Introduction

In recent years, negative pressure wound therapy (NPWT) has played an important role in treating chronic ulcers. Devices for NPWT have also been applied to other areas, such as the fixation of skin grafts. The effectiveness of incisional NPWT (iNPWT) in preventing wound dehiscence and surgical site infection in sutured wounds is also gaining attention.

Patients who are wheelchair-bound because of spinal cord injury and have pressure ulcers in the sciatic region are often candidates for surgery using skin flaps. However, some patients develop problems such as postoperative wound dehiscence. This can be caused by overstraining or displacement of the wound during position changes, defecation, fecal contamination, or infection due to prolonged osteomyelitis. We applied NPWT devices to reduce the postoperative force on the wound, thus preventing such complications.

The introduction of the RENASYS TOUCH (Smith & Nephew plc, London, UK), a negative-pressure maintenance device, has facilitated the treatment of multiple wound sites using Y-connectors has become easier. In addition, the release of drainage accessories has expanded the treatment options. In this study, we combined the RENASYS wound therapy system with drains and incisional negative pressure wound therapy (iNPWT) (diNPWT [tentative name]).

The RENASYS TOUCH main unit, Y-connector, foam, and drain accessories were prepared. Conventional drain insertion was replaced by a drain accessory for wound closure after surgical treatment of intractable ulcers. After the drain accessory was placed, the wound was closed, a nonadherent dressing and foam were placed on the sutured wound, and the Y-connector was connected to the main unit. The patient was managed with a negative pressure of −80 to 100 mmHg for 5 to 7 days postoperatively.

The drain accessory used in this study can adjust the pressure according to the instrument itself, and we believe that it can adhere to the lumen with stronger pressure. In addition, by applying NPWT to the sutured wound, postoperative misalignment stress can be avoided, and a good outcome can be obtained.

Key words: drainage and incisional negative pressure wound therapy (diNPWT), intractable skin ulcers, Y-connector

Case Report

Drainage and Incisional Negative Pressure Wound Therapy for Intractable Skin Ulcers: A Novel Technique

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ABSTRACT

With the introduction of the RENASYS TOUCH negative-pressure maintenance and management device (Smith & Nephew plc, London, UK), the treatment of multiple wound sites using Y-connectors has become easier. In addition, the release of drainage accessories has expanded the treatment options. In this study, we combined the RENASYS wound therapy system with drains and incisional negative pressure wound therapy (NPWT) (diNPWT [tentative name]).

The RENASYS TOUCH main unit, Y-connector, foam, and drain accessories were prepared. Conventional drain insertion was replaced by a drain accessory for wound closure after surgical treatment of intractable ulcers. After the drain accessory was placed, the wound was closed, a nonadherent dressing and foam were placed on the sutured wound, and the Y-connector was connected to the main unit. The patient was managed with a negative pressure of −80 to 100 mmHg for 5 to 7 days postoperatively.

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Materials and methods

The RENASYS TOUCH main unit, Y-connector, foam, and drain accessories were prepared. The drain accessory was replaced with a conventional drain for wound closure after surgical treatment of intractable ulcers. After placement of the drain accessory, the wound was closed, a nonadherent dressing and foam were placed on the sutured wound, and the Y-connector was connected to the main unit (Fig. 1). The
The patient was managed with a negative pressure of \(-80\) to \(100\) mmHg for 5 to 7 days postoperatively. Check the nature of drainage fluid. If signs of infection are observed, diNPWT should be immediately discontinued.

**Case reports**

We performed diNPWT in three patients: two with pressure sores and one with diabetic foot gangrene. In all three patients, wound closure was achieved without complications using diNPWT (Table 1).

**Table 1. Patient list**

| Case | Age | Sex | Diagnosis          | Site of a lesion | Pressure | Period | Past history                                       |
|------|-----|-----|--------------------|------------------|----------|--------|--------------------------------------------------|
| 1    | 73  | M   | Subcutaneous abscess | Rt.inguinal      | \(-100\) mmHg | 7 days  | Amputation of both thighs after a traffic accident |
| 2    | 52  | M   | Pressure ulcer      | Rt.sciatric       | \(-100\) mmHg | 7 days  | Spinal cord injury                               |
| 3    | 60  | M   | Foot gangrene       | Rt.lower leg      | \(-80\) mmHg  | 5 days  | Diabetes mellitus, limb ischemia                  |

**Case 1: 73-year-old man with right sciatic abscess due to pressure sore**

At the age of 25, the patient had undergone amputation of both thighs after a traffic accident. One month before presentation, he developed a pressure ulcer in his right inguinal region, which became infected and formed an abscess. The patient was referred to our hospital. After admission to the hospital, a pocket incision was made in the infected wound, and wound management involving NPWT with instillation and dwell time (NPWTi-d) (V.A.C. ULTRA; KCI, San Antonio, TX, USA) was performed for 3 weeks.

The patient then underwent wound closure surgery. Debridement of the necrotic tissue and infected granulation tissue revealed dead space, leading to the sciatic bone (Fig. 2a). After a thorough cleansing, a drainage accessory was placed in the deepest part, and the wound was closed (Fig. 2b). Because of concerns about the strain on the wound due to positional changes, the foam was also applied to the sutured wound, and negative pressure was maintained at \(-100\) mmHg with drains for 1 week (Fig. 2c). The wound progressed well, and the patient was transferred to a hospital for rehabilitation 3 weeks after the operation (Fig. 2d).

