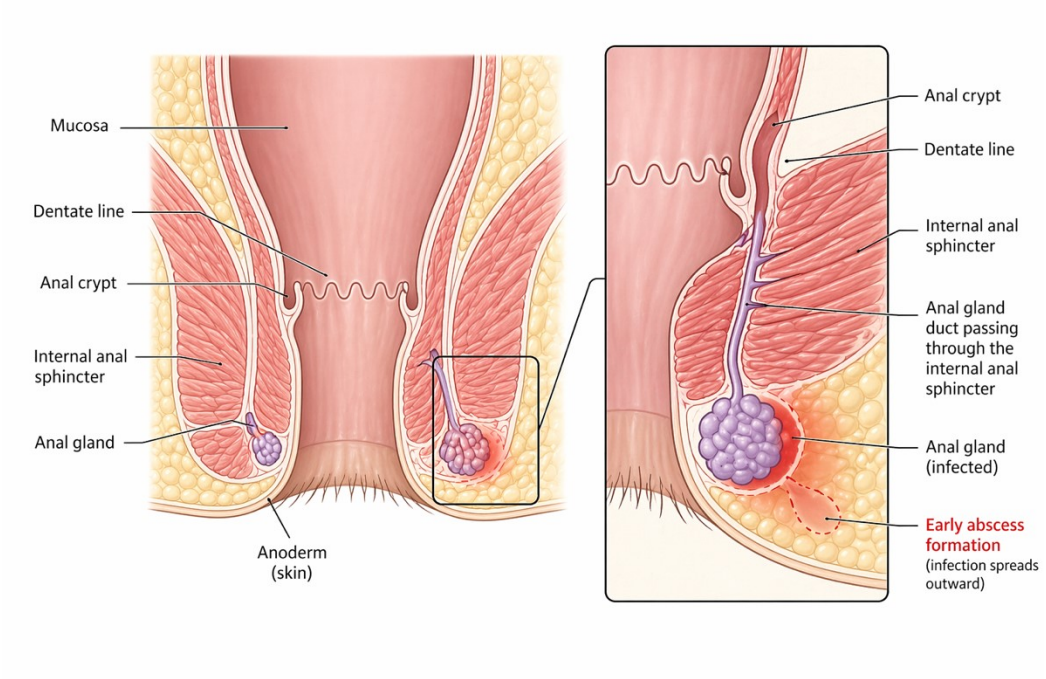

Figure 1: *AI-generated schematic illustration of the cryptoglandular pathogenesis of perianal abscess formation adapted from: Schünke M, Schulte E, Schumacher U. PROMETHEUS Atlas of Anatomy, Internal Organs. 6th ed. Stuttgart: Thieme; 2022.*

In the majority of cases, perianal abscesses in infants occur idiopathically, frequently affecting otherwise healthy individuals. For an extended period, the underlying cause remained unclear (7). However, potential etiological factors and predisposing conditions contributing to the development of this localized infection have since been identified. In recent years, particular anatomical and environmental influences have been recognized as significant determinants (7,8).

An overview of the proposed causes and risk factors is provided below:

Cryptoglandular Infection: The principal mechanism underlying infection of the crypts of Morgagni is typically obstruction or inflammation of these glands, for instance as a result of minor trauma to the anal mucosa. Such disruption of the glandular epithelium facilitates bacterial invasion and subsequent abscess formation (9). Bacterial invasion of these small glands or crypts initially results in cryptitis, followed by inflammatory infiltration of the walls of the crypts of Morgagni.

This process promotes the development of a superficial abscess cavity, which, as it progressively enlarges, gives rise to the clinical manifestations described below. In most instances, this pathophysiological mechanism leads to the formation of a perianal abscess comparable to those observed in adults. The infection is most commonly attributable to Staphylococcus species, Streptococcus species or anaerobic bacteria, reflecting the composition of the normal intestinal flora in otherwise healthy young patients (10).

Congenital Anal Gland Anomalies: Congenital anomalies of the perianal region may also predispose infants to infection and subsequent abscess formation. In some cases, infants are born with an increased number of anal crypts or with crypts that are abnormally deep, thereby elevating the risk of bacterial colonization and infection. A recent study demonstrated that infants diagnosed with fistulas exhibit crypt lengths ranging from 3 to 10 mm, whereas in healthy infants the crypts typically measure only 1 to 2 mm (11). The increased depth of these niches facilitates bacterial retention and proliferation, as the enlarged anatomical space provides favorable conditions for microbial growth (8,12).

This hypothesis is further supported by the consistent lateral localization of lesions in the perianal region, which will be discussed in a subsequent section. Thus, congenital anatomical variations may create a predisposed structural environment that promotes infection (13).

Hormonal and Sex Factors: It is clear that perianal abscesses predominantly affect males. It is estimated that 80-90% of cases occur in male infants (1,3,7).
One proposed hypothesis suggests that androgenic hormonal influence may stimulate enlargement and increased secretory activity of the anal glands, thereby predisposing to glandular obstruction and subsequent infection. Accordingly, it has been postulated that male infants may exhibit a significantly higher incidence of perianal abscess formation compared with females, potentially attributable to hormonal factors (13).

However, this male predominance is primarily observed during infancy, as the gender distribution becomes more balanced after the first 12 months of life (14). The high incidence of perianal abscesses in this age group suggests that, on the one hand, the condition is related to developmental factors, and on the other hand, it predominantly affects male infants under 12 months of age (15,16).

Diaper Use and Hygiene: In general, it should be noted that most infants with perianal abscesses present with otherwise normal perianal skin, exhibiting no signs of diaper rash or other dermatological conditions (8). Nevertheless, one study has identified diaper use as a significant risk factor, indicating a higher likelihood of abscess formation in diapered infants compared with those who are toilet trained (16). It is important to note that diaper rash or other superficial skin irritations are not the decisive factor in the development of a perianal abscess (16).

It is well established that diaper use creates a warm and moist environment which, when combined with contact with urine and feces, provides an ideal setting for bacterial growth and proliferation. While it might be assumed that frequent diaper changes and enhanced hygiene practices would mitigate this risk, the same study was unable to identify any specific interventions that reliably reduce the likelihood of abscess formation (8,16).

In general, however, meticulous perianal care and regular diaper changes are recommended to reduce the local bacterial load. These measures not only have the potential to lower the risk of perianal abscess formation but also help prevent common skin irritations, such as diaper dermatitis.

Immune status: A comprehensive review of multiple cases has revealed that affected infants generally demonstrate normal immune function and overall good health, with the exception of the localized perianal abscess (13). In infancy, the presence of concomitant systemic disease is generally not assumed, unlike in older children or adults, where perianal abscesses are often associated with underlying conditions such as Crohn’s disease or immune deficiencies. Nevertheless, in cases where a perianal abscess proves particularly refractory to treatment, diagnostic evaluations for rare disorders are frequently performed and taken into consideration.

Thus, while multiple factors may contribute to the development of a perianal abscess, it should be emphasized that the condition is most often idiopathic, with infancy itself representing a primary risk factor.

1.6. Clinical Presentation in Infants

In almost every case, the typical signs of a local infection can be found, but sometimes systemic symptoms such as fever also occur. The duration of the infection is particularly important here and can also be an indication of how severe the infection is. The most important clinical symptoms are described in more detail below (9):

Local Sign of Infection: Typically, parents first notice a localized abnormality—often during diaper changes—characterized by swelling and erythema. The lesion usually presents as a reddish, raised area situated at the periphery of the anal canal. The swelling is most often unilateral, commonly appearing at either the 3 o'clock or 9 o'clock position (1). The anatomical locations described above will be examined in greater detail in a subsequent section of this thesis. The duration of the infection is a critical determinant of disease progression, as prolonged infection is associated with an increased likelihood of swelling exacerbation and expansion of erythema (15).

Other characteristic signs include tenderness and pain (17). Even minimal physical contact can provoke a pronounced response in infants, often manifesting as crying or agitation. This reaction is commonly triggered by contact between the soft fabric of a diaper and the highly sensitive perianal region, particularly during diaper changes and routine hygiene care (18). It is important to recognize that pressure or traction applied to this area can rapidly elicit acute pain (15). Distinguishing whether an infant's distress is due to genuine pain or another cause can be challenging; however, careful observation of redness or related symptoms—especially during cleaning or other tactile interactions—is essential. Pain is frequently accompanied by localized erythema and swelling (18).

Defecation Problems: Considering the local symptoms described above, it becomes apparent that these findings are also relevant to subsequent clinical manifestations. During defecation, increased pressure is exerted on the perianal abscess, which may result in acute pain. Consequently, infants may begin to withhold stool in response to discomfort, potentially leading to constipation or the passage of hard stools (19). It is important to recognize that parents may observe signs such as increased crying or alterations in bowel habits, including reduced stool frequency, because of stool withholding. As a result, in cases presenting primarily with constipation, the presence of a perianal abscess may not be immediately suspected or considered as initial differential diagnosis.

