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Pediatric endoscopic pilonidal sinus treatment (PEPSiT) as standard of care results over 10 years' experience in 507 patients

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PEDIATRIC ENDOSCOPIC PILONIDAL SINUS TREATMENT (PEPSiT) AS STANDARD OF CARE RESULTS OVER 10 YEARS' EXPERIENCE IN 507 PATIENTS

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ABSTRACT

Pilonidal sinus disease (PSD) is an acquired inflammatory condition of the gluteal cleft predominantly affecting teenagers. We report our 10-year experience adopting this minimally invasive approach, pediatric endoscopic pilonidal sinus treatment (PEPSiT).
We retrospectively reviewed all patients, with primary or recurrent PSD, undergoing PEPSiT in the 2016–2025 period. We operated 507 patients (313 boys and 194 girls) with a median age of 15.5 years (IQR 12-18 years). All patients received our postoperative management. Data regarding success rate, healing rate/time, post-operative management, short- and long-term outcome and patient satisfaction were assessed.
The post-operative course was painless in 100% of patients (median VAS pain score < 2/10, IQR 1-2). Patient satisfaction was excellent (median score 4.8/5, IQR 4-5). Dressing after surgery was performed with ozone oil products in every patient and in the last 18 months Platelet-Rich Plasma (PRP) has been added to the intra and post-operative care too.
Disease recurrence occurred in 53/507 patients (10.4%), mostly within 3 months (range 2 months-23 months), and all were successfully re-operated with PEPSiT with no further recurrence.
This study demonstrates that a standardized perioperative protocol, including tailored pre- and post-operative management and structured long-term follow-up, is effective in ensuring favorable clinical outcomes, with negligible pain, high patient satisfaction and a low rate of recurrence.

Keywords: PEPSiT, Fistuloscope, Laser, Dressing, Technique, Teenagers

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Introduction

Pilonidal sinus disease (PSD) is a chronic and inflammatory disease that is located at the level of sacrococcygeal region. The name of the pathology was created by combining 2 latin words, ‘‘pilus,’’ which means hair, and ‘‘nidus,’’ which means nest, underlying the etiology of this pathology which lies in follicles of hairs. [1] The incidence of this pathology is approximately 26 per 100,000 individuals, with a marked predominance in adolescents and a male predominance of around 3:1. PSD risk factors include hirsutism, family history, local trauma, sedentary occupation, and obesity. Symptoms typically begin during adolescence, with most cases diagnosed between 14 and 18 years old. PSD is characterized by a spectrum of clinical manifestations ranging from acute abscess formation, accompanied by pain, swelling, and erythema, to chronic disease with persistent sinus tracts and intermittent seropurulent discharge. Common complications include recurrent infections, abscess formation, chronic inflammation and delayed or impaired wound

healing, frequently necessitating repeating surgical interventions. The recurrent and sometimes prolonged course of the disease can significantly affect patients' quality of life, leading to pain, restriction of daily and physical activity. Moreover, the chronicity and location of the disease may contribute to psychological distress and social discomfort. [2]

Although many techniques, for surgical treatment of PSD using open surgery, have been described until now, yet no consensus exists regarding gold standard treatment option. [3]

The traditional open excision, still widely performed in adults, is extremely invasive, with a long and painful postoperative course, and patients generally doubt whether to submit themselves to this procedure. [4] According to literature there is a high recurrence rate of PSD ranging from 20% to 40% after a traditional surgical excision. [5]

The incidence of this pathology has significantly increased over the last decades with no clearly identified causes. [6]

Minimally Invasive techniques emerged as an attempt to reduce morbidity. [7]

The first Minimally Invasive treatment of PSD was called GIPS and it consists of a metallic device to remove the hairs through the orifices of the PSD blindly. [8]

Endoscopic treatment aimed to treat the PSD in a video-assisted way using a fistuloscope. [9] This approach was described for the first time in 2014 in adults by Meniero who called the technique (EPSiT) endoscopic pilonidal sinus treatment. [10] First evidence showed that it was a safely performed procedure with better aesthetic outcome and very well tolerated pain control with a rapid and less complicated recovery. [11]

Esposito et al in 2016 modified the technique described in adults adapting this approach for the pediatric population and established a standardized protocol known as Pediatric Endoscopic Pilonidal Sinus Treatment (PEPSiT)[12], which incorporates pre-operative and post-operative laser epilation [13], endoscopic ablation using a fistuloscope, structured wound care adopting ozone products and more recently, platelet-rich plasma (PRP).

Our group begun to use PEPSiT in 2016 publishing early outcome data in 2017.

In this manuscript we report our 10-year experience (2016-2025) with pediatric endoscopic pilonidal sinus treatment (PEPSiT) in 507 pediatric patients operated for PSD focusing on the long-term outcomes, protocol evolution and factors associated with treatment success. Effective post-operative management is critical for achieving optimal outcomes in pilonidal sinus disease.

It includes optimal wound care, infection prevention, pain control, early mobilization and hair removal strategies, all combined with structured long-term follow-up to detect recurrence early and ensure patient adherence to preventive measures.

Methods

Study design and population

We retrospectively reviewed all patients, with primary or recurrent pilonidal sinus disease (PSD), undergoing PEPSiT in the period 2016–2025.

We operated 507 patients (313 boys and 194 girls) with a median age of 15.5 years (12-18 years). All patients received pre-operative laser therapy, PEPSiT

procedure and post-operative dressing and laser epilation. All patients were treated using the PEPSiT technique, as alternative, more invasive approaches are considered outdated in our center, which specializes in minimally invasive surgery.

All the patients presented when scheduled for the operation a non-infected pilonidal sinus fistula, in case of an active infection or abscess, we usually perform an antibiotic therapy to solve the infection and after 1–3 weeks, we proceed with the surgical intervention.

Four-hundreds-thirty-six patients (86%) presented a primary PSD.

Seventy-one patients (14%) presented a recurrent PSD after open surgery.

Two hundred-thirty-five patients (46.3%) presented more than 1 orifice and twenty-seven patients (5.3%) presented an associated cyst.

Variable	Value
Total of patients (n)	507
Median age (years)	15.5 (range 12-18)
Sex – male	313 (61.7%)
Sex – female	194 (38.3%)
Primary PSD	436 (86%)
Recurrent PSD after open surgery	71 (14%)
Patients with >1 orifice	235 (46.3%)
Patients with associated cyst	27 (5.3%)
Preoperative laser epilation	100%
Fistuloscope used	100%
Laser instead of monopolar energy	10 (2%)
Irrigation: saline	400 (78.9%)
Irrigation: mannitol	107 (21.1%)

Table 1. Patient demographics and preoperative characteristics (N = 507)

Surgical technique

All patients and their parents signed a specifically formulated informed consent before the procedure. Patients received a specific type of subarachnoid spinal anesthesia with hyperbaric mepivacaine 0.1% and

antibiotic prophylaxis with ampicillin 50mg/kg EV at the time of induction. The patients were placed in prone position with buttocks separated by two big plasters.

Surgeon’s position was on the lateral side of the patients, and the screen was at feet of the patient. We also adopted a second screen, placed at the head of the patient if we moved cranially, in relation to the fistula opening and direction. [14]

All procedures were performed using a fistuloscope, a brusher, a monopolar electrode, and an endoscopic grasping forceps. In 10 patients (2%) instead of monopolar coagulation we adopted laser to coagulate the inflammation tissue.