**Case 2: 52-year-old man with right sciatic pressure sore after recurrence**

At the age of 32, the patient played baseball when he collided...
with an opponent, resulting in a cervical spine injury that left him paralyzed and wheelchair-bound. The patient developed a pressure ulcer on the right sciatic area and underwent reconstruction with a posterior thigh flap performed in our clinic 1 year before the current presentation. The patient was readmitted to the hospital 1 month before the current presentation because of ulceration of a part of the right sciatic postoperative scar.

After pocket incision and debridement, wound management with NPWTi-d was performed for 2 weeks. Closed wound surgery was then performed using a previously operated posterior thigh flap (Fig. 3a). The sutured wounds were also treated with foam, a drainage accessory was placed, and negative pressure was maintained at −100 mmHg for 1 week (Fig. 3b).

After the previous surgery, the wound healing process was complicated by wound dissection; however, the wound was in good condition after the recent surgery (Fig. 3c). The patient was discharged 4 weeks postoperatively.

Case 3: 60-year-old man with left leg amputation due to diabetic foot gangrene

The patient had a history of poorly controlled diabetes mellitus and a 1-week history of fever, redness, and swelling of the left lower limb. He presented to our clinic with purulent discharge from his left leg. The patient was already in a state of necrotizing soft tissue infection at the time of presentation, and salvage of the lower extremity was difficult.

The patient was admitted to the hospital on an emergency basis and underwent amputation of the left lower leg (Fig. 4a). The amputated end of the lower limb was drained, and negative pressure was applied to the sutured wound with foam at a pressure of −80 mmHg for 5 days with no complications (Fig. 4b, c).

Discussion

NPWT, which has been performed since 1997, is now an
Diathermic suction wound therapy (dNPWTi-d, which can be used when a mild infection is a concern, could be seen as a weak point of NPWT), became available in Japan in 2017. This technique is also used to fix skin grafts, and its application is expanding.

Drainage accessories were originally developed for more efficient negative pressure closure therapy in wounds requiring deep pockets, by applying negative pressure from deep within.

Conventional negative pressure drains, such as J-VAC drains, have a pressure of −20 to 30 mmHg. Accordingly, we believe that postoperative complications can be reduced by applying a stronger pressure of −80 to 100 mmHg to the deep tissue and

Essential part of chronic ulcer treatment. Since then, NPWT devices have evolved from various manufacturers. NPWTi-d, which can be used when a mild infection is a concern, became available in Japan in 2017. This technique is also used to fix skin grafts, and its application is expanding.

One of these applications is incisional NPWT (iNPWT), in which NPWT is applied over a sutured wound. The purpose of this technique is to prevent wound dehiscence and surgical site infection. It has been reported to stabilize the sutured surface postoperatively and reduce shear stress by about 50%.

Drainage accessories were originally developed for more efficient negative-pressure closure therapy in wounds requiring deep pockets by applying negative pressure from deep within. Conventional negative pressure drains, such as J-VAC drains, have a pressure of −20 to 30 mmHg. Accordingly, we believe that postoperative complications can be reduced by applying a stronger pressure of −80 to 100 mmHg to the deep tissue and
iNPWT to adhere to the tissue. The drainage accessory used in this study can adjust the pressure according to the drainage and the instrument itself, allowing it to adhere to the lumen with stronger pressure.

In addition, signs of infection can be identified by observing the properties of the drainage fluid. Furthermore, by applying NPWT to the sutured wound, postoperative displacement stress can be avoided (Fig. 5). Notably, each of these characteristics is integrated into a single device using a Y-connector to be carried around the neck.

This device was used to treat a chronic ulcer caused by a pressure sore in the present case. In general, after surgery for bedsore, patients are placed on bed rest for about three weeks. The degree of rest is gradually expanded while monitoring the condition of the wound, after which they are often transferred to rehabilitation such as wheelchair transfer. Even after surgery, repositioning of the patient is necessary for pressure relief, and shear stress on the wound is inevitable, even if sufficient care is taken. In such a situation, diNPWT is considered effective. In addition, the lower extremity amputation wound in case 3 was not strictly chronic but a case with a high risk of wound problems such as ischemia and infection associated with diabetes. The use of diNPWT, in this case, had the advantage of reducing edema and facilitating postoperative wound management at the amputation site. In all three cases, we believe that we could avoid postoperative problems on the skin side without a decrease in activities of daily living due to severe positional restrictions. In addition, it could contribute to shortening hospital stays and reducing medical costs.

However, this technique has several disadvantages. First, the circuit is complicated and requires familiarity. Additionally, although it is possible to observe the drain properties, it is difficult to measure the daily volume in detail. Finally, iNPWT is not approved as an insurance-covered treatment in Japan, resulting in a financial burden on the patient.

We believe that diNPWT is indicated for wounds with lumen and tissue stress, such as displacement, and longitudinal wounds with a risk of wound separation even with simple sutures. However, if signs of infection are observed, this therapy should be discontinued without hesitation, and caution should be exercised. Therefore, we believe that indications should be carefully considered at the time of closure of infected wounds when debridement is inadequate or when there is a possibility of exacerbation by additional compression in cases of critical limb ