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Operative Techniques

Technical standardization of MIS management of children with pilonidal sinus disease using pediatric endoscopic pilonidal sinus treatment (PEPSiT) and laser epilation☆

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ABSTRACT

Purpose: This study aimed to standardize the technique of pediatric endoscopic pilonidal sinus treatment (PEPSiT) associated with laser epilation.
Methods: All pediatric patients presenting with acute or chronic pilonidal sinus disease (PSD) who underwent PEPSiT in our institution over a 36-month period (July 2015–July 2018), were included in the study. Pre- and postoperative management, recurrence rate, postoperative pain, hospital stay, analgesic requirements, and patient satisfaction levels were evaluated.
Results: A total of 59 patients (23 girls and 36 boys) underwent PEPSiT during the study period. Ten/59 patients (16.9%) had recurrent PSD after open repair, and 4/59 (6.7%) presented a concomitant pilonidal cyst. All children underwent laser epilation pre- and postoperatively over the last 15 months. The average length of surgery was 27.5 min (range 20–45). The average pain score during the first 48 postoperative hours was 2.7 (range 2–5), and the average analgesic requirement was 20 h (range 16–24). The average hospitalization was 22.4 h (range 18–36). At 1 month postoperatively, external openings were healed in all patients. During follow-up, 1 recurrence (1.6%) was recorded and successfully re-treated with PEPSiT.
Conclusions: We believe that PEPSiT represents the technique of choice for treatment of PSD in the pediatric population. It is crucial to standardize the technique consisting of pre- and postoperative laser epilation, PEPSiT, and accurate postoperative wound management with eosin and sulfadiazine spray.
Level of evidence: Treatment study — Level IV

Pilonidal sinus disease (PSD) is a common inflammatory disease, with a reported incidence among teenagers of 26:100.000 [1,2]. Known risk factors include family history, local irritation, sedentary occupation, and obesity [3,4]. PSD is considered an acquired disorder, owing to the obstruction of hair follicles in the natal cleft, causing recurrent inflammation with formation of subcutaneous abscesses and usually multiple fistula tracts [5]. The clinical presentation is variable, ranging from asymptomatic pits to acute abscess to chronic cyst, with a considerable negative impact on quality of life [1,3]. Although PSD is common, very little has been written about its occurrence in pediatric patients. More recently, there has been an increasing interest with treatment of this pathology, related to the use of minimally invasive surgery [6]. However, the gold standard technique for surgical treatment of PSD still remains under debate. The ideal surgical technique should eradicate the cyst and remove and clean the sinus tract and secondary tracts, leading to complete and durable healing with good cosmetic outcome [7,8]. The traditional open excision is extremely invasive, with a long and painful postoperative course and high morbidity rates [9]. All these reasons have moved the surgeons to find new surgical strategies to treat this pathology. In 2014, Meinero et al. described a novel minimally invasive approach for PSD, named endoscopic pilonidal sinus treatment (EPSiT), reporting very promising results in adults such as a shorter wound healing and time off work and also improved pain control and cosmesis [10]. We applied this technique in the pediatric population, calling it pediatric EPSiT or PEPSiT and we recently published our preliminary experience with PEPSiT as an effective treatment option of PSD in children and adolescents [11,12]. After about 3 years of experience with this technique, we believe that the key-factor to obtain the complete and fast healing of PSD after PEPSiT is not only the standardization of the surgical technique but also a pre- and postoperative laser epilation and a scheduled wound management.

In this paper we reported the different steps of PEPSiT adopted in our center with the aim to describe the technical standardization of this procedure.

☆ Declarations of Interest: None

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1. Materials and methods

All pediatric patients, presenting with acute or chronic pilonidal sinus disease (PSD), who underwent PEPSiT in our institution over a 36-month period (July 2015–July 2018), were included in the study. Patients presenting with acute pilonidal abscess were not excluded from the study; however, they received antibiotic therapy and they were operated on 2–3 weeks after resolution of the inflammatory process.

