

Pilonidal Cyst Excision: Primary Midline Closure with versus without Closed Incision Negative Pressure Therapy

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Background: Pilonidal cysts are a painful condition that primarily affect young adult men. In the literature, numerous operative techniques for resolving pilonidal cysts are described, with variable outcomes. The objective of this study was to compare primarily closed midline incisions managed with or without the use of closed incision negative pressure therapy after pilonidal cyst excision.

Methods: Twenty-one patients underwent excision and midline primary closure. Postoperative care composed of closed incisional negative pressure therapy (study group; n = 10) or gauze dressings (control group; n = 11). In both groups, the sutures were partially removed on day 14 and completely removed on day 21. Compared outcomes included the duration of hospitalization, pain on the day of surgical procedure, and on postoperative day 7, and time-to-healing.

Results: The median hospital stay was about 9 hours and 23 hours in the study and control groups, respectively ($P < 0.05$). The median pain scores on the day of operation were 1.20/10 in the study group and 3.36/10 in the control group ($P < 0.05$). On day 7, study group showed median pain score 0.9/10 and control group showed 2.63/10 ($P < 0.05$). The mean healing time was 23.8 and 57.9 days in the ciNPT group and gauze group, respectively ($P < 0.05$).

Conclusion: These outcomes supported the incorporation of closed incision negative pressure therapy into our surgical treatment protocol for pilonidal cysts. (*Plast Reconstr Surg Glob Open* 2021;9:e3473; doi: [10.1097/GOX.0000000000003473](https://doi.org/10.1097/GOX.0000000000003473); Published online 23 March 2021.)

INTRODUCTION

Pilonidal cysts, which manifest as small holes that are visible in the intergluteal groove, sometimes containing tufts of hair, are a fairly common, benign disease that primarily affects young adults under the age of 40.¹ The incidence rate of these cysts, which affect men 3–4 times more frequently than women,¹ has been reported in up to 48 in 100,000 inhabitants, consisting of 0.7% of the population.^{2,3} Although the pathogenesis is not fully understood,

the most accepted theories currently relate the disease to hair follicles, micro-trauma, and the depth of the intergluteal groove.⁴

Signs of infection of the pilonidal cyst include the presence of pain, heat, and erythema at the site, accompanied by secretion.⁵ In an asymptomatic patient with no signs of cyst infection, no surgical measures are necessary and general recommendations include the removal of local hair and adequate hygiene.^{6–8} In contrast, the treatment of symptomatic pilonidal cysts is preferably surgical,^{4,6,9} although there is still uncertainty regarding the best type of treatment to be adopted.⁶ Several techniques are described in the literature, from incision with drainage under local anesthesia in urgent situations to complex procedures such as excision with healing by primary or secondary intention.^{7,10,11} Primary intention includes suturing the wound edges in the midline or off-midline, with or without skin flaps.^{7,10,11} Excision of the cyst with primary or secondary closure of the intergluteal sulcus has been the most commonly used technique worldwide.^{6,11} However, recurrence rates after cyst treatment ranges from 0% to 100% in the literature^{11,12} and seem to depend more on follow-up time than on the type of therapy itself.^{11,13,14}

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Closing incisions following cyst removal is also a complex issue, with complications being primarily related to the lateral tension upon the sutures and excessive exudate.^{15,16} The *German National Guideline on the Management of Pilonidal Disease* study recommended avoiding delayed closure due to associations with prolonged scarring and late return to daily activities, and suggested primary closure with the incision outside the intergluteal groove.⁶ This procedure needs specific training owing to its technical difficulty.⁶ Guidelines from the American Society of Colon and Rectal Surgeons strongly recommended complete excision and primary closure outside the gluteal groove.¹⁷ Lastly, Singh et al advocated for complete excision of the pilonidal sinus with primary closure to shortening hospital stay, and minimizing risk of recurrence.¹⁶

Several factors have been reported to contribute to a reduction of morbidity at the surgical site. Including closure without tension, appropriate exudate management, efficient blood circulation, and the use of closed incision negative pressure therapy (ciNPT).^{18–20} Closed incision NPT uses a sterile foam dressing on the incision. It's connected to a device in order to apply a controlled sub-atmospheric pressure over the incisional surface.^{19,20} This creates a vacuum-closed system that can hold the incisional edges together, keep blood supply, and facilitate the removal of exudate.²⁰ Because it is a fully closed system, ciNPT can act as a barrier, keeping infectious materials out of the incisional area.¹⁹ Conventional negative pressure wound therapy (NPWT) was initially described in open wounds with tissue loss or several infections, whereas the application of ciNPT has shown encouraging results when used over closed incisions.^{19,21,22} In the surgical treatment of pilonidal cysts, the use of conventional NPWT for secondary closures showed advantages in terms of improved wound closure time and lower postoperative pain when compared with the secondary closure without NPWT.^{23,24} However, there have not yet been studies assessing the use of ciNPT over primary closure following surgical excision of pilonidal cysts.