A fistuloscope (8° angled view, optical and working channels, with saline or mannitol irrigation) was used to identify the primary and secondary tracts. A removable handle permits easier maneuvering and better ergonomics for the surgeon. [15]

As irrigation solution we adopted standard saline solution in 400 cases and mannitol solution in 107 cases, the choice was guided on the availability of these products. [16]

According to the technique described in previous papers in the diagnostic phase all external orifices were explored to avoid untreated tracts. The cavity was ablated circumferentially, including the roof, by rotating the fistuloscope to ensure complete coagulation, using the 3 fistuloscope set instruments, a grasper, a monopolar electrode and a brusher. [17]

Postoperative management

After discharge from the hospital, parents were instructed on how to take care of the wound daily (twice a day) by cleansing it with sterile saline solution and applying topically different products. [18] In first 2- years of our experience we adopted eosin and silver sulfadiazine spray, between 2nd and 8th year we adopted ozone oil products and in the last 18 months we associated to ozone products also platelet rich plasma (PRP) serum. [19] The wound care protocol includes irrigation of the cavity with 10-20 mL of saline and injection of a little amount (<0.5cc) of ozonated oil by introducing the tip of the syringe through external tip. The wound is then covered with a hyaluronic acid-based wet gauze. [20] All the dressings were performed at home for 3-5 weeks after surgery. The external openings were left open and covered with a dressing. [21]

No drain was placed after surgery, except for severe cases. Laser epilation continued postoperatively after wound healing. Oral amoxicillin-clavulanate

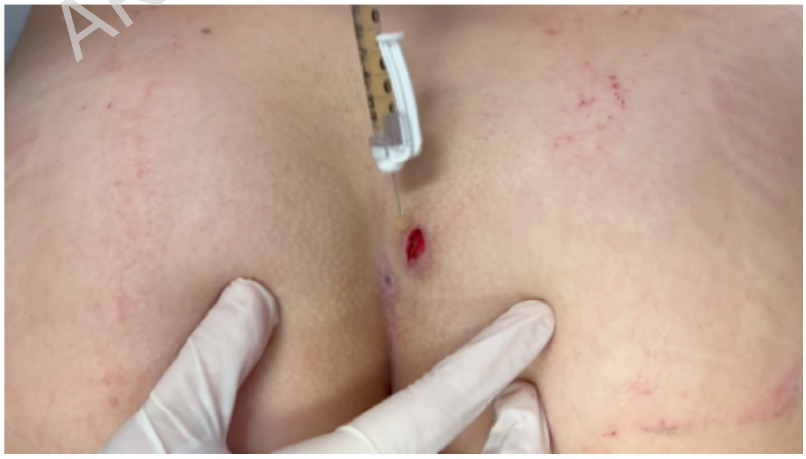

Figure 3

was prescribed for 5 days. [22]

Outcomes

Primary outcomes assessed included time to complete wound healing, defined as the number of days from the surgical procedure to complete epithelization of the wound without discharge or signs of infection, confirmed on clinical examination; the incidence of postoperative complications, any adverse event occurring after surgery, including wound infection, dehiscence, or delayed healing, recorded according to standard clinical criteria; disease recurrence defined as the reappearance of pilonidal disease at the surgical site after initial complete healing, confirmed on physical examination; and overall patients' satisfaction assessed using the Pediatric Quality of Life Enjoyment and Satisfaction Questionnaire (PQ-LES-Q) for a more subjective evaluation of life satisfaction.

Secondary outcomes included postoperative pain calculated with VAS score, return to daily activities, defined as the time required for the patient to resume normal school or recreational activities without limitations due to pain or wound care, and feasibility of home wound care, evaluated based on patient and caregiver reports regarding the ease, comfort, and adherence to the prescribed home care regimen, including dressing changes and hygiene practices.

Follow up

Follow up was conducted at regular intervals, with a median duration of 72 months (range 4-120 months). It was standardized according to the postoperative adjunctive treatment. Patients treated with ozonated oil dressings were scheduled for clinical evaluations on postoperative day 7 and at 1 and 2 months after surgery. Following visits were planned accordingly to

the wound healing and the patient recovery. Patients undergoing platelet-rich plasma (PRP) therapy followed at regular 10-day intervals starting from the first postoperative visit, for a total of four visits in which PRP was administered according to the study protocol and a comprehensive clinical evaluation of the surgical site was performed. Most patients had long-term surveillance well beyond the 24-month window in which all recurrences were observed. Therefore, limited follow-up for a little number of patients is unlikely to have substantially biased recurrence detection.

Statistical analysis

Descriptive statistics were used to summarize baseline characteristics and clinical outcomes. Continous variables were reported as median and range or mean ± standard deviation while categorical variables were reported as counts and percentages. Follow-up duration was calculated from the date of surgery to the last clinical visit or recurrence.

Results

Postoperative course

All patients resumed normal daily activities 1 day after surgery and they were discharged the same day or the morning after. The post-operative course was painless in 100% of patients (median VAS pain score < 2/10). Patient satisfaction was excellent (median score 4.8/5).

The dressing after surgery was performed in all patients with ozone oil products and in the last 18 months also with PRP. The median follow-up was 72 months (range 4–120).

Variable	Value
Same-day discharge or next morning	100%
Return to normal daily activities	Within 24 hours in all patients
Pain score (VAS)	<2/10 in 100%
Patient satisfaction score	Median 4.8/5
Postoperative dressing: ozone oil	100%
Postoperative oral antibiotics	Amoxicillin-clavulanate x 5 days

Table 2. Operative and postoperative data

Healing process

Complete healing in 4-5 weeks was achieved in 397 patients (78.3%) and the median healing time was 27.5 days (range 21–37).

Follow up duration

Follow-up was predominantly long term. Only 20 patients (3.9%) had <24 months of follow up, 39 (7.7%) between 24-36 months, and 80 (15.8%) between 36-60 months, whereas the majority of patients (368, 72.6%) were followed for more than 60 months with a median of 72 months (range 4-120).

Complications

We reported post-operatively immediate Clavien grade 2 complications in 17/507 (3.3%) patients (12 oedema, 5 burns) and delayed Clavien grade 2 complications in 41/507 (8 %) patients (9 granulomas, 32 wound infections).

Wound infections were defined based primarily on clinical criteria, including local signs of infection such as erythema, warmth, swelling, pain and purulent discharge. There was no sign of systemic symptoms. Diagnosis was made during scheduled outpatient follow-up visits or additional visits as soon as symptoms were reported. All infections were treated conservatively with local disinfection of the wound and oral antibiotic therapy with amoxicillin-clavulanic acid if tolerated by the patient. Wound infections were associated with delayed healing and only in one patient was it associated with disease recurrence in our series.

Recurrence rate

Disease recurrence occurred in 53/507 (10.4%), in median after 3 months (2 months-23 months) who were re-operated using PEPSiT with no further recurrence observed. No events were recorded beyond 2 years, indicating that late recurrence was not observed in this cohort.

Outcome	**Value**
Median follow-up	72 months (range 4–120)
Follow up duration	**n (%)**
<24 months	20 (3.9%)
24-36 months	39 (7.7%)
36-60 months	80 (15.8%)
>60 months	368 (72.6%)
Total	**507 (100%)**
Patients healed in 4–5 weeks	397 (78.3%)
Median healing time	27.5 days (range 21–37)
Complication Category	**n (%)**
Immediate complications (n = 17; 3.3%)	
– Edema	12
– Burns	5
Delayed complications (n = 41; 8.0%)	
– Granuloma	9
– Wound infection	32
Total complications	58/507 (11.4%)
Recurrence rate	53/507 (10.4%)
Median time to recurrence	3 months (range 2–23)
Reoperation with PEPSiT	100% of recurrences

Further recurrence after redo PEPSiT	0%

Table 3. Healing outcomes and follow-up

Discussion

Pilonidal sinus disease (PSD) is an inflammatory disease affecting the gluteal region. [23]

This condition mainly affects adolescents and young adults with a peak incidence between 13 and 22 years. [24]

The symptoms of this pathology can be debilitating, physically and especially socially, and the only solution to treat this disease is surgical therapy. [25]

In the last 25 years several techniques have been described for the surgical treatment of PSD. [26]