All PEPSiT procedures were performed by a single pediatric surgeon, who mastered proficiently the technique. All patients and their parents signed a specific informed consent before the procedure.

Follow-up included outpatient evaluation at 1, 2 and 4 weeks postoperatively, then monthly until 6 months after surgery and then every 3 months until 18 months after surgery, followed by annual controls. During the follow-up, all the patients were monitored for healing, pain, complications, recurrence and satisfaction. We asked to all patients at time of follow-up evaluations to score their satisfaction about postoperative course of PEPSiT using a 5-items Likert-type scale (0–5), with 1 = very poor; 2 = poor; 3 = average; 4 = good; 5 = excellent, considering cosmetic results and level of pain, discomfort and physical limitations that they experienced after PEPSiT.

The primary endpoint of the study was complete wound healing, defined as closure of all external openings during the first 60 postoperative days. Disease recurrence was considered when symptoms and/or local inflammatory signs such as secretion occurred after any interval following complete wound healing. Secondary outcome parameters were healing time, operative time, intra- and postoperative complications such as wound infections.

Since the definitive standardized protocol for PEPSiT has been applied during the last 15 months of the study period, with definitive introduction of pre- and postoperative laser epilation, we analyzed separately the outcomes of PEPSiT, before and after the introduction of our standardized treatment protocol. We grouped the patients according to the study period, before and after the introduction of our protocol: Group 1 (July 2015–April 2017) and Group 2 (April 2017–July 2018) and we compared the 2 groups in regard to patients' characteristics and outcome of surgery.

The study received the appropriate Institute Review Board (IRB) approval at Federico II University of Naples, Italy.

1.1. Preoperative management

In the last 15 months, hair removal was performed in all of the patients before surgery by the same technician using a pulse-dye laser. Hair removal was performed in the affected area of the intergluteal sulcus including an additional 5 cm area on both sides of the natal cleft. Each patient received preoperatively at least 2–3 laser treatments at 4–6 weeks intervals, according to their local status (Fig. 1).

1.2. Operative technique

Patients received a specific type of subarachnoid spinal anesthesia and antibiotic prophylaxis. They were placed in prone position with buttocks retracted with adhesive tape. The main surgeon was at the patient's right on a step, in order to have a better ergonomics for shoulders. Two screens were placed, one at feet and the other at head of the patient, to be adopted alternatively in relation to the fistula opening. PEPSiT was performed using a 10 Ch fistuloscope, manufactured by Karl Storz, equipped with a monopolar electrode connected to the electrosurgical knife power unit, an endoscopic brush and an endoscopic grasping forceps. The fistuloscope has an 8° angled eyepiece and is equipped with an optical channel and a working and irrigation channel. Its diameter is 3.2 × 4.8 mm, and its operative length is 18 cm. A removable handle allows easier maneuvering and better ergonomics for the surgeon; the handle can be moved in different position in order to ease the surgical procedure, according to the surgeon's preference.

A 5-phase surgical technique was employed in all cases. In the first phase (fistuloscope's entry), the fistuloscope was introduced through the fistula's external orifice. If the external orifice was too small, it was widened with a spreading clamp in order to allow introduction of the fistuloscope. In patients with >1 opening, the lower pit was used for access. In the second phase (sinus and its lateral tracts identification), a clear identification of the anatomy of the sinus cavity and its lateral tracts was allowed by a continuous jet of irrigation solution used as distension medium. In the third phase (hair removal), all the hairs and bulbs were removed under vision using the endoscopic forceps, inserted through the operative channel of the fistuloscope. In the fourth phase (sinus brushing), the sinus cavity was accurately debrided using the endoscopic brush and any necrotic material and granulation tissue were eliminated by the saline solution flow. Finally, the fifth phase (sinus cavity ablation) was to obtain complete ablation of the sinus cavity. During this step, a cautery ablation of the sinus granulation tissue was performed using the monopolar electrode, proceeding centimeter by centimeter and cauterizing all fragments of the material adhering to the wall of the sinus, commencing in the main tract and where appropriate traversing secondary tracts. All potential accessory cavities and any lateral tracts were identified and ablated and an accurate hemostasis was performed. No drain was placed at the end of procedure. External openings were not closed and were covered by a compression dressing.