Considering the evidence supporting the use of ciNPT in multiple incision types, we conducted a retrospective review of 22 cases of excised pilonidal cysts. Eleven patients received postoperative care with ciNPT, and 11 were managed with standard dressings. The objective of the present study was to compare the outcomes after surgical treatment of pilonidal cysts with primary closure technique over the intergluteal sulcus, with and without the use of ciNPT.

METHODS

Experimental Design

This was a retrospective study of patients who underwent surgical procedure for pilonidal cysts. All patients were diagnosed with symptomatic pilonidal cysts and admitted for complete surgical excision of the compromised tissue, followed by primary closure over the intergluteal groove and postoperative care with or without ciNPT. The exclusion criteria for the ciNPT group included unsupervised removal of the ciNPT dressing or loss of negative pressure before postoperative day (POD) 7, for any

reason. Twenty-two patients met the inclusion criteria and were included in the study: 11 patients received incision management with standard dressings (control group), and 11 patients received ciNPT (study group) (Fig. 1). One patient in the ciNPT group was excluded due to the premature removal of ciNPT dressings for bathing.

Surgical Procedure

The operations were done by the same surgeon.

All patients were placed in the horizontal ventral decubitus position, under spinal block and sedation, without using cushions or table angulations; all patients received prophylactic antibiotic therapy with cefazolin at induction of anesthesia. The buttocks were separated with a wide tape for better exposure of the intergluteal sulcus (Fig. 2). Aseptic and antiseptic techniques with 2% chlorhexidine gluconate were used in the preparation of sterile fields.

Cysts were removed with a wedge incision into the skin and subcutaneous cellular tissue (SCCT) (Fig. 3A). Removal of the cyst occurred without opening of the cyst. The depth of removal was the sacral fascia, with preservation of the integrity of the anal and perianal tissues (Fig. 3B). To avoid tension after closure, the skin was undermined approximately 1.5 cm from the edge of the incision (Fig. 3C). Adhesive tape was then removed, allowing the edges of the surgical wound to be approximated. Primary closure of the SCCT was achieved using inverted, interrupted 2-0 monofilament polydioxanone sutures. The skin was closed with simple interrupted 3-0 monofilament nylon sutures (Fig. 3D).

Postoperative Incision Management

In the control group (n = 11), the wound was covered with gauze and Tegaderm (3M+KCI Company; San Antonio, Tex.). In the ciNPT group (n = 11), the incision was managed with the PREVENA PEEL & PLACE 20 cm Incision Management System (3M+KCI Company, San Antonio, Tex.)^{19,22} and negative pressure was applied at -125 mm Hg (Fig. 4). The patients in both groups were evaluated 6 hours postoperatively for pain using the visual analog scale (VAS) (Fig. 5).²⁵ Patients would be discharged if the reported pain score was $\leq 2/10$; otherwise, the patient would be hospitalized until the next day.

One patient in the ciNPT group was excluded due to the premature removal of ciNPT dressings for bathing.

The patients returned on POD 7 for evaluation of the wound and pain assessment with the same VAS. For patients of the study group, ciNPT dressings were removed, and incisions were kept without any dressings from then on. Patients of the control group had the incision without dressing from the second day on. At POD 14, half of stitches were removed; the remaining stitches were removed on POD 21. The patients continued to visit the clinic every 7 days until the incision was completely healed.

Data Collection and Statistical Analysis

The duration of hospital stay, patient-reported pain level 6 hours after the end of the procedure and on POD 7, and total incision healing time of both groups were

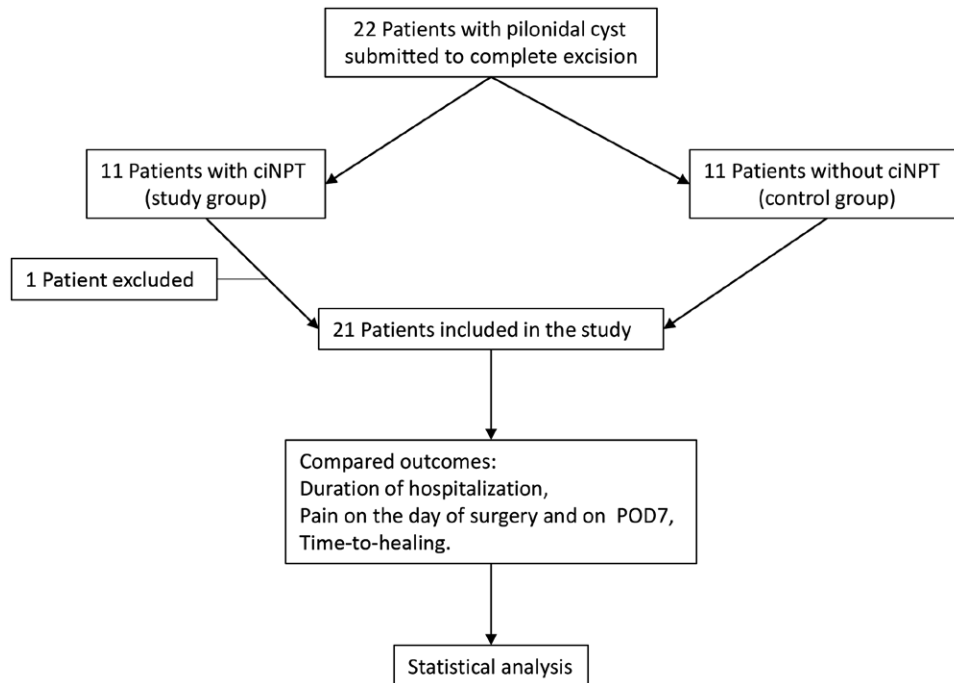


Fig. 1. Flowchart of surgeries and follow-up of patients up to discharge. NPWT, Negative pressure wound therapy; ciNPT, closed incision negative pressure therapy; POD, postoperative day.



Fig. 2. Patient in the ventral decubitus position under spinal anesthesia and sedation with exposure of the intergluteal cleft.

collected from patient records. The duration of hospital stay was defined (in hours), as the time between the conclusion of operation and discharge from the hospital. The total incision healing time was defined as the days from operation to full epithelialization over the incision in days. No patients were lost to follow-up.

Continuous data were statistically analyzed using a 2-tailed Mann-Whitney-Wilcoxon test. Categorical data were statistically analyzed using a 2-sided Fisher exact test. $P < 0.05$ was required to reach statistical significance. Statistical analyses were performed using GraphPad Prism 8 (GraphPad Software; San Diego, Calif.).

RESULTS

Of the 21 patients included in this study, 12 were men and 9 were women. Ages ranged from 15 to 60 years, with a mean of 30.19 years. There were no significant differences in age or gender between groups.

Six hours after the operation, patient-reported pain scores were significantly lower in the ciNPT group than in the control group. In the control group, the median pain score was 3, ranging from 2 to 4 on the VAS. The median pain score in the ciNPT group was 1, ranging from 1 to 2 ($P < 0.0001$; Fig. 6). Due to the lower pain scores, the time to discharge from the hospital was significantly shorter for the ciNPT group versus the control group. In the ciNPT group, time to discharge ranged from 6 to 12 hours, with a median of 9 hours and 20 minutes. In the control group, time to discharge ranged from 18 to 30 hours, with a median of 23 hours ($P < 0.0001$; Fig. 7).



Fig. 3. A, Wedge incision around the cyst; B, block removal of the cyst; C, creation of small skin flap to facilitate closure without tension; D, final aspect of the sutured skin.

At each follow-up visit, the incision appearance was re-evaluated, and based on the incision status, patients were allowed to return to normal daily activities. Patients in the control group were allowed to return to school or work at POD 14, whereas the patients receiving postoperative care with ciNPT were allowed to return to normal daily activities on POD 4.

When the patients returned for the first follow-up 1 week after the surgical procedure, pain levels were still significantly lower in the ciNPT group than in the control group. Pain scores ranged from 2 to 3 in the control group, with a median score of 2.63. Pain scores at the first follow-up in the patients receiving ciNPT ranged from 0 to 2, with a median score of 0.9 ($P < 0.0001$; Fig. 8).

Upon complete removal of the remaining sutures on POD 21, there was a noticeable difference in incision appearance between the patient groups, with greater scarring and erythema in the control group (Fig. 9). Minor complications occurred in 5 of the patients: 2 patients in the ciNPT group experienced superficial (not involving the SCCT) dehiscence ≤ 1.5 cm in length; 3 patients within the control group experienced dehiscence of skin and SCCT ≤ 2.5 cm in length. However, no surgical interventions were necessary for any of the patients.

When the incisions were sufficiently epithelialized, the weekly assessments were discontinued. This milestone was reached sooner in the ciNPT group than in the control group ($P < 0.001$; Fig. 10). In the ciNPT group,

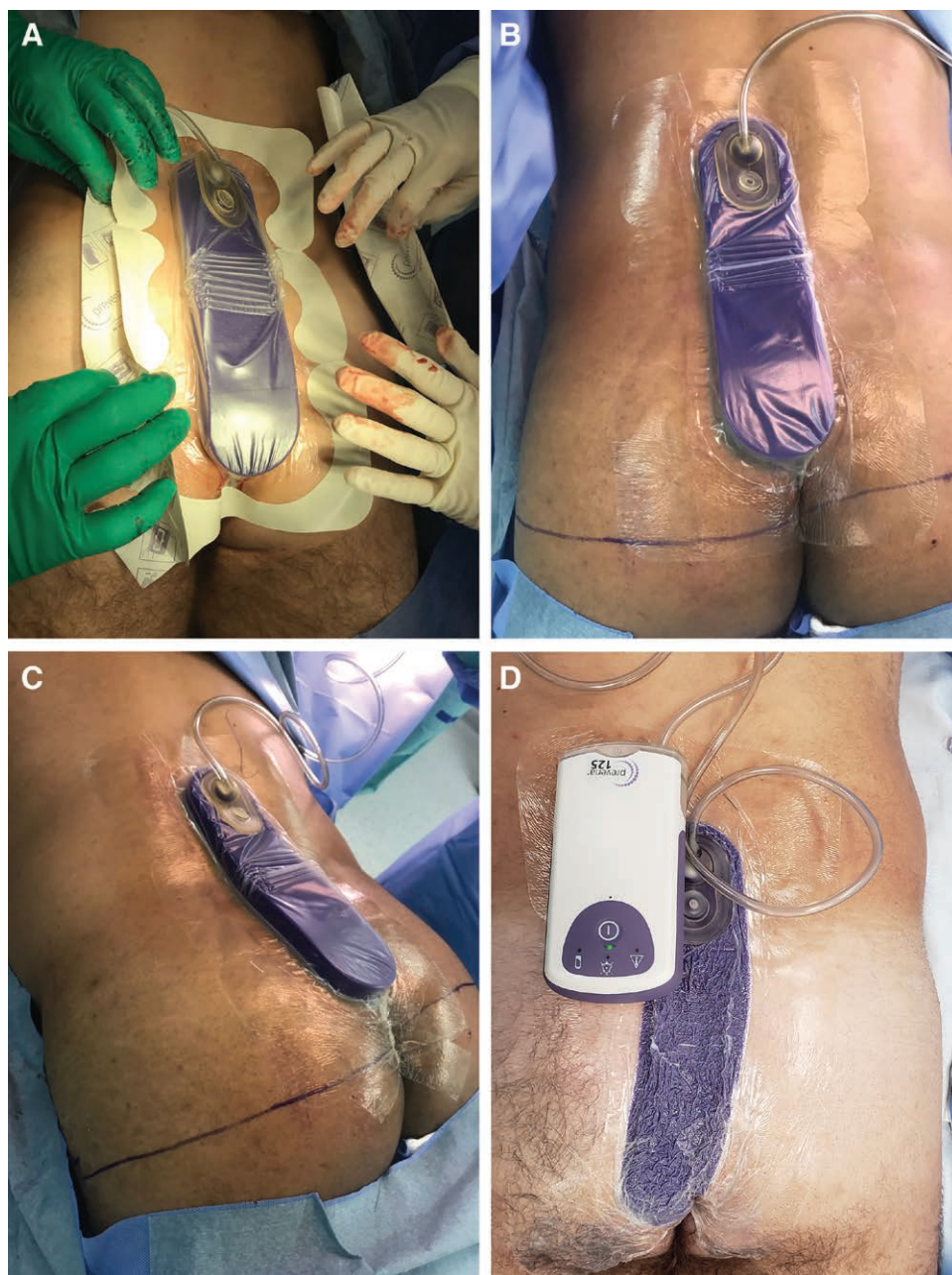


Fig. 4. A, Placement of ciNPT dressing; B, superior view of the dressing once a seal has been created; C, lateral view of the foam location; D, vacuum created and no leakage detected.