Fever and Systemic Signs: Perianal abscesses are predominantly localized infections and are typically not associated with elevated body temperature. In a minority of cases, however, infants may develop a low-grade fever accompanied by systemic manifestations such as decreased appetite, irritability or general malaise. The presence of fever or signs suggestive of systemic involvement may indicate a more extensive or spreading infection and therefore warrants prompt medical evaluation. In most instances, however, the clinical presentation remains confined to local symptoms, and systemic complications are reported only rarely (20).

Spontaneous Drainage (Perforation): More commonly, the abscess cavity—once distended with purulent material—may undergo spontaneous perforation or abruptly drain because of minor mechanical irritation, leading to the discharge of pus (21). In such cases, parents may observe purulent discharge or yellowish staining in the diaper, accompanied by a noticeable reduction in swelling and the appearance of a small central opening at the site of the abscess. Additionally, decreased pain during diaper changes or defecation may become evident. In many instances, spontaneous drainage is sufficient to allow permanent resolution of the abscess. However, there remains a risk of recurrent infection arising from the residual cavity or the subsequent development of a fistula-in-ano (20). The development of fistulas will be addressed in greater detail in the chapter on complications. In summary, spontaneous drainage of purulent material may occur and can result in symptomatic relief or, in some cases, complete resolution of the condition.

Behavior and Other Signs: Beyond the typical local symptoms, parents may also notice behavioral changes in their infant. These may include increased irritability in certain situations, such as when the child is dressed in tight clothing, or a marked decline in sleep quality (17). Such observations may be explained by the fact that infants are unable to localize or verbally express discomfort, which can lead caregivers to misinterpret the underlying cause of distress (22).

On clinical examination in cases of perianal abscess, the abdomen is generally soft and non-tender. In the majority of instances, affected infants are otherwise in good general condition, with a normal appetite and no signs of systemic illness. These findings support the conclusion that the condition is typically confined to a localized inflammatory process (23). Consequently, particularly in young patients, a comprehensive physical examination is essential, including careful inspection of the perianal region and the contents of the diaper (17).

In summary, the key clinical features can be reiterated as follows: a perianal abscess typically presents with the classic signs of localized infection, namely erythema, swelling and tenderness, most observed in a lateral position within the perianal region. In most cases, the symptoms remain confined to the local area; however, in rare instances, systemic involvement may occur.

Accordingly, the clinical spectrum ranges from a minor localized infection that may resolve spontaneously to a more extensive process that can lead to fistula formation and, in exceptional cases, require surgical intervention. The latter scenario is observed only very infrequently. It is therefore essential for parents to remain attentive to subtle signs of discomfort—particularly during diaper changes— to ensure timely medical evaluation and to prevent unnecessary distress for the infant.

2. Diagnosis of Perianal Abscess in Infants

2.1. Clinical Evaluation

The initial step involves obtaining a detailed medical history from the caregiver, including the duration of the lesion and whether any discharge has been observed. Additional information should include the presence of swelling, fever, diarrhea and whether any treatment has already been initiated—either independently or following consultation with a pediatrician. If therapy has been started, it is essential to clarify whether systemic or local treatment was employed and whether antibiotic therapy was administered. Routine hygiene practices should also be reviewed, particularly noting any changes that occurred after the abscess appeared, especially if medical evaluation was delayed. A history of previous abscesses or fistulas, as well as underlying conditions such as Crohn's disease or diabetes, should also be documented (17,20).

This is followed by a comprehensive clinical examination in which the infant is assessed systematically from head to toe, with particular attention to the perianal region. The abscess location is determined in the lithotomy position (Steinschnittlage, SSL), noting the corresponding "o'clock" position. The examiner documents erythema, swelling and any associated skin changes. During palpation, attention is focused on tender or indurated areas, which may indicate pus accumulation (18,20). Concurrently, a blood sample is obtained for laboratory evaluation, including a differential blood count. Key parameters include C-reactive protein (CRP), leukocyte count and the presence of a left shift. Measurement of body temperature should also be routinely performed (20).

2.2. Imaging Techniques

If the initial clinical and laboratory evaluations are insufficient to establish a definitive diagnosis, or if a more precise assessment of the abscess in relation to adjacent structures—including the potential presence of a fistula tract—is required, imaging studies such as ultrasound or, in select cases, magnetic resonance imaging (MRI) may be performed.

Ultrasound represents the simpler and more practical modality, particularly given the challenges of maintaining infant cooperation. It is a rapid, non-invasive, and cost-effective method that is often sufficient to address the key diagnostic questions in cases of perianal abscess. Both transperianal and endoanal probes can be employed to delineate the extent and spread of the abscess (24). Studies have demonstrated that transperianal ultrasound is highly effective in accurately identifying the location and boundaries of perianal abscesses (25); however, the reliability of the results is strongly dependent on the examiner's expertise.

MRI is reserved for more complex cases, including recurrent abscesses, where enhanced visualization of anatomical structures is required (26). This examination necessitates sedation or general anesthesia to ensure that the child remains completely still for optimal image quality. The use of contrast medium can further improve diagnostic accuracy by clearly differentiating inflamed or infected tissue from surrounding healthy structures and by detecting fistulous tracts or other complications associated with perianal abscesses. MRI thus facilitates precise preoperative planning and enhances differentiation between inflamed tissue, pus collections and necrotic areas (26).

2.3. Differential Diagnoses

The primary differential diagnosis that is often considered is a **perianal fistula**, defined as an abnormal tract connecting the anal canal to the perianal skin. Fistulas may arise secondary to a perianal abscess or, less commonly, exist primarily prior to abscess formation. Chronicity and recurrent abscess formation are characteristic features that help distinguish fistulas from isolated abscesses (17,20).

A **haemangioma** is a benign vascular tumor presenting as a red, raised lesion and is typically distinguishable from abscesses because it may bleed or ulcerate and become inflamed, but they do not contain pus and generally develop over a longer period than perianal abscesses (27).

Perianal dermatitis is an inflammatory condition of the skin surrounding the anus, often triggered by irritation or allergic reactions. It is characterized by diffuse erythema and irritation but lacks the firm, tender swelling and purulent content

typical of an abscess (28). Similarly, **nappy dermatitis**—a localized inflammatory response caused by prolonged exposure to moisture, urine, feces, or friction—should be considered in the differential diagnosis (29).

Infectious dermatitis, caused by bacterial or fungal pathogens, can mimic some features of a perianal abscess, presenting with diffuse redness and possible exudate. However, these infections are generally less well-circumscribed and do not form the firm, purulent swelling seen in abscesses (30).

Anal fissures are also relatively common in infants and involve small tears in the anal mucosa. Typical causes include constipation, diarrhea, anatomical factors, or straining during bowel movements. Dietary transitions to complementary foods or inadequate fluid intake may also contribute. Fissures are usually associated with painful defecation and minor bleeding, but they do not produce swelling or purulent discharge (31).

Chronic inflammatory bowel disease, such as **Crohn's disease**, should also be considered, as it can present with perianal manifestations including abscesses and fistulas. Differentiation is aided by the presence of gastrointestinal symptoms and a chronic disease course, which are more characteristic of Crohn's disease than isolated abscesses (32).

Finally, the presence of a **foreign body** in the anal canal or perianal region may provoke localized inflammation. A careful medical history and suspicion of a foreign object are critical, particularly as the clinical course is typically shorter than that associated with other etiologies (33).

2.4. Definition of Localization

The diagnostic process now includes, independent of clinical findings, precise documentation of the abscess location. This allows subsequent clinicians to accurately identify the original site during follow-up evaluations, thereby facilitating ongoing management. The lithotomy position, or Steinschnittlage (SSL), is widely used across multiple medical specialties, including proctology, urology and gynecology. Beyond routine clinical practice, this positioning is also employed in

research settings to determine the anatomical distribution and prevalence of specific pathologies (34).

In lithotomy position, there are again different ways of positioning the patient or angling the legs to achieve better access for surgical interventions, for example. A classic clock is used to describe this. In principle, the location is named so that when the patient is lying on the back and you look at the perineum from caudal to cranial, the symphysis is termed 12 o'clock *(***Figure 2***)*. Consequently, the dorsal direction towards the os sacrum is 6 o'clock. The two lateral sides are numbered 3 o'clock and 9 o'clock, as on a clock, with the anatomical right side being 9 o'clock and the anatomical left side being 3 o'clock (17).

Perianal abscesses are frequently located laterally at the 3 and 9 o'clock positions (1). A case report illustrates this phenomenon by noting the presence of increased subcutaneous adipose tissue on both lateral aspects, which may provide greater potential for the spread of infection (20). An additional contributing factor to the tendency for pus accumulation in the lateral regions is the comparatively lower density of anal crypts in the ventral and dorsal positions (17).

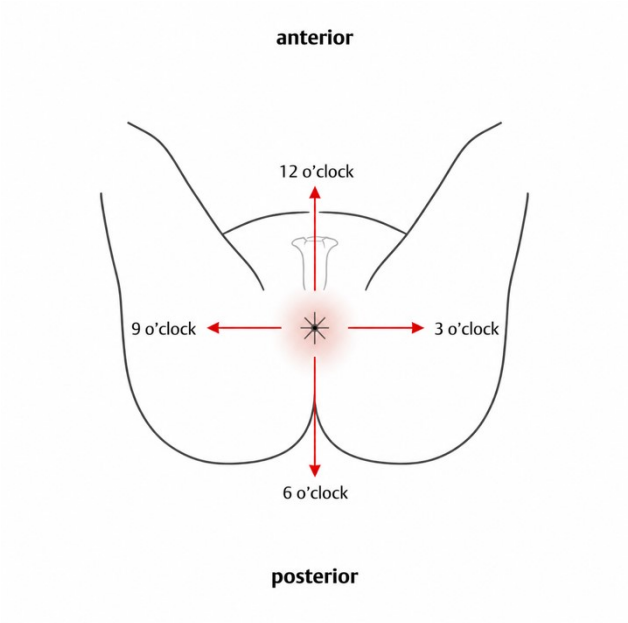

Figure 2: *AI-generated schematic of the lithotomy position (SSL), created using ChatGPT (OpenAI, GPT-5)*

3. Treatment Approaches

As a general principle, non-invasive therapeutic approaches should be prioritized whenever clinically feasible, provided that the stage and progression of the disease still permit conservative management (35). Invasive therapeutic measures should only be considered once conservative management is no longer appropriate or has proven ineffective. There are clinical scenarios in which the extent or progression of the abscess renders pharmacological therapy alone insufficient, thereby necessitating invasive or surgical intervention. In certain cases, a combined approach consisting of systemic medical therapy and invasive treatment may be required to achieve adequate disease control (14).

A large-scale study conducted at two university pediatric surgery centers evaluating children with perianal abscesses demonstrated that consistent local hygiene measures combined with systemic antibiotic therapy, in the absence of surgical drainage, significantly reduced the risk of subsequent fistula-in-ano formation (20).

Numerous publications have demonstrated that conservative management—consisting of analgesic therapy, topical antibiotics and sitz baths—can achieve outcomes comparable to those of surgical intervention, which is typically followed by postoperative pain management and, in many cases, antibiotic therapy (17,20).

It is therefore essential that therapeutic decisions are made on an individual basis, carefully weighing the clinical findings and disease severity. Invasive treatment should be reserved for clearly indicated cases to avoid unnecessary surgical procedures in infants. At the same time, undertreatment must be prevented, as insufficient initial management may predispose to fistula formation or other complications, thereby prolonging the disease course and exposing the infant to avoidable discomfort and pain (36).

3.1. Medical Management

Pharmacological therapy should not be regarded as synonymous with antibiotic treatment alone; rather, it may also include the administration of analgesics for pain control, antipyretics for fever reduction or agents to manage constipation, depending on the individual clinical presentation (37).

3.1.1. Antibiotic Therapy

Antibiotic therapy is generally reserved for infants presenting with systemic symptoms, such as fever or lethargy, or for those who are immunocompromised. However, in clinical practice, antibiotics are also frequently administered to infants without systemic manifestations as a preventive measure, particularly when surgical intervention or simple drainage of the abscess alone is considered insufficient to ensure adequate resolution (9).

Antibiotic therapy may be administered via two principal approaches. The first consists of systemic treatment, typically given orally over a course of 7 to 10 days. This approach achieves systemic antibacterial coverage and may help prevent potential septic progression (38). The second approach involves topical antibiotic therapy, in which ointments or powders containing antimicrobial agents are applied locally. Such treatment aims to exert a localized antibacterial effect, thereby supporting resolution of the infection and potentially reducing the risk of delayed healing or recurrence (39,40).

In the management of perianal abscesses in infants, broad-spectrum antibiotics such as amoxicillin–clavulanate or clindamycin are commonly utilized to ensure adequate coverage of typical pathogens, particularly *Staphylococcus aureus* and *Escherichia coli* (8,41). When there is a strong clinical suspicion of infection with methicillin-resistant *Staphylococcus aureus* (MRSA), the antimicrobial regimen may be modified accordingly, incorporating agents such as vancomycin or clindamycin, which demonstrate enhanced efficacy against resistant strains (42).

Postoperative antibiotic therapy following incision and drainage should also be carefully considered, as it may contribute to reducing the risk of recurrence or subsequent fistula formation (43). Ciprofloxacin and metronidazole play a significant role in certain postoperative treatment regimens. These agents are typically administered orally, thereby providing systemic antimicrobial coverage aimed at reducing the risk of recurrent infection and subsequent abscess formation (44). Various approaches have been described regarding the optimal duration of antibiotic therapy. One study demonstrated that, following primary closure, a one-day course of metronidazole combined with amoxicillin was comparably effective to

a four-day regimen, suggesting that shorter treatment durations may be sufficient in selected cases (45).

3.1.2. Pain Management

Effective symptom control is of paramount importance in the management of perianal abscesses in infants to ensure adequate comfort and well-being.

Paracetamol (acetaminophen) and ibuprofen are the primary agents used for analgesia (46,47). Both medications provide effective pain relief and possess antipyretic properties when fever is present. It is essential that dosing is carefully adjusted according to the infant's age and body weight and administered in strict accordance with established pediatric dosing guidelines to ensure safety and efficacy.

The use of stronger analgesics, such as opioids, is rarely required in the postoperative setting, as non-opioid analgesics are generally considered sufficient to achieve adequate pain control in this patient population (48).

In addition, clinicians frequently recommend non-pharmacological measures, such as sitz baths, which have been shown to promote local hygiene, support wound healing and alleviate discomfort (49). Care should be taken to avoid mechanical irritation of the affected area—for example, through vigorous wiping with a towel—especially in the immediate postoperative period. The administration of stool softeners or mild laxatives may also be beneficial, as they facilitate defecation and reduce strain-related discomfort (50).

In summary, a range of pharmacological and supportive measures is available to alleviate pain and prevent additional discomfort in infants, with the overarching goal of ensuring optimal patient comfort throughout the course of treatment (47).

3.2. Surgical Interventions

Surgical management of small perianal abscesses typically involves the application of local anesthesia, followed by limited incision, evacuation of purulent material and irrigation of the cavity (51). In infants, the standard treatment for perianal abscesses

is surgical drainage. This procedure is generally performed under general anesthesia in an operating theatre to ensure thorough drainage while minimizing pain and distress for the patient (52).

3.2.1. Incision and Drainage (I&D) Procedure

Surgical intervention is indicated in cases with a confirmed diagnosis of a perianal abscess, typically presenting as a localized, variably sized swelling in the perianal region that is soft, erythematous and often associated with systemic symptoms such as fever or irritability. The primary objective of incision and drainage (I&D) is to evacuate the purulent contents of the abscess cavity, thereby reducing local pressure, alleviating pain and preventing the further spread of infection (53).

The patient is typically placed in the lithotomy position (SSL) under general anesthesia (51). A cross-shaped incision is made as close to the anal verge as possible to minimize the risk of subsequent fistula formation (36). Blunt palpation is then performed to evacuate all purulent material, ensuring that any septations or additional abscess pockets are identified and drained (52).

Before concluding the procedure, it is often recommended to excise one of the skin flaps from the cross incision—or, alternatively, the extremities of all four flaps—to promote adequate drainage and prevent premature closure of the overlying skin (51). Postoperatively, maintaining meticulous hygiene at the incision site is essential. The use of sitz baths is encouraged, as they can provide both comfort and pain relief while supporting local healing (54).

Studies have demonstrated that in cases complicated by fistula-in-ano formation, surgical intervention—including fistulotomy combined with incision and drainage—effectively reduces the risk of recurrence and the need for subsequent surgical procedures (36,51,52).

3.2.2. Role of Fistulotomy

In some cases, a perianal abscess may progress to the development of a fistula-in-ano. This complication is often suspected in patients with multiple recurrences, even

when routine clinical examinations have not previously revealed clear evidence of a fistulous tract (17,55).

In the management of fistula-in-ano, fistulotomy is currently regarded as the preferred and most effective surgical approach. A randomized prospective study entitled *"Fistulotomy versus Fistulectomy for Fistula-in-Ano"* by Srikantaiah Chandra, Sekhariah Hiremath and Rakesh Patil demonstrated that fistulotomy offers a slight advantage over fistulectomy, particularly concerning reduced operative time and favorable postoperative outcomes (56). Comparable findings have been reported in additional studies. The advantages of fistulotomy are primarily attributed to its shorter operative duration, reduced length of postoperative hospital stay, accelerated wound healing, diminished postoperative pain and a lower incidence of postoperative complications (18).

3.2.3. Other Surgical Options

The selection of the appropriate surgical technique depends on multiple factors, including the anatomical location and size of the abscess, the presence or absence of an associated fistula, and the patient's overall clinical condition. Comprehensive postoperative care is essential to promote optimal healing and to minimize the risk of complications or recurrence (57).

The seton procedure is a surgical technique utilized in the management of perianal abscesses complicated by fistulous tracts that traverse the sphincter musculature, with the primary aim of preserving continence to the greatest extent possible. In this approach, a specialized suture or elastic thread (seton) is placed within the fistula tract to maintain patency or gradually widen the tract, thereby ensuring continuous drainage and preventing premature closure. The seton is subsequently monitored during follow-up and may be adjusted, tightened, or removed as clinically indicated (58).

Marsupialization is a surgical technique traditionally employed in the management of cysts that cannot be completely excised or in situations where total removal is not advisable. It may also be applied in the treatment of abscesses that are intended to remain open to allow continuous drainage. Following incision and evacuation of the

purulent material, the edges of the abscess cavity are sutured to the surrounding skin. This approach maintains patency of the cavity, facilitates ongoing drainage and promotes improved wound healing (51,59).

An alternative surgical approach is primary closure, in which the abscess cavity is closed immediately following incision and drainage. This technique requires meticulous surgical technique, thorough irrigation of the abscess cavity and careful verification that no fistulous tract is present. Postoperative care is particularly critical with this method, as close monitoring is necessary to prevent the formation of a new abscess and to ensure proper healing (60).

4. Postoperative Care and Complications

Postoperative management in infants requires a higher level of precision compared with adults undergoing similar procedures (36). Infants are particularly vulnerable to postoperative complications due to their delicate skin and immature immune system (52). Key aspects of care include meticulous wound management, close monitoring in collaboration with the parents, and regular follow-up examinations to ensure proper healing and early detection of any complications (61).

4.1. Wound Care

Maintaining optimal hygiene of the surgical site is of critical importance. Given the high bacterial load in the perianal region, the wound requires more frequent cleaning than other areas of the body (36). Cleaning should be performed regularly, and particularly after each bowel movement or diaper change, using lukewarm water and a mild, neutral soap (52).

In addition, surgeons often recommend both antibiotic and non-antibiotic sitz baths as part of postoperative care. Sitz baths should be performed two to three times daily for 10–15 minutes, promoting local cleanliness and supporting wound healing (49,61). When drying the area, it is essential to avoid rubbing, friction or other aggressive manipulation; instead, the site should be gently patted with a clean, soft cloth to prevent irritation and facilitate recovery (36).

4.2. Monitoring for Complications

Close monitoring during the postoperative period is essential and typically involves both nursing staff during inpatient stays and, critically, the parents at home (36). Because parents are responsible for daily care activities—such as bathing, diaper changes and general supervision—they are often the first to notice subtle changes in the infant's condition (61). Consequently, it is crucial to educate parents about potential warning signs and abnormalities that should prompt immediate notification of the surgeon, ensuring timely intervention and optimal recovery (61).

The first critical indicator of postoperative complications is evidence of **infection**. Signs such as localized erythema, warmth, swelling, and increased tenderness at

the surgical site warrant prompt medical evaluation (36). Fever may also indicate infection; while mild temperature elevation is common after surgery, a persistent temperature exceeding 38°C should be considered a clear warning sign (52).

Bleeding that is difficult to control or that recurs repeatedly should also be assessed by a surgeon. Minor spotting in the diaper or light, self-limiting bleeding is generally considered normal and can be managed at home without concern (61). Delayed wound healing is uncommon in the perianal region of infants, as these wounds typically exhibit rapid and efficient recovery (36).

Recurrence of the abscess is possible, necessitating repeat drainage. In such cases, a more detailed evaluation for a previously undetected fistula tract should be considered (18,61).

Surgical intervention may temporarily affect bowel function, potentially resulting in constipation or diarrhea. Constipation can exacerbate pain due to increased pressure on the wound but is generally manageable with the use of stool softeners or mild laxatives (52). Diarrhea poses a different risk by increasing local contamination, which in turn elevates the likelihood of infection, highlighting the need for careful hygiene and monitoring during such episodes (36).

4.3. Follow-up Visits

Patients are typically discharged home on the first postoperative day, provided no abnormalities are observed (36,61). Parents should also be thoroughly informed about potential complications and the recommended postoperative care (52). In most cases, an outpatient follow-up with the pediatrician is explicitly advised (36).

During this follow-up visit—sometimes also conducted within the pediatric surgery department—the surgical site is carefully examined to assess wound healing and to identify any emerging complications (61). Clinicians also review parental observations, including any changes in the infant’s stooling patterns or general behavior (52).

Additional follow-up appointments are generally required only if complications arise or if the wound has not healed adequately at the initial check-up, necessitating

further evaluation (36). In most cases, ongoing monitoring and care can be effectively managed by the child's primary pediatrician in an outpatient setting (52).

5. Preventive Strategies

It is also important to consider the potential for implementing prophylactic measures to prevent perianal abscesses in infants. However, the feasibility of such prevention strategies is limited, particularly given that some infants develop a perianal abscess as early as two weeks of age, suggesting that early onset may occur before any practical preventive interventions can be applied (36,52).

5.1. Identifying and Addressing Predisposing Factors

Congenital Anomalies

Congenital anomalies represent one of the most significant risk factors for the development of perianal abscesses in infants (36).

Of relevance are anorectal malformations, which can be identified through careful physical examination and imaging (62). Early detection allows for corrective surgery, which may prevent the subsequent formation of abscesses or fistulas (62).

Hirschsprung's disease is another important consideration, as it markedly impairs intestinal motility and predisposes infants to constipation, thereby increasing the risk of local infection (63,64). Preventive measures include close monitoring of bowel movements and, when indicated, surgical resection of the affected bowel segments.

Immature Immune System

Newborns possess an immature immune system, rendering them more susceptible to infections such as perianal abscesses and other skin infections (65). Adherence to the recommended immunization schedule, along with strict hygiene practices, provides additional protective benefits.

Poor Hygiene

As emphasized throughout this work, hygiene is a critical preventive measure for perianal abscesses. Regular cleaning of the perianal area and timely diaper changes can substantially reduce infection risk, particularly after urination or defecation (66,67). The importance of meticulous hygiene is discussed in further detail in a subsequent chapter.

Bowel Dysfunction

Both diarrhea and constipation can increase the risk of perianal infections. Frequent episodes of diarrhea lead to repeated exposure of the perianal region to pathogens and excessive cleansing may cause skin irritation, which further facilitates bacterial colonization (68). Identifying and addressing the underlying cause of diarrhea—such as dietary intolerance—and applying protective ointments are important preventive strategies.

Conversely, constipation may result in minor perianal trauma, which also increases infection risk (69). Preventive measures include ensuring adequate fluid intake, age-appropriate high-fiber nutrition, and, when necessary, the use of stool softeners.

Family History

A family history of perianal abscesses or broader gastrointestinal disorders should be considered. Although a definitive hereditary link has not been established, awareness of familial patterns can aid in early detection and monitoring (11).

Infantile Hemangiomas

Rare congenital hemangiomas, which are benign vascular tumors, may also occur in the perianal region. Early medical or surgical management is recommended upon detection to prevent irritation, secondary infection or bleeding (70).

5.2. Hygiene Practices

Hygiene as the Most Important Preventive Measure

Hygiene is considered a key modifiable factor in maintaining perianal skin integrity in infants. Although direct evidence linking hygiene practices to the prevention of perianal abscesses is limited, appropriate diaper care reduces moisture exposure and helps preserve epidermal barrier function.

Frequent Diaper Changes

As repeatedly emphasized throughout this work, consistent and thorough hygiene is the cornerstone of prevention. Based on current recommendations, diapers should be changed every two to three hours to reduce prolonged moisture exposure

and bacterial colonization. In addition, diapers should always be changed promptly after every bowel movement.

Regular diaper changes help prevent diaper dermatitis, a condition associated with epidermal barrier disruption and increased bacterial colonization, which may facilitate secondary infection (68,71).

Cleaning Methods

Gentle cleaning of the perianal area is recommended to maintain skin integrity. Lukewarm water combined with a mild, fragrance-free cleanser is commonly advised. Cleansing products should be free from perfumes and harsh additives to minimize skin irritation and preserve epidermal barrier function (68).

If wipes are used, alcohol-free and fragrance-free products are preferable (71). For infants with particularly sensitive skin, cotton pads soaked in water may represent a gentler alternative.

For female infants, wiping from front to back is recommended to reduce fecal contamination of the urethral area and lower the risk of urinary tract infections (72).

Whenever feasible, allowing the perianal area to air-dry before applying a new diaper may help reduce residual moisture and minimize skin irritation (68). If drying with a cloth is necessary, the area should be gently patted rather than rubbed to avoid mechanical skin trauma.

Barrier Creams

Barrier creams provide a protective layer for the delicate perianal skin and are commonly applied after diaper changes. Preparations containing zinc oxide offer protective properties and support epidermal barrier function (68).

Such creams help protect the skin from irritation caused by urine and feces and may therefore indirectly reduce the risk of secondary bacterial invasion (71). However, they are not sufficient for treating severe irritation or established dermatitis, which may require medical evaluation.

Regular application of a protective cream is often recommended, particularly in infants prone to irritant dermatitis (71,73).

New Technologies and Products in Perianal Hygiene

Biodegradable diapers are increasingly available and may contain alternative materials with reduced exposure to certain chemical additives (71). While these products are often marketed as being gentler to the skin, robust clinical evidence demonstrating a reduced incidence of irritant dermatitis compared to conventional diapers remains limited.