All the steps of the surgical technique are shown in Video 1.

In 4 patients, beside the fistula, we also found a concomitant pilonidal cyst that was always located laterally to the fistula's orifice. The cysts were removed with a small 1-cm incision and then sent to histological examination.

1.3. Postoperative management

Oral intake was allowed immediately after operation and patients were encouraged to walk after 2–3 h and to keep a normal decubitus in the immediate postoperative period. After discharge, the patients were instructed to clean the wound with sterile saline solution and apply a 2% eosin solution and a silver sulfadiazine spray 3–4 times/day for at least 2–3 weeks postoperatively (Video 2). All the patients were given no restrictions in return to daily activity. After complete wound epithelization, they underwent radical hair epilation using pulse-dye laser technology. Hair removal was performed in the affected area of the intergluteal sulcus including an additional 5 cm area on both sides of the natal cleft. Each patient received average 4–5 laser treatments at 4–6-week intervals, according to their local status (Fig. 2).

2. Results

The medical records of 59 consecutive pediatric patients, 23 girls and 36 boys with an average age of 16 years (range 13–18) with PSD, who underwent PEPSiT in our institution during the study period, were retrospectively reviewed. All the patients presented with acute or chronic pilonidal sinus fistulas. Ten out of 59 patients (16.9%) had a recurrent PSD after failed open repair performed in general surgery units. All of the recurrent cases had been treated with a wide excision followed by primary closure. In addition, 4/59 (6.7%) patients presented a pilonidal cyst in association with the fistula.

The average length of surgery was 27.5 min (range 20–45). No intra- or postoperative complications were reported. All the patients were asked to evaluate postoperative pain using the Visual Analogue Scale (VAS) pain scale and the average pain score during the first 48 postoperative hours was 2.7 (range 2–5). The analgesic requirement (Paracetamol 15 mg/kg every 8 h) was limited to the first 24 postoperative hours (average 20 h; range 16–24). The average hospital stay length was 22.4 h (range 18–36). We performed PEPSiT as an outpatient

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Fig. 1. Preoperative laser epilation: results at time 0 (0), after 1st laser session (1) and after 2nd laser session (2).

procedure in selected cases but most of patients had an overnight hospitalization since we preferred to appropriately instruct the parents about the wound management they had to perform at home, considering it a crucial point for the success of the procedure. Parents were instructed on how to treat the wound daily by applying topically an antiseptic solution of 2% eosin and a silver sulfadiazine spray for at least 2–3 weeks postoperatively. In general, we selected the patients for admission on the basis of the expected compliance of the parents to the recommendations prescribed after hospital discharge. The average time to return to work and/or school and daily activities was 2.5 days (range 1–4). The average score reported by patients about their satisfaction level was 4.7 (range 3.8–5). They declared to be highly satisfied with the overall postoperative course and above all with the excellent cosmetic results and the absence of pain and any physical limitations during the postoperative period. The overall healing rate was 100% and the average healing time was 24 days (range 21–30). At 1 month postoperatively, the complete healing of external openings was obtained in all the patients (Fig. 3). With a maximum follow-up of

Fig. 2. Postoperative laser epilation: results after 1st (1), 2nd (2), 3rd (3) and 4th laser session (4).

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Fig. 3. Wound healing process, after 1 week (a), 2 weeks (b), 3 weeks (c) and 4 weeks (d) postoperatively.

30 months, only 1 recurrence (1.6%) was recorded and successfully re-treated with PEPSiT 3 months following the first treatment.

Patients' demographics and results are summarized in Table 1.

The comparative analysis of the 2 groups, treated before and after the introduction of our standardized treatment protocol, revealed no significant difference between the 2 groups in regard to patients' characteristics. Regarding outcome of surgery, Group 2 was associated with a significantly shorter operative time compared to Group 1 (32 min vs 23.5 min) ($p = 0.001$). In addition, the average healing time was significantly shorter in Group 2 (20.5 days) compared to Group 1 (27.5 days) ($p = 0.001$). One recurrence was reported in Group 1 but this difference was not statistically significant ($p = 0.51$). We believe that the shorter operative time in Group 2 was because of the improvement of the learning curve of PEPSiT. In addition, the faster healing process reported in Group 2 could be related to the improvement of wound management, including dressings and laser epilation, offered by our treatment protocol, that provided more local hygiene and a dry setting to ease the process healing.

The separate outcome analysis before and after the introduction of our standardized treatment protocol for PEPSiT was reported in Table 2.

Table 1
Patients' demographics and results.

Patients' demographics	Value
Number of patients, n	59
Male/female, n/n	23/36
Average age, n (range)	16 (13–18)
Average weight, kg (range)	66.5 (55–92)
Associated comorbidity, n	0
Recurrent PSD, n (%)	10 (16.9%)
Associated pilonidal cyst, n (%)	4 (6.7%)
Results	**Value**
Average operative time, min (range)	27.5 (20–45)
Intraoperative complications, n	0
Average VAS score:	2.7 (range 2–5)
▪ 48 h after surgery	
Average analgesic requirement, h (range)	20 (16–24)
Average hospital stay length, h (range)	22.4 (18–36)
Average time to return to daily activities, days (range)	2.5 (1–4)
Wound infection, n (%)	0
Recurrence, n (%)	1 (1.6%)
Overall healing rate (%)	100
Average healing time, days (range)	24 (21–30)
Satisfied patients (%)	100

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Table 2
Separate outcome analysis before and after the introduction of our standardized treatment protocol for PEPSiT.

	Group 1 (July 2015–April 2017)	Group 2 (April 2017–July 2018)	Statistical analysis
Patients' demographics			
Number of patients, n	20	39	p = 0.001
Male/female, n/n	13/7	22/17	p = 0.55
Average age, years	15.5	16.5	p = 0.37
Average weight, kg	63.5	69.5	p = 0.55
Associated comorbidity, n	0	0	
Recurrent PSD, n (%)	3 (15%)	7 (17.9%)	p = 0.51
Associated pilonidal cyst, n (%)	1 (5%)	3 (7.6%)	p = 0.55
Outcome of surgery			
Average operative time, min	32	23.5	p = 0.001
Intraoperative complications, n	0	0	
Average VAS score:	2.5	2.2	p = 0.57
▪ 48 h after surgery			
Average analgesic requirement, hours	22	18	p = 0.33
Average hospital stay length, hours	24	20.8	p = 0.55
Average time to return to daily activities, days	2.7	2.3	p = 0.55
Wound infection, n (%)	0	0	
Recurrence, n (%)	1 (5%)	0	p = 0.51
Overall healing rate, %	100	100	p = 0.33
Average healing time, days	27.5	20.5	p = 0.001