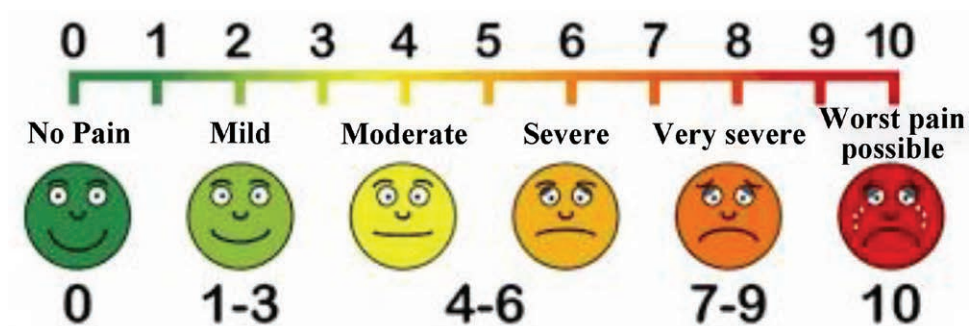


Fig. 5. Visual Analogic Scale (VAS) used to determine patient-related pain.

DISCUSSION

Treatment of symptomatic pilonidal cysts typically involves surgical intervention, with complete excision of the abscess being the most effective method of minimizing the risk of reoccurrence.¹⁶ After excision of the abscess, primary closure is the most common approach to treatment, with closure via primary intention being recommended to shorten time to healing and enabling a more rapid return to daily activities.¹⁰ However, challenges to incision healing include lateral tension and the potential for contamination. Although primary midline closures require less technical training and have shorter operative times,²⁶⁻²⁸ they have also been associated with higher lateral tension and postoperative complications.²⁹ Data from this study suggest that the use of ciNPT may promote favorable outcomes (eg, decrease in the length of hospital stay, postoperative pain, and time-to-healing) after excision when used over closed, primary midline incisions in the intergluteal groove.

Closed incision NPT has been demonstrated to be a valuable asset in supporting post-surgical healing. In a 2019 meta-analysis by Singh et al, ciNPT was associated with a lower rate of surgical site infections in multiple incision types.³⁰ Randomized clinical trials comparing ciNPT with standard dressings have also reported lower rates of dehiscence³¹ and overall complications^{32,33} in the observed patient populations. The data from this study are consistent with these outcomes, whereby ciNPT can effectively facilitate post-surgical incision management in closed incisions prone to lateral tension.

To our knowledge, this is the second report of the use of ciNPT over the primarily closed incision after excision of pilonidal cysts. The first is an abstract published by Bianchi et al, although the authors do not specify whether the closure was over the midline.³⁴ Among the 65 patients receiving ciNPT, infection and overall complication rates were 4.6% and 11%, respectively, which reflected a benefit of ciNPT over standard dressings. In our study, we expand upon the current literature by demonstrating that the use of ciNPT on closed midline incisions led to favorable outcomes related to length of hospital stay and healing time when compared with gauze dressings. For the ciNPT group, some patients were able to be discharged shortly after the initial pain assessment at 6 hours postoperative, which was a significantly shorter length of stay compared with patients receiving postoperative incisional care with gauze dressings where the length of hospital stay after the excision procedure ranged from 18 to 30 hours. This hospital length of stay for the gauze-treated group is similar to previously published studies^{35,36} and consistent with findings from recent meta-analyses by Stauffer,¹¹ Kallis,⁷ Wani,³⁷ and McCallum.¹⁰ The healing time in the ciNPT group was also significantly shorter when compared with the control group. In the meta-analysis by Al-Khamis et al, 10 publications were identified to have reported time-to-healing in patients treated for pilonidal cysts with primary midline closures.²⁹ The healing time for these surgeries ranged from 7 to 203 days, although the data could not be analyzed due to variations in the definition