“Smart diapers” represent a newer technological development and are equipped with moisture sensors that notify caregivers when a change is required. By potentially reducing prolonged exposure to wetness, such technologies may support skin barrier protection (68); however, clinical data evaluating their impact on dermatologic outcomes are currently lacking.

Probiotic wipes and topical preparations have also entered the market, aiming to promote a balanced skin microbiome and reduce pathogenic colonization. Although the role of the skin microbiome in diaper dermatitis is increasingly recognized, evidence supporting routine use of probiotic products in infant perianal care remains insufficient, and further research is required before clear recommendations can be made (70).

6. Patients and Methods

6.1. Study Design and Ethical Framework

This study was established as a comprehensive, retrospective, single-center observational analysis at the Department of Paediatric and Adolescent Surgery of the Medical University of Graz. The primary objective was to evaluate the efficacy, safety and long-term outcomes of different management modalities for perianal abscesses in infancy in patients treated between 2005 and 2022.

The study protocol underwent a formal review process and received approval from the Institutional Review Board (Ethics Committee) of the Medical University of Graz (EK-Number: 35-003 ex 22/23). In strict compliance with the Declaration of Helsinki and Austrian data protection laws, individual informed consent was waived due to the retrospective nature of the data and the use of pseudonymized records.

6.2. Patient Selection and Eligibility

The study population was identified through a highly systematic search of the hospital's internal electronic medical database ("MEDOCS"). We specifically targeted infants under the age of 12 months who were diagnosed with a perianal abscess (PA) or a perianal fistula (PF), utilizing the International Classification of Diseases (ICD-10) codes K60.3, and K61.0 through K61.5.
Inclusion and Exclusion Criteria: To ensure a high degree of homogeneity within the study cohort and to eliminate confounding variables associated with older pediatric populations or complex systemic diseases, the cohort was refined by applying strict eligibility criteria:

- **Inclusion:** Infants (<12 months of age at the time of initial clinical presentation) with a confirmed primary diagnosis of a perianal abscess or perianal fistula, whose primary diagnostic and therapeutic management was conducted exclusively at our department.
- **Exclusion:** Patients were systematically excluded if they presented with chronic underlying conditions that fundamentally alter the pathophysiology and healing of perianal tissue, such as early-onset inflammatory bowel disease (e.g., Crohn’s disease or ulcerative colitis). Furthermore, infants with

congenital anorectal malformations (e.g., anal atresia or cloacal anomalies), severe immunodeficiency syndromes, or hematological malignancies were excluded. Cases with substantially incomplete medical records lacking primary outcome parameters or follow-up data were also removed from the analysis.

Following the rigorous application of these criteria, a total of 145 infants met all inclusion requirements and formed the robust basis for the final statistical analysis.

6.3. Clinical Definitions and Stratification

Recognizing the highly dynamic nature of pediatric clinical decision-making, where treatment plans must frequently be adapted based on the infant's real-time response, a static "intention-to-treat" model was deemed insufficient. Therefore, patients were stratified into three distinct clinical trajectories to accurately reflect their definitive clinical course:

1. **Successful Conservative Management:** Infants who achieved complete and sustained healing exclusively through non-invasive measures, avoiding general anesthesia and surgical trauma entirely.
2. **Primary Surgical Intervention:** Infants who presented with advanced, highly fluctuant, or systemically symptomatic abscesses, prompting the attending surgeon to perform immediate operative source control upon the initial presentation.
3. **Conservative Treatment Failure:** A critical subgroup comprising infants who were initially managed with a conservative approach but failed to show adequate clinical improvement. These patients required surgical escalation after a minimum trial period of seven days due to non-response, progressive tissue induration, or worsening of local/systemic symptoms.

Definition of Success and Recurrence: Clear clinical endpoints were defined to ensure objective evaluation.

- **Treatment Success** was defined as the rapid, complete resolution of all local inflammatory symptoms and full wound epithelialization without the need for secondary surgical intervention during the documented follow-up period.

- **Recurrence** was strictly defined as the reappearance of an abscess or the new manifestation of a discharging fistula at the exact same anatomical site, following a documented, symptom-free interval of at least 14 days post-initial clinical healing.

6.4. Data Collection and Management

Data extraction was systematically performed utilizing the hospital's internal medical information system ("MEDOCS"). An advanced search algorithm was deployed using patient identification numbers cross-referenced with relevant clinical keywords to capture all associated outpatient and inpatient records. Extracted data were meticulously pseudonymized via a sequential numbering system to ensure strict patient confidentiality and were securely stored in a password-protected, encrypted database accessible solely to authorized study personnel.

To provide a comprehensive overview of the disease characteristics, the following granular parameters were collected for each patient:

- **Demographics:** Date of birth, biological gender, and exact age (in months) at the time of the initial surgical or pediatric consultation.
- **Clinical and Laboratory Data:** The precise anatomical localization of the abscess (documented systematically utilizing the clock-face method in the standard lithotomy position), the caregiver-reported duration of symptoms prior to presentation, body temperature at admission, and acute-phase laboratory inflammatory markers—specifically the absolute leukocyte count and C-reactive protein (CRP) levels.
- **Therapeutic Details:** The primary treatment modality applied, the specific surgical technique employed (e.g., simple incision and drainage versus definitive fistulotomy), the administration route of adjuvant antibiotics (systemic versus topical), and the total duration of the antibiotic therapy.
- **Follow-up Metrics:** The total duration of treatment (defined from the day of initial presentation to the day of documented definitive healing) and the incidence and timing of any post-procedural complications or recurrences.

6.5. Statistical Analysis

A rigorous statistical analysis was performed to ensure the validity and reliability of the findings, utilizing IBM SPSS Statistics for Windows, Version 29.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were initially employed to comprehensively characterize the baseline parameters of the study population.

Prior to selecting the appropriate comparative tests, all continuous variables (such as age at presentation, duration of symptoms, total treatment duration and laboratory parameters) were tested for normal distribution utilizing the Shapiro-Wilk test and visual inspection of Q-Q plots. Continuous variables with a non-normal, right-skewed distribution (e.g., treatment duration) were summarized as medians with interquartile ranges (IQR), whereas approximately normally distributed variables (e.g., baseline characteristics and laboratory parameters) were reported as means with standard deviations (SD). Consequently, robust non-parametric statistical tests were systematically applied. Categorical variables were presented as absolute numbers and valid percentages.

Group comparisons and association testing were conducted using the following specific methods:

- **Mann–Whitney-U test:** Utilized for comparing differences in non-normally distributed continuous variables (e.g., age, duration of symptoms, total treatment duration, CRP levels) between two independent cohorts (e.g., conservative versus surgical groups).
- **Pearson’s Chi-square test:** Applied to analyze categorical variables and assess differences in proportions (e.g., comparing recurrence rates or gender distributions across primary treatment groups).
- **Fisher’s Exact test:** Employed in place of the Chi-square test when the expected cell counts in any contingency table were less than five, particularly during the granular subgroup analyses of specific surgical techniques.
- **Spearman’s rank correlation (ρ):** Used to assess the strength and direction of monotonic relationships between continuous variables, specifically addressing the correlation between the duration of antibiotic therapy and the total clinical treatment time.

For all applied statistical models, a two-tailed p-value of <0.05 was prospectively defined as the threshold for statistical significance.

7. Results

7.1. Demographics and Baseline Characteristics

A total of 145 infants treated for perianal abscesses or fistulas at our center between 2005 and 2022 were included in this retrospective single-center analysis. The study population demonstrated a pronounced and highly characteristic gender discrepancy with a male predominance. The cohort comprised 139 male infants (95.9%) and only 6 female infants (4.1%) (**Figure 3**).

The overall mean age at initial presentation was 4.1 months (SD ± 2.8). When comparing the age at presentation between genders to identify potential demographic variances, male infants presented at a mean age of 4.1 months (SD ± 2.8), whereas the small cohort of female infants presented at a mean age of 2.8 months (SD ± 2.8). Statistical analysis revealed no significant difference in the age of onset between the sexes (p=0.268, Mann-Whitney-U test). This confirms that the condition predominantly manifests in the first months of life, regardless of gender.

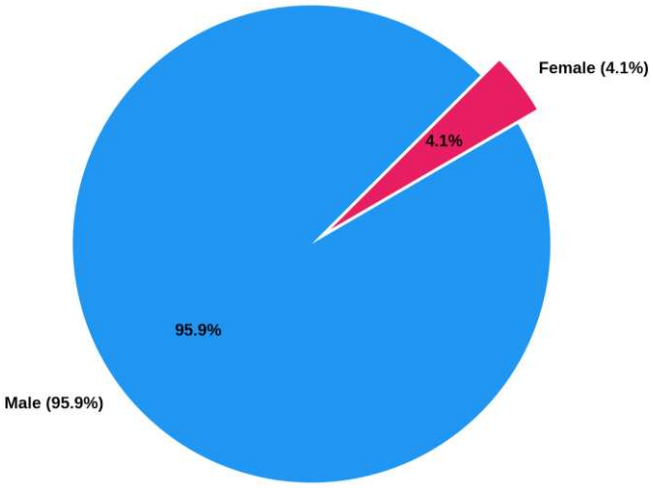

***Figure 3**: Gender distribution in the study cohort.*

Regarding anatomical localization, assessed in the standard lithotomy position, abscesses were almost exclusively lateralized. The left perianal region was affected in 74 cases (51.0%), and the right perianal region in 66 cases (45.5%). Midline presentations (12 o'clock or 6 o'clock positions) were exceedingly rare, documented in only five patients (3.5%) (**Figure 4**).