3. Discussion

After the first application of endoscopic surgery to treat anal fistulas in adults described by Meinero in 2006 and named Video-Assisted Anal Fistulas Treatment (VAAFT) [13] and the subsequent application of endoscopic surgery also for treatment of pilonidal sinus disease (PSD) described by Meinero in 2014 and named Endoscopic Pilonidal Sinus Treatment (EPSiT) [10], this technique has also been adopted to treat PSD in the pediatric population [11,12,14]. We started to adopt this technique in 2015 and we modified some aspects of the technique originally described by Meinero in adults [10] with the aim to adapt the procedure to the pediatric population and we called it PEPSiT (Pediatric Endoscopic Pilonidal Sinus Treatment) [11,12]. The first paper [11] that we published on PEPSiT reported our preliminary experience with this technique and the preliminary results in the first 15 patients operated on over an 18-month period (July 2015–January 2017). The second report [12] was a multicentric series, coordinated by Pini Prato in the same period (July 2015–March 2017). We participated to this multicentric study, referring the results of the same 15 patients published in the first report [11]. This third paper aimed to present a larger series (n = 59), including all patients operated on with PEPSiT in our surgical unit over a 36-month period (July 2015–July 2018). In addition, the paper reported a longer follow-up with more standardization of the procedure, compared to the previous two reports [11,12].

We believe that this technique has dramatically changed the management of PSD in children; in fact, whereas we operated only 3–4 patients per year in our center before introduction of endoscopic surgery, the average number of patients has grown to about 30 per year after introduction of PEPSiT. Since introduction of PEPSiT in our surgical practice in July 2015, all patients presenting with PSD were candidates to PEPSiT. We believe that there are practically no contraindications to PEPSiT. Probably, only recurrent cases presenting as open wounds from previous failed open repair, which we did not encounter in our experience, would be not suitable for PEPSiT. Furthermore, until a few years ago many patients with pilonidal fistulas refused to be operated for the bad postoperative course of open repair associated with high postoperative pain, prolonged hospital stay and long time for healing [15–17]. In the last 2 years, we observed, as we already stated, a huge increase in the number of patients who choose to undergo PEPSiT.

After more than 36 months of experience, we have standardized the steps of the technique reporting a success rate higher than 98% with a painless postoperative course and a very short hospital stay. In our opinion, essential factors for the treatment success are the use of PEPSiT procedure with all advantages of endoscopic surgery but also the laser epilation in the pre- and postoperative period in order to decrease the recurrence rate near to zero. It is crucial to standardize not only the procedure itself but also the pre-operative preparation and the postoperative management.

The originality of the paper is that for the first time we set-up a standardized protocol to treat patients with PSD. This protocol includes 3 steps, the first one providing preoperative laser epilation, the second one providing surgical treatment and postoperative wound management until complete wound healing, and finally the third step providing a radical hair removal with laser technology after complete wound epithelization. We believe that this standardized protocol is crucial to obtain the excellent results reported in our series and can be replicated in any other surgical center. Our clinical results confirmed the great impact of this protocol on surgical outcomes; in fact, a faster healing process was reported in Group 2 (treated with standardized protocol) and this faster healing process could be related to the improvement of wound management, offered by our standardized treatment protocol, that provided more local hygiene and a dry setting to ease the process healing.

Considering that the hirsutism is one of the most common etiologic factors of PSD and an important risk factor for its recurrence [4], before surgery all the patients underwent a laser epilation of the pilonidal region. Each patient received preoperatively at least 2–3 treatments according to the local status.

PEPSiT, as we already reported, has two phases: a diagnostic phase and an operative phase [11]. In the diagnostic phase, it is crucial to identify the anatomy of the pilonidal sinus and any secondary tracts and/or abscess cavities. Before entering into the fistula's path with the fistuloscope, injection under pressure of saline solution with a syringe may be useful in order to enlarge and wash the cavity. If the fistula's orifice is too tight, it may be widened with a spreading clamp in order to allow introduction of the 10 Ch fistuloscope. In the patients with multiple external orifices, the lower pit is usually used for access. However, in some more complex cases, the fistuloscope can be introduced through multiple pits, according to the local anatomy. In the following operative phase, it is extremely important to remove all the hairs and bulbs present in the pilonidal cavity with the grasping forceps and all the necrotic material with the endobrush. Then, a careful cautery ablation of all sinus granulation tissue should be performed with the monopolar electrode, commencing in the main tract and where appropriate traversing secondary tracts and abscess cavities. In presence of a concomitant pilonidal cyst, which is usually located laterally to the fistula's opening, an additional small incision may be required in order to remove the cyst, as happened in about 6% of our patients. From technical point of view, a key-point of PEPSiT is the use of the fistuloscope with its removable handle that allows an easy maneuvering and a better ergonomics for the surgeon. Additionally, the surgeon usually stands on a step, in order to achieve a better ergonomics for shoulders during the procedure. The postoperative management is another key-factor for the success of the procedure. Parents should be instructed about the wound management that they have to perform daily by applying topically an antiseptic solution of 2% eosin and a silver sulfadiazine spray for at least 2–3 weeks postoperatively. In addition, laser epilation should be continued in the postoperative period in order to achieve a radical hair removal in the affected area with the aim to significantly decrease the recurrence rate. After completion of the wound healing process, all the patients of