Analyzing the international literature, open surgery with a large excision of tissues of the affected area is largely adopted in adult patients. However, open surgery is always performed using general anesthesia and it is associated with high complication rate and morbidity, with a very long healing time of more than 2 months, and high recurrence rate in about 20-40 % of cases. [27]

After the first report of the endoscopic treatment of pilonidal sinus disease called EPSIT firstly described by Meinero in 2014 in the adults, our group modified in 2015 this approach to adapt it to children, creating a new structured protocol. [28]

The protocol consists in pre- and post-operative laser epilation [29], endoscopic treatment using a fistuloscope using monopolar coagulation or laser energy, and a 4–5-week duration post-operative wound dressing with oxygen-enriched oil and platelet rich plasma (PRP).

In the last 10 years, our group published several papers about several aspects of the minimally invasive treatment of pediatric endoscopic treatment of PSD (PEPSiT) showing that PEPSiT has less post-operative discomfort for the patients and lower recurrence rates compared with open surgery. [30] In children and adolescents, pilonidal disease is traditionally managed with a variety of approaches, ranging from conventional open excision with secondary healing to primary closure or flap-based procedures. However, these techniques are often associated with prolonged wound care, postoperative pain, delayed return to daily activities, and relatively high recurrence rates, which may be particularly burdensome in younger patients. In recent years, there has been a progressive shift toward minimally invasive strategies in pediatric surgery aimed at reducing tissue trauma and accelerating recovery.

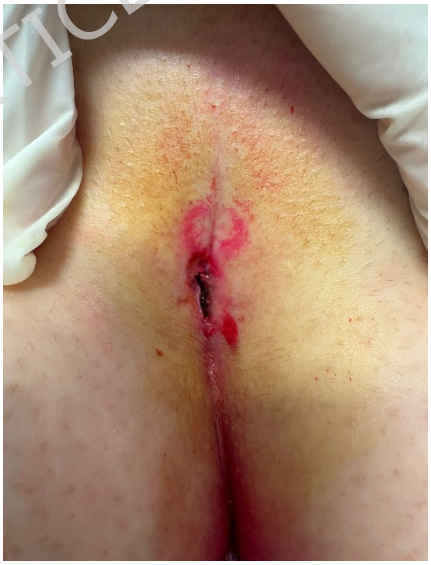

Figure 1

With this paper after 10 years' experience of PEPSiT, we would like to give an overview of the results of this technique with more than 500 patients treated.

We believe that PSD is mainly a pediatric pathology, because the symptoms of PSD always begin during the adolescence period (14-15 years old) and in the last years the number of patients that we operated per year increased dramatically, passed from 3-4patients per year before PEPSiT to 50 patients per year in PEPSiT era. [31]

We believe that the 3 key points of the technique are the pre- and post-operative laser epilation, the use of an adequate instrument, the fistuloscope and the post-operative dressing using ozone products and PRP.

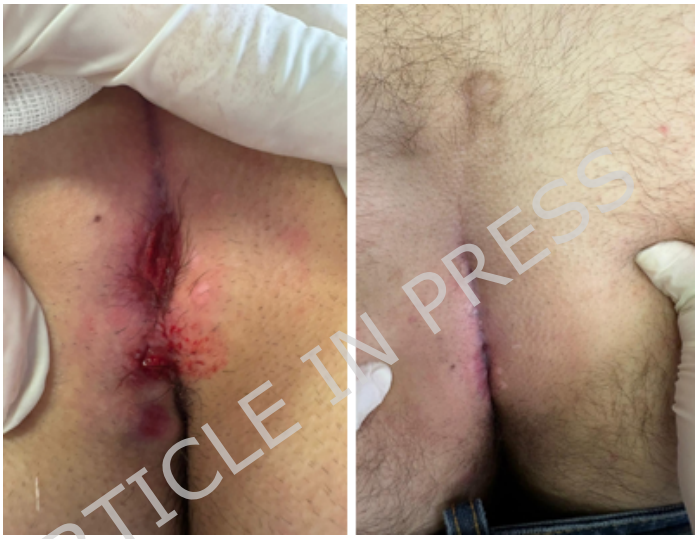

Figure 2

Analyzing singularly these 3 points, the laser epilation pre and postoperatively is an essential aspect of the technique above all in patient with hirsutism, in a previous paper we showed that laser epilation improves statistically the results of surgical technique. [32]