Pain after 6 hours		
	With ciNPT	Without ciNPT
1	2	4
2	1	4
3	2	4
4	1	3
5	1	4
6	1	4
7	1	2
8	1	3
9	1	3
10	1	3
11	-----	3
*	1.20	3.36

-P = 0.000057*

*Statistical significance (-p < 0.05)

Fig. 6. Distribution of pain scores in patients receiving incision management with ciNPT or standard dressings at 6 hours after operation. Each symbol represents 1 patient.

epithelialization occurred after a median of 23.8 days, ranging from 14 to 28 days. In the control group, epithelialization was observed at a median of 57.9 days, ranging from 35 to 112 days. There were no surgical site infections for either group within the observation time. All patients healed from the procedure without the need for reoperation. Two patients in the control group subsequently returned to the hospital 1 year after operation due to pilonidal cyst recurrence, but there were no recurrences in the ciNPT group.

Time to Discharge (hours)		
	With ciNPT	Without ciNPT
1	12	20
2	12	30
3	10	25
4	10	28
5	16	20
6	8	24
7	8	8
8	6	22
9	6	25
10	6	30
11	-----	22
*	9h20m	23h

-P = 0.0016*

* Statistical significance (-p < 0.05)

Fig. 7. Distribution of the hours between the conclusion of operation and discharge from the hospital in patients receiving incision management with ciNPT or standard dressings. Each symbol represents 1 patient.

of healed incisions. In our patients, weekly follow-ups to verify healing was continued for 35–112 days in the control group and from 14 to 28 days in the ciNPT group. These outcomes have encouraged us to continue utilizing ciNPT for postoperative care following pilonidal excision.

Patient-reported pain was also lower for patients treated with ciNPT in this study. The pain assessment at both 6 hours after operation and POD 7 showed significantly lower

Pain after 7 days		
	With ciNPT	Without ciNPT
1	1	3
2	1	3
3	1	2
4	1	3
5	2	2
6	1	3
7	1	3
8	0	2
9	0	3
10	1	3
11	-----	2
*	0.90	2.63

-p = 0.00011*

*Statistical significance (-p < 0.05)

Fig. 8. Distribution of pain scores in patients receiving incision management with ciNPT or standard dressings on postoperative Day 7. Each symbol represents 1 patient.

pain scores in the ciNPT group compared with the control group. Patient-reported pain levels for patients undergoing primary midline closure after operation for pilonidal cysts vary in the published literature based on the method of closure. In retrospective interviews with 192 male patients who underwent primary midline closure for pilonidal cysts, Doll et al reported a median pain score of 4/10 during hospitalization.³⁸ Dass et al observed that patients with midline incisions had pain scores of 4.21/10 at POD 1 and 2.01/10 at POD 2.³⁹ Rao et al reported POD 1 pain scores of 20/100



Fig. 9. Photographs showing appearance after removal of all sutures on POD 21. A, representative photograph of a patient in the ciNPT group. B, Representative photograph of a patient in the control group.

Time to healing (days)		
	With ciNPT	Without ciNPT
1	21	35
2	28	56
3	28	35
4	21	63
5	28	49
6	28	49
7	21	112
8	28	56
9	14	56
10	21	70
11	-----	56
*	23.80	57.90

-P = 0.00010*

*Statistical significance (-p < 0.05)

Fig. 10. Distribution of the days from operative procedure to complete incision healing in patients receiving incision management with ciNPT or standard dressings. Each symbol represents 1 patient.

for primarily closed midline incisions.; by POD 7, this score had declined to 7/100.⁴⁰ In our control group, pain scores shortly after operation were similar, with a median score of 3/10. These reduced patient-reported pain scores in the study group encouraged us to allow earlier patient return to their daily activities such as driving and office work or going back to school.

This study is limited by a relatively small sample size, and further studies with a large sample size will be needed to determine whether these outcomes can be applied to the general population. Due to the overt nature and appearance of ciNPT versus standard dressings, it was difficult to control for bias. As per our clinic’s protocol, we relied upon patient self-reported pain levels to reach below a pre-specified threshold to determine the timing of hospital discharge. This approach reduces physician-bias, but is vulnerable to the placebo effect.

This study reports our initial experience with a device that seems promising to improve the early results of the surgical treatment of pilonidal cysts. These improved outcomes have encouraged us to incorporate ciNPT into our treatment protocol for symptomatic pilonidal cysts. Additional work should be performed with larger patient populations and with the use of ciNPT in other techniques for the correction of the pilonidal cyst, as well as longer follow-up periods to evaluate recurrence rates.