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our series received average 4–5 laser treatments at 4–6-week intervals. In many cases, the reason for the high recurrence rate of PSD is not likely to be an unsuccessful operative procedure and unsuccessful removal of the lesion. Rather, it is more likely to be because of failure to pay strict and constant attention to the prevention of reaccumulation of hair in this area [19,20]. The role played by hair influences the management of PSD and control of hair growth in the perisinus area has shown to help in healing of the PSD and preventing recurrence [21–23]. Hair growth can be controlled by shaving the natal cleft regularly, using depilatory cream or with laser technology [20]. The latter option aims at removal of hair by photothermolysis of the hair follicles [24,25]. Laser depilation has an advantage over conventional shaving as the light can reach deep crevices in the natal cleft, which would otherwise be difficult to access [22]. The rationale of this management was to maintain a dry and clean setting in order to avoid the inclusion of hair and to facilitate wound healing [24,25]. Thanks to the standardization of the procedure, we obtained a success rate higher than 98% with only 1 recurrence (1.6%) that occurred in one of the first patients of our series, who did not undergo laser epilation. With the advent of PEPSiT, the recurrence rate of PSD has dramatically diminished, from 30% as reported with open repair [18] to 1.6% as reported with PEPSiT in our series. Additionally, none of our patients treated with PEPSiT experienced any of the problems encountered using the classic open repair, such as esthetical problems, infection, hematoma or wound dehiscence. In our experience, PEPSiT reported several advantages compared with traditional open techniques. First of all, the direct vision allows surgeons to clearly identify not only the pilonidal sinus, but also any possible fistula tracts or abscess cavities. The destruction can be modulated and there is the certainty of the complete removal of the infected area. Moreover, the hemostasis, which is one of the major problems with traditional open treatment, is perfectly done under direct vision. This direct vision also allows the complete removal of the hairs and their follicles, often located not only in the pilonidal sinus, but also in the surrounding tissues. PEPSiT was also useful in case of recurrent PSD after open treatment, as happened in 10 patients (16.9%) of our series. Before undergoing PEPSiT, all these patients, who had previously experienced the long and painful postoperative course of open surgical repair, were terrified by the idea to undergo a repeat surgery. After PEPSiT, all of them were enthusiasts with this technique for the excellent postoperative course and also for the good cosmetic outcome. Lack of pain, absence of scar, easy self-management at home, faster recovery and return to full daily activities and a low risk of recurrence or infections may explain the high satisfaction rate reported in our study.

On the basis of our experience, we believe that PEPSiT represents the technique of choice for surgical treatment of PSD in children and teenagers. PEPSiT is technically easy and fast to perform, with a short learning curve for the surgeons and a short and painless postoperative outcome for the patients and a low recurrence rate (1.6% in our series). However, it is crucial to standardize the steps of the technique consisting of pre- and postoperative laser epilation, PEPSiT procedure and postoperative wound management with eosin and sulfadiazine spray for at least 2–3 weeks postoperatively.

Declaration of interest

All authors declare that they have no conflicts of interest or financial ties to disclose.

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