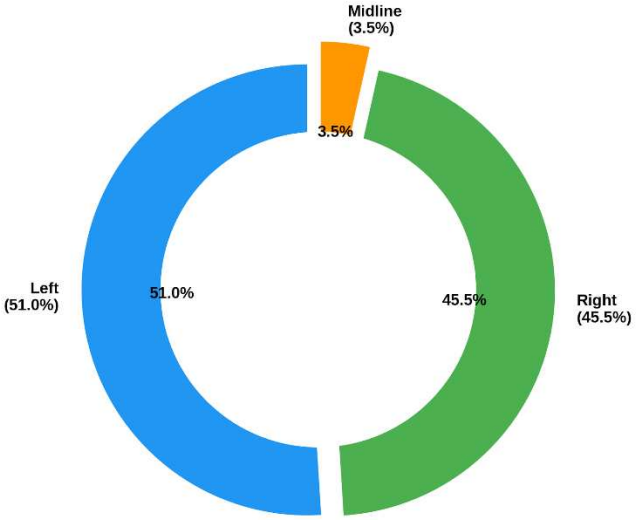

***Figure 4**: Anatomical localization of perianal abscesses. Assessed in the standard lithotomy position.*

7.2. Clinical Presentation and Laboratory Parameters

At the time of the initial emergency department or outpatient presentation, caregivers reported a mean duration of localized symptoms of 8.6 days (SD ± 14.3) prior to seeking medical attention. Thorough clinical evaluations were routinely performed to assess the severity of the local and systemic infection.

- **Systemic Signs:** Exact body temperature measurements were specifically documented in patients presenting with clinical signs of fever. Elevated body temperature (prospectively defined as a core body temperature ≥ 38.0°C) was recorded in 14 patients (9.7% of the total cohort). Among these febrile infants, the mean body temperature was 38.6°C (SD ± 0.5), indicating that pronounced systemic involvement is relatively uncommon in the overall cohort.

- **Inflammatory Markers:** Laboratory parameters were obtained in a subset of the cohort based on clinical necessity, avoiding routine blood draws in otherwise stable infants. This laboratory analysis revealed a mean leukocyte count of 13.4 G/l (SD ± 4.5) and a mean CRP level of 13.6 mg/l (SD ± 20.6). Leukocytosis was present in 23 of 66 patients (34.8%). Additionally, 13 of 66 patients (19.7%) had a CRP level > 5 mg/l.

To ensure that subsequent comparisons of treatment outcomes were not biased by inherent discrepancies in initial disease severity, these baseline inflammatory

markers were statistically compared. Crucially, no significant differences were observed between patients assigned to primary conservative management and those undergoing primary surgery regarding initial CRP levels (p=0.252, Mann-Whitney-U test) or leukocyte counts (p=0.655, Mann-Whitney-U test). This objectively confirms a comparable baseline severity of infection across both cohorts prior to the allocation of treatment.

7.3. Treatment Outcomes by Strategy and Clinical Course

Patients were categorized into three distinct groups based on their definitive clinical trajectory: (1) successful conservative management (n=53), (2) primary surgical intervention (n=63), and (3) conservative treatment failure (n=29).
The clinical outcomes, most notably the required total treatment duration, differed profoundly across these strategies:

- **Conservative Success:** Patients who responded positively to non-operative management experienced the most favorable and rapid outcomes. This group demonstrated a significantly shorter median treatment duration of merely 3 days (IQR 6), compared to a median of 8 days for the overall surgical group (IQR 16). A direct statistical comparison between successful conservative management and primary surgical treatment demonstrated a significantly shorter treatment duration in the conservative group ($p = 0.007$, Mann–Whitney-U test).
- **Primary Surgical Intervention:** Infants who were managed operatively (primarily simple incision and drainage, fistulotomy) from the onset underwent surgical source control at a mean of 5.3 days (SD ± 14.1) after their initial presentation. This approach resulted in a total mean treatment duration of 29.6 days (SD ± 86.0).
- **The Burden of Conservative Failure:** Infants who failed initial conservative therapy experienced a prolonged and complicated clinical course. The mean time to escalation to definitive surgery (treatment delay) was 73.1 days (SD ± 209.4), whereas the overall treatment duration was 97.1 days (SD ± 209.9). This extended course was largely driven by chronification and delayed wound healing (**Figure 5**).

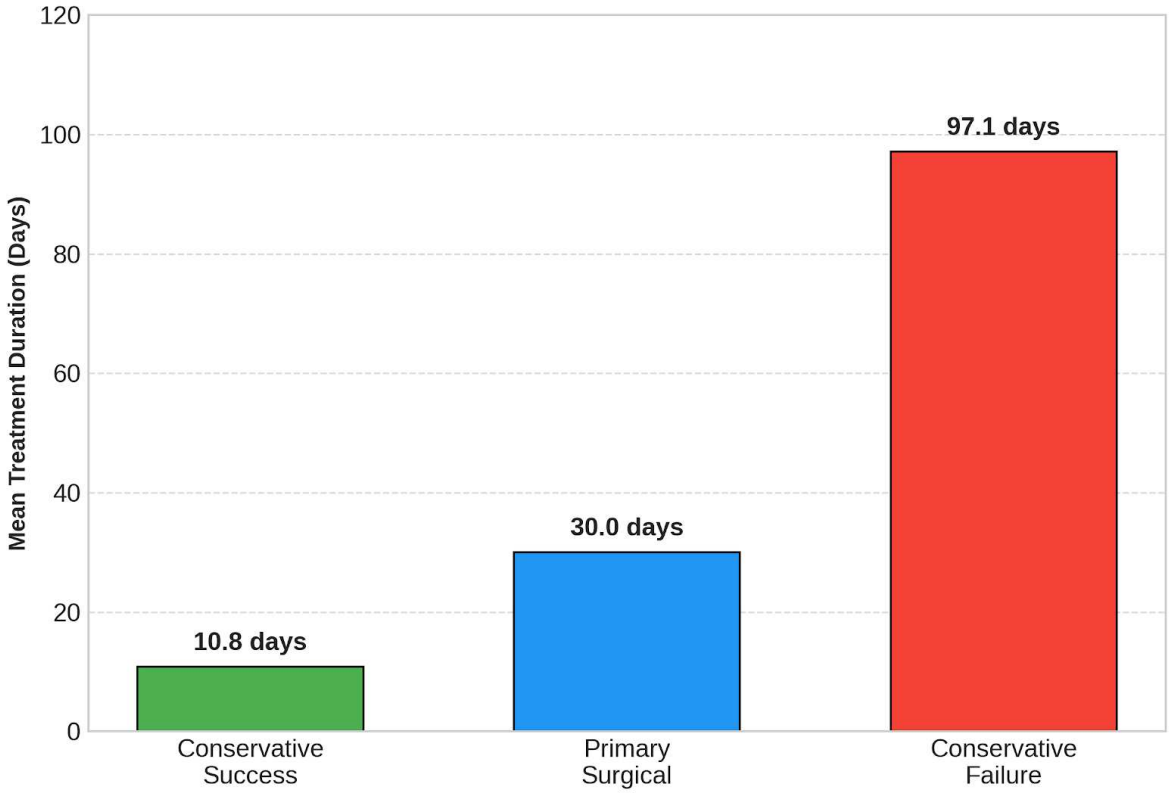

***Figure 5**: Mean overall treatment duration by clinical trajectory.*

7.4. Recurrence Rates and Re-interventions

Recurrence rates were evaluated to assess the long-term safety, durability, and efficacy of the chosen treatment strategies. Recurrences occurred in 13 out of the 117 patients (11.1%) for whom complete long-term follow-up data were available.

- **Conservative vs. Primary Surgical:** The recurrence rate in the successfully conservatively treated patients was remarkably low at 3.8%. In comparison, patients undergoing primary surgical intervention exhibited a recurrence rate of 14.3%. Despite this numerical difference, statistical testing indicated that this variance did not reach statistical significance (p=0.251, Fisher's exact test). This pivotal finding demonstrates that initiating an observation period with a conservative approach does not inherently increase the risk of recurrent disease, provided the infant responds well.
- **The Risk of Conservative Failure:** In contrast, patients classified as "conservative treatment failure" demonstrated a substantially higher disease burden. The recurrence rate in this escalating subgroup spiked to 31%. This rate was significantly higher when compared with the remaining primarily

surgically treated cohort (14.3 %) (p=0.029, Fisher's exact test). These findings underscore that the failure of an initial conservative treatment trial represents a major, statistically significant predictor of a prolonged, complicated disease course and elevated recurrence risk (**Figure 6**).

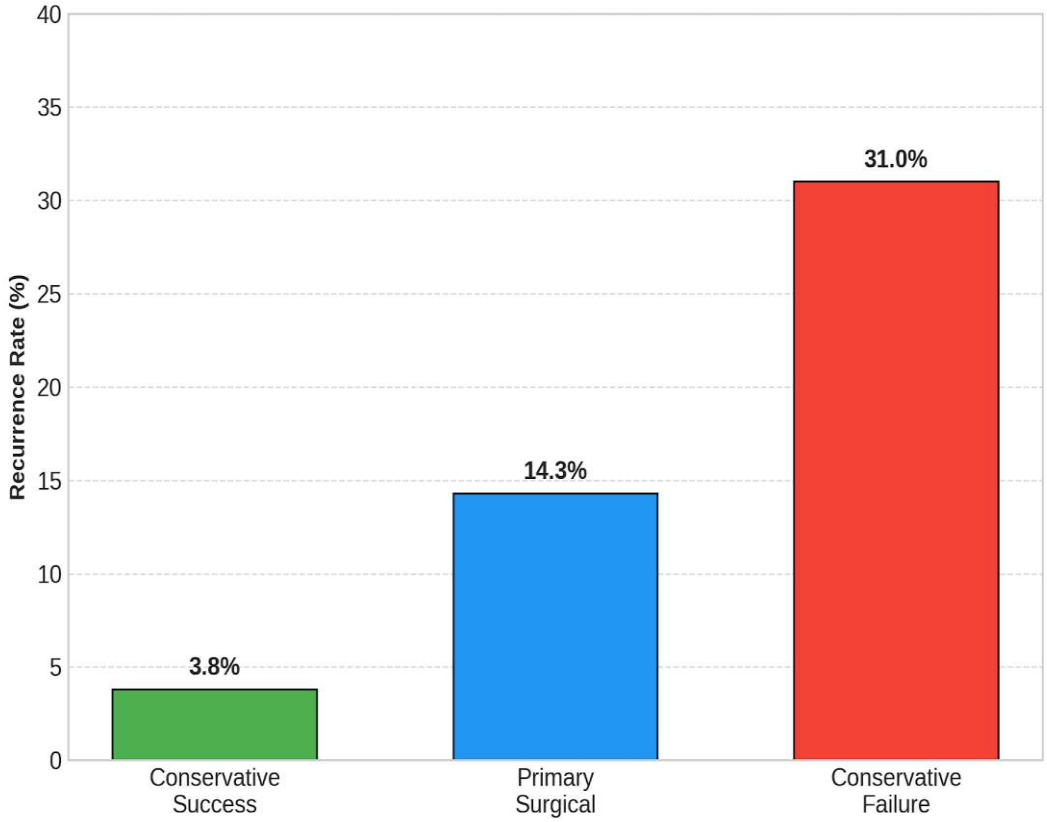

***Figure 6**: Recurrence rates across the different clinical trajectories.*

7.5. Subgroup Analysis: The Impact of Surgical Timing and Technique

To investigate the pathophysiological drivers behind the poor outcomes in the "conservative failure" cohort, a targeted subgroup analysis was conducted. This focused specifically on the timing of the secondary surgery ("early" ≤ 14 days versus "late" > 14 days) and the precise surgical technique utilized.

- **Early Intervention (≤ 14 days, n=15):** Within this early therapeutic window, the choice of technique dictated the outcome. Patients undergoing a definitive fistulotomy or fistula repair (n=4) within 14 days of their initial presentation showed a perfect outcome, with a 0% recurrence rate. Conversely, a simple incision and drainage (I&D) (n=11) performed during this identical early time interval resulted in a high recurrence rate of 27.3%.

Statistical analysis confirmed the superiority of early fistulotomy over simple I&D in preventing recurrent disease across all operative patients (p=0.042, Fisher's exact test).

- **Late Intervention (> 14 days, n=12):** The above-mentioned surgical advantage was entirely negated if the intervention was delayed. When surgical escalation was postponed beyond two weeks, the recurrence rates increased to over 40% (specifically 42.9% for fistulotomy and 40% for incision and drainage) (**Table 1**), regardless of the surgical technique utilized (**Figure 7**). This highlights that delaying surgical intervention severely compromises tissue integrity, likely due to advancing chronic inflammation that obscures the primary cryptoglandular source.

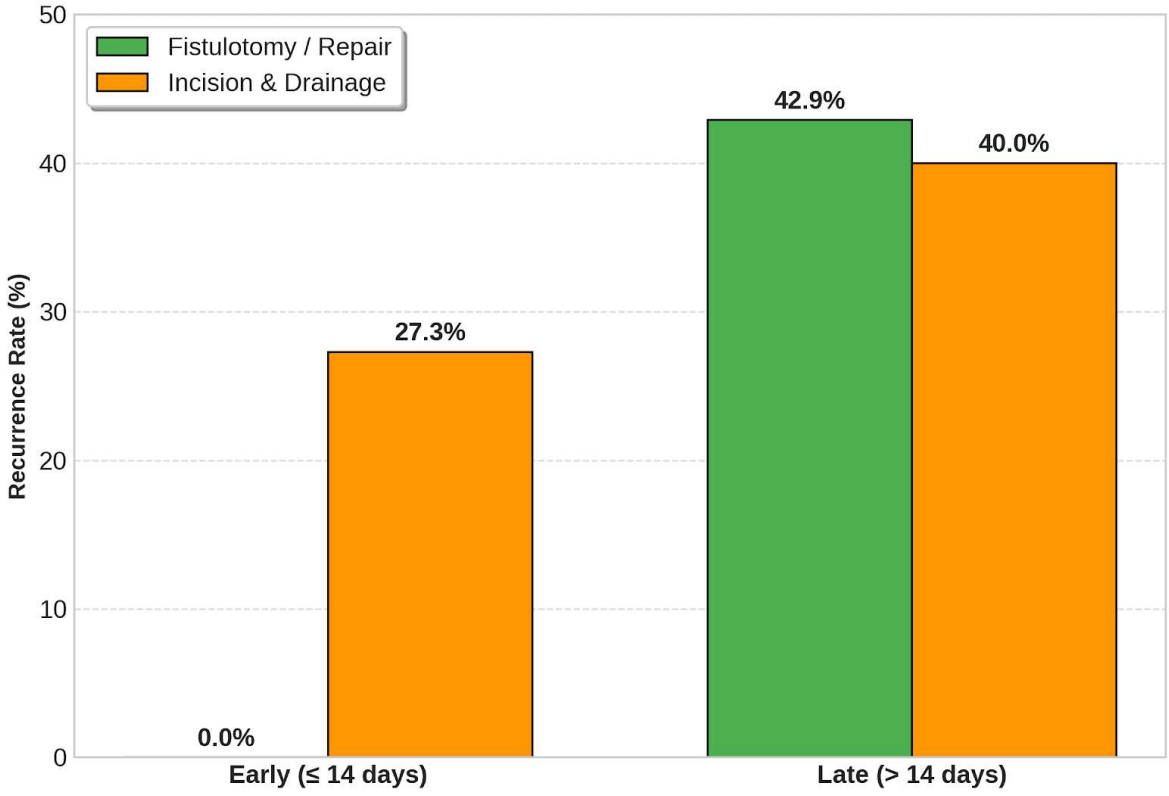

Figure 7: *The "Window of Opportunity" in conservative failure patients.*

Timing of Surgery	Surgical Technique	Patients (n)	Recurrences (n)	Recurrence Rate (%)
Early (≤ 14 days)	Fistulotomy / Repair	4	0	0.0%
	Incision & Drainage	11	3	27.3%
Late (> 14 days)	Fistulotomy / Repair	7	3	42.9%
	Incision & Drainage	5	2	40.0%

Table 1*: Subgroup Analysis of "Conservative Failure" Patients - Impact of surgical timing and technique on recurrence in patients who failed initial conservative therapy*

7.6. Comprehensive Impact of Antibiotic Therapy

- Given the widespread and often debated use of adjuvant pharmacological therapy in pediatric surgery, a dedicated analysis evaluated the clinical impact of antibiotic administration. Antibiotic therapy was administered in 42 patients, predominantly via the systemic route (n=33), with topical treatment used in only 9 cases.

- **Route of Administration:** A statistical comparison between patients receiving exclusively topical (n=9) and systemic (n=33) antibiotic therapy showed no significant difference in the overall mean treatment duration (20.7 ± 40.6 days vs. 31.7 ± 50.3 days; p=0.225, Mann-Whitney-U test). Similarly, long-term recurrence rates did not differ significantly between both groups (22.2% vs. 9.1%; p=0.288, Fisher's exact test).

- **Antibiotics versus No Antibiotics:** When comparing patients receiving any form of antibiotic therapy (n=42) with those managed entirely without antibiotics (n=103), no significant difference in recurrence rates was demonstrated (11.9% vs. 14.6%; p=0.795, Fisher's exact test). Likewise, there was no statistically significant difference in total treatment duration between patients with and without antibiotic coverage (34.3 ± 73.7 vs. 37.2 ± 125.1; p=0.217, Mann–Whitney-U test).