The second aspect is that you need fistuloscope to perform this procedure, fistuloscope is similar to a pediatric operative cystoscope, but it is stronger because you can use monopolar coagulation for a long time during the procedure. At the beginning of our experience when we did not have a fistuloscope, we broke a couple of neonatal cystoscopes that we used to perform PEPSiT since they were too fragile for this procedure. [33]

The last aspect is wound care which plays a central role in achieving timely healing. In many patients, more than 78%, the healing time was 4-5 weeks. As for postoperative dressing, we tested several products, and in our experience ozone oil products give better results compared to the standard dressing. [34]
In the last 18 months we adopted also platelet rich plasma serum (PRP) [35] that is particularly useful to heal big orifice or when there is an associate cyst to PSD. [36] We noted also that the PRP treatment is contraindicated in case of small orifices, because we noted that it causes the rapid closure of the orifice while the deeper cavity under the orifice remains open and it can increase the recurrence rate. [37]
As for the technical point of view, the mannitol seems better than saline solution as irrigation liquid because it conducts electricity better.
In addition is important, during the last phase of procedure, when you need to coagulate all the walls of fistulas circumferentially, to rotate the fistuloscope of 180% to coagulate also the roof of the fistulas in a perfect way. [38]
As for complication rate in our series, it varies from 3% to 8%, and in general there were problems easy to solve that did not require further surgery.
After 10 years of experience our recurrence rate (10%) is higher compared to the beginning of our experience when it was about 7%, because we noted that recurrences can happens also 2 years after surgery.
PEPSiT can be adopted also in patients with a recurrent PSD after open surgery, but in this category of patients the recurrence rate seems higher. [39]

However the main advantage of PEPSiT is the post-operative course, the patient can sit and sleep normally, and patients resume sports and social life immediately after surgery.

Also, post-operative dressing, that is an essential point, is easy to perform at home by parents.

From an anatomical point of view, we noted that about 50% of the patients have more than one orifice. It is mandatory to explore all the orifices with the fistuloscope and to treat all the PSD tracts in the same way, because leaving an orifice untreated can cause the recurrence of the disease. [40]

Limitations

The main limitations of this study include its retrospective nature and the lack of a randomized comparative group. Moreover, follow-up was not uniform across all patients, and a small number were observed for less than 24 months. Although this may represent a potential source of bias, the large sample size and the early occurrence of all recurrences reduce the impact of this limitation on the overall interpretation of the results. The single-center design may limit the generalizability of our findings, such as patient populations, clinical protocols, and resource availability can vary substantially across institutions. Additionally, outcomes may have been influenced by the specific expertise and experience of the team at our institution, potentially leading to results that are not fully reproducible in centers with different levels of specialization or procedural volume. Therefore, while these aspects should be considered, they do not significantly weaken the clinical relevance of findings.

Conclusion

In conclusion, we believe that PEPSiT may represent a promising approach for surgical treatment of PSD in children and teenagers. PEPSiT is technically easy to perform if you have adequate instrumentation, with short and painless post-operative course and low recurrence rate (10.4%). Standardized treatment protocol, correct patient pre- and post-operative management and long-term follow-up are key points for the success of the procedure.[41]

Additional information

Data availability

The datasets generated and analyzed are not publicly available due to restrictions related to patient confidentiality but are available from the corresponding author upon reasonable request.

Ethics approval

This study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board (IRB) at Federico II University Hospital at Federico II University of Naples. Written informed consent was obtained from all participants and their legal guardians prior to inclusion.

Competing interests

The authors declare no competing interests.

Funding declaration

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Figures legend

Figure 1 PSD after treatment
Figure 2 Follow up after PEPSiT
Figure 3 PRP injection

Author contributions

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