CONCLUSION

The use of ciNPT was associated with decreases in the length of hospital stay, postoperative pain, and time-to-healing when used over closed incisions in the intergluteal groove after the surgical treatment of pilonidal cysts.

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REFERENCES

- da Silva JH. Pilonidal cyst: Cause and treatment. *Dis Colon Rectum*. 2000;43:1146–1156.
- Elalfy K, Emile S, Lotfy A, et al. Bilateral gluteal advancement flap for treatment of recurrent sacrococcygeal pilonidal disease: A prospective cohort study. *Int J Surg*. 2016;29:1–8.
- Aysan E, Ilhan M, Bektas H, et al. Prevalence of sacrococcygeal pilonidal sinus as a silent disease. *Surg Today*. 2013;43:1286–1289.
- Karydakos GE. Easy and successful treatment of pilonidal sinus after explanation of its causative process. *Aust N Z J Surg*. 1992;62:385–389.
- Kanat BH, Sözen S. Disease that should be remembered: Sacrococcygeal pilonidal sinus disease and short history. *World J Clin Cases*. 2015;3:876–879.
- Iesalnieks I, Ommer A, Petersen S, et al. German national guideline on the management of pilonidal disease. *Langenbecks Arch Surg*. 2016;401:599–609.
- Kallis MP, Maloney C, Lipskar AM. Management of pilonidal disease. *Curr Opin Pediatr*. 2018;30:411–416.
- Doll D, Friederichs J, Boulesteix AL, et al. Surgery for asymptomatic pilonidal sinus disease. *Int J Colorectal Dis*. 2008;23:839–844.
- Strassmann V, Prieto Velhote MC, Santoro S, et al. Surgical treatment of pilonidal disease: Meta-analysis of the main procedures adopted worldwide. *Rev Col Bras Cir*. 2004;31:257–261.
- McCallum IJ, King PM, Bruce J. Healing by primary closure versus open healing after surgery for pilonidal sinus: Systematic review and meta-analysis. *BMJ*. 2008;336:868–871.
- Stauffer VK, Luedi MM, Kauf P, et al. Common surgical procedures in pilonidal sinus disease: A meta-analysis, merged data analysis, and comprehensive study on recurrence. *Sci Rep*. 2018;8:3058.
- López JJ, Cooper JN, Halleran DR, et al. High rate of major morbidity after surgical excision for pilonidal disease. *Surg Infect (Larchmt)*. 2018;19:603–607.
- Bradley L. Pilonidal sinus disease: A misunderstood problem. *Wounds UK*. 2006;2:45–46,48,50–53.
- Sakr MF, Elserafy ME, Hamed HM, et al. Management of 634 consecutive patients with chronic pilonidal sinus: A nine-year experience of a single institute. *Surg Sci*. 2012;3:145–154.
- Riou JP, Cohen JR, Johnson H Jr. Factors influencing wound dehiscence. *Am J Surg*. 1992;163:324–330.
- Singh A, Kumar S, Jyoti V, et al. Excision and primary closure of pilonidal sinus: Excellent results. *Int J Surg*. 2017;4:3711–3713.
- Johnson EK, Vogel JD, Cowan ML, et al. The American Society of Colon and Rectal Surgeons' clinical practice guidelines for the management of pilonidal disease. *Dis Colon Rectum*. 2019;62:146–157.
- Kilpadi DV, Cunningham MR. Evaluation of closed incision management with negative pressure wound therapy (CIM): Hematoma/seroma and involvement of the lymphatic system. *Wound Repair Regen*. 2011;19:588–596.
- Javed AA, Teinor J, Wright M, et al. Negative pressure wound therapy for surgical-site infections: A randomized trial. *Ann Surg*. 2019;269:1034–1040.
- Birke-Sorensen H, Malmjö M, Rome P, et al; International Expert Panel on Negative Pressure Wound Therapy [NPWT-EP]. Evidence-based recommendations for negative pressure wound therapy: Treatment variables (pressure levels, wound filler and contact layer)—steps towards an international consensus. *J Plast Reconstr Aesthet Surg*. 2011;64(suppl):S1–S16.
- Glaser DA, Farnsworth CL, Varley ES, et al. Negative pressure therapy for closed spine incisions: A pilot study. *Wounds*. 2012;24:308–316.