- **Duration of Therapy:** The total duration of antibiotic therapy did not differ significantly between patients who ultimately developed a recurrence (14.2 ± 17.4) and those who remained disease-free (7.3 ± 12.2) (p=0.113, Mann–Whitney-U test). Furthermore, Spearman's rank correlation analysis

demonstrated a weak but statistically non-significant association between the duration of antibiotic therapy and the total treatment duration ($p=0.083$, Spearman's $\rho=0.271$).

Overall, these analyses provide evidence that antibiotic therapy—regardless of its route or duration—showed no measurable influence on minimizing recurrence risk or accelerating healing in this infant cohort.

8. Discussion

This study presents a comprehensive retrospective analysis of 145 infants treated for perianal abscesses. By tracking the exact clinical trajectories of these infants, our findings provide critical insights into optimizing care. The data indicate that, although conservative management serves as a highly effective, non-invasive first-line approach for many patients, infants who fail this initial therapy require extremely careful clinical consideration and highly time-sensitive surgical intervention to prevent severe chronification.

8.1. Conservative vs. Primary Surgical Management

Consistent with shifting paradigms in pediatric surgery that favor organ-preserving and minimally invasive approaches, our data strongly support conservative management as a safe and highly efficient initial strategy for uncomplicated cases (20). Successful conservative management yielded a remarkably short median treatment duration of just 3 days and an exceptionally low recurrence rate of 7.3%. From a pathophysiological standpoint, avoiding surgery in infants prevents the inherent risks of general anesthesia, eliminates iatrogenic trauma to the delicate, developing sphincter complex, and prevents postoperative scarring.

Importantly, our statistical analysis demonstrated that attempting a conservative approach first does not significantly increase the risk of recurrence compared to primary surgery ($p=0.213$). This gives clinicians the confidence to prescribe baths and topical treatments safely as a primary line of defense (9). However, the significantly higher recurrence rate in the primary surgical group (14.5%) and the disastrous outcomes observed in late conservative failures highlight that surgical intervention, while inevitably necessary in non-responders, must be deployed strategically and with precise timing rather than indiscriminately.

8.2. The "Window of Opportunity"

Perhaps the most pivotal finding of this study is the critical role of timing in the escalation from a conservative trial to surgical management. Overall, infants in the “conservative failure” group experienced vastly poorer outcomes, with a recurrence rate of 31% and markedly prolonged treatment durations averaging nearly 100 days.

However, our granular subgroup analysis revealed a distinct and highly actionable “window of opportunity.” Patients who did not respond to conservative therapy but underwent surgical intervention within 14 days of their initial presentation achieved excellent outcomes when a definitive fistulotomy was performed, demonstrating a perfect 0% recurrence rate ($p=0.042$ compared to simple incision) (51). These results strongly suggest that the early identification and surgical management of an underlying crypto glandular fistula tract—prior to the development of chronic inflammation, tissue maceration, and severe induration—can facilitate rapid, curative treatment (74). During this early phase, the anatomy is generally preserved, allowing the surgeon to clearly identify and eradicate the primary source of the infection.

8.3. The Pathological Consequence of Delay

In stark contrast, delaying surgery beyond two weeks (> 14 days) appears to entirely negate the benefits of advanced surgical techniques like fistulotomy (75). In our "late intervention" group, recurrence rates spiked to over 40%, regardless of the specific surgical technique utilized.

This phenomenon is likely attributable to the relentless progression of the localized inflammatory process. Prolonged purulent collections lead to the breakdown of adjacent tissue planes, resulting in complex, branching abscess cavities. Furthermore, chronic inflammation induces fibrosis and severe tissue induration, which severely distorts the perianal anatomy. This distortion obscures the primary fistula tract, making it nearly impossible for the surgeon to completely eradicate the crypto glandular source. This finding provides profound clinical evidence against prolonged "wait-and-see" strategies when no clear clinical improvement is observed within the first week of conservative care.

8.4. The Limited Role of Antibiotics

Another notable finding of our analysis is the limited impact of adjuvant antibiotic therapy on definitive clinical outcomes. The administration of antibiotics is a frequent reflex in clinical practice; however, our analyses demonstrated that neither the route of administration (systemic versus topical) nor the total duration of the antibiotic

course significantly altered the total treatment duration (p=0.217) or the recurrence rates (p=0.674).

This strongly challenges the routine and prolonged prescription of systemic antibiotics in uncomplicated infant perianal abscesses. Unnecessary systemic antibiotics in infancy carry significant risks, including the alteration of the developing neonatal microbiome, an increased risk of antibiotic-associated diarrhea and the promotion of antimicrobial resistance (76). Our data emphasize that source control—whether achieved through spontaneous drainage facilitated by baths or through timely surgical fistulotomy—alongside meticulous local wound care remains the absolute cornerstone of effective therapy (49).

8.5. Pathophysiological Considerations: The Underlying Fistula and the Microbiome

The striking finding that early fistulotomy resulted in a 0% recurrence rate in our failure cohort prompts a fundamental pathophysiological question: Does every infantile perianal abscess inherently harbor an underlying fistula tract (77)?

According to the established cryptoglandular hypothesis, these inflammatory lesions originate from an infection of the anal glands located at the dentate line (11). Consequently, it is highly plausible that an epithelialized tract—or at least a microscopic communication to the anal canal—acts as an obligate precursor to the visible subcutaneous abscess. If only a simple incision and drainage (I&D) is performed, this primary anatomical source remains fully intact. The persistent cryptoglandular communication explains the high recurrence rate of 27.3% following early I&D, whereas definitive eradication of the tract via fistulotomy proved absolutely curative. This strongly suggests that what is clinically diagnosed as a "simple abscess" in non-responders is, in reality, the outward manifestation of an active fistulizing process.

This pathophysiological concept is intrinsically linked to the role of the local microbiome. The infant perineal region is subject to a unique microenvironment, characterized by constant exposure to fecal flora, moisture and occlusion due to diaper use. Once a dysbiosis occurs and bacteria from the gastrointestinal tract translocate into the anal crypts, they can migrate through the anal sphincter muscle and establish a protected microbial reservoir within the deep fistula tracts.

This spatial separation of the microbiome is crucial: while the external perineal skin microbiome can be positively influenced by meticulous local hygiene and sitz baths (explaining the success of conservative management in highly responsive cases), the sequestered bacteria deep within the fistula tract remain entirely shielded. Once a biofilm is established within these tracts, surface-level interventions—including topical antibiotics—are rendered completely futile (8). This microbial persistence drives the chronification of the tissue, further explaining why delayed surgical intervention (> 14 days) leads to recurrence rates exceeding 40%. The chronically inflamed and indurated tissue prevents proper surgical identification and eradication of the microbial niche, highlighting the absolute necessity of intervening while the anatomical planes are still preserved.

8.6. Strengths and Limitations

The primary strength of this study is the large cohort of 145 infants, which ensures a highly representative dataset for this specific pediatric population. Moreover, the use of rigorous statistical stratification based on clinical trajectories—rather than static group comparisons—provides a more nuanced reflection of real-world clinical practice.

However, this study is not without limitations. Its retrospective, single-center design inherently introduces the potential for selection bias and reliance on the accuracy of historical medical records. While we rigorously verified data points, variables such as exact parental compliance with home-based conservative measures (e.g., frequency of baths) could not be objectively quantified. Future prospective, randomized controlled trials are warranted to further validate the exact timing protocols proposed herein.

9. Conclusion

In conclusion, this retrospective analysis of 145 infants strongly advocates for a structured, time-sensitive clinical algorithm in the management of perianal abscesses in infancy.

While conservative management—focusing on local hygiene, sitz baths, and targeted topical therapy—remains a highly effective and safe first-line approach with a short treatment duration and a low recurrence rate, its ultimate success is strictly dependent on a rapid clinical response. Our data unequivocally reveal that infants who fail this initial conservative trial face a significantly higher disease burden. Consequently, to optimize patient outcomes, we propose the following standardized treatment protocol:

1. **Crucial Re-evaluation (Days 7–10):** Systematic clinical monitoring is paramount. If significant clinical regression or symptom relief is absent between the seventh- and tenth-day post-presentation, the patient must be strictly classified as a "conservative failure."
2. **The "Window of Opportunity" (≤ 14 Days):** Upon conservative failure, a definitive shift to operative management is required. Surgical intervention should ideally occur within 14 days of the initial clinical presentation to prevent the chronification of the inflammatory process.
3. **Definitive Surgical Technique:** Within this early intervention window, primary fistulotomy/fistula repair emerges as the definitively superior technique compared to simple incision and drainage, effectively eliminating the risk of recurrent disease in our cohort.

Ultimately, this study highlights that prolonged "wait-and-see" strategies extending beyond two weeks are highly detrimental and insufficient. Adopting a time-sensitive approach minimizes the duration of the infant's discomfort, prevents chronic morbidity, and reduces the overall healthcare burden. Further prospective, multicenter studies are needed to validate these findings and to continue optimizing evidence-based pediatric treatment guidelines.

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Note on the use of artificial intelligence:

Portions of the text in this paper were linguistically revised and stylistically improved with the assistance of ChatGPT (OpenAI) version GPT-5.