- Haghshenasskashani A, Varcoe RL. A new negative pressure dressing (Prevena) to prevent wound complications following lower limb distal arterial bypass. *Br J Diabetes Vasc Dis*. 2011;11:21–24.
- Banasiewicz T, Bobkiewicz A, Borejsza-Wysocki M, et al. Portable VAC therapy improve the results of the treatment of the pilonidal sinus—randomized prospective study. *Pol Przegl Chir*. 2013;85:371–376.
- Lynch JB, Laing AJ, Regan PJ. Vacuum-assisted closure therapy: A new treatment option for recurrent pilonidal sinus disease. Report of three cases. *Dis Colon Rectum*. 2004;47:929–932.
- Martinez JE, Grassi DC, Marques LG. Analysis of the applicability of different pain questionnaires in three hospital settings: Outpatient clinic, ward and emergency unit. *Rev Bras Reumatol*. 2011;51:299–303, 308.
- Kumar R, Hastir A, Walia RS, et al. Prospective randomized study of surgical treatment of pilonidal sinus; primary midline closure after elliptical excision versus rhomboid excision with limberg flap reconstruction versus open excision and healing by secondary intention. *Int J Surg*. 2017;4:3646–3651.
- Muzi MG, Milito G, Cadeddu F, et al. Randomized comparison of Limberg flap versus modified primary closure for the treatment of pilonidal disease. *Am J Surg*. 2010;200:9–14.
- Arnou M, Elgendy H, Thabet W, et al. Excision with primary midline closure compared with Limberg flap in the treatment of sacrococcygeal pilonidal disease: A randomised clinical trial. *Ann R Coll Surg Engl*. 2019;101:21–29.
- Al-Khamis A, McCallum I, King PM, et al. Healing by primary versus secondary intention after surgical treatment for pilonidal sinus. *Cochrane Database Syst Rev*. 2010;1:CD006213.
- Singh DP, Gabriel A, Parvizi J, et al. Meta-analysis of comparative trials evaluating a single-use closed-incision negative-pressure therapy system. *Plast Reconstr Surg*. 2019;143(suppl 1):41S–46S.
- Stannard JP, Volgas DA, McGwin G III, et al. Incisional negative pressure wound therapy after high-risk lower extremity fractures. *J Orthop Trauma*. 2012;26:37–42.
- Kwon J, Staley C, McCullough T, et al. A randomized clinical trial evaluating negative pressure therapy to decrease vascular groin incision complications. *J Vasc Surg*. 2018;68:1744–1752.
- Newman JM, Siqueira MBP, Klika AK, et al. Use of closed incisional negative pressure wound therapy after revision total hip and knee arthroplasty in patients at high risk for infection: A prospective, randomized clinical trial. *J Arthroplasty*. 2019;34:554–559.e1.
- Bianchi E, Lei J, Adegboye A, et al. Negative pressure wound therapy is beneficial in the treatment of pilonidal disease. *J Am Coll Surg*. 2018;227:109–110.
- Awad MM, Elbaset AA, Ebraheem S, et al. A scoring system as a method to evaluate pilonidal sinus disease to make an easy decision for its management. *Indian J Plast Surg*. 2009;42:43–48.
- Teot L, Granier P. Pilonidal sinus: healing by primary closure versus open healing surgery. In: Sen CK, ed. *Advances in Wound Care: Volume 1*. New Rochelle, N.Y.: Mary Ann Liebert, Inc.; 2010.

37. Wani MA, Shah M, Wani KA, et al. Excision and primary closure of sacrococcygeal pilonidal sinus using suction drain. *Int J Surg.* 2016;3:837–840.
38. Doll D, Luedi MM, Evers T, et al. Recurrence-free survival, but not surgical therapy per se, determines 583 patients' long-term satisfaction following primary pilonidal sinus surgery. *Int J Colorectal Dis.* 2015;30:605–611.
39. Dass TA, Zaz M, Rather A, et al. Elliptical excision with midline primary closure versus rhomboid excision with limberg flap reconstruction in sacrococcygeal pilonidal disease: A prospective, randomized study. *Indian J Surg.* 2012;74:305–308.
40. Rao MM, Zawislak W, Kennedy R, et al. A prospective randomised study comparing two treatment modalities for chronic pilonidal sinus with a 5-year follow-up. *Int J Colorectal Dis.* 2010;25:395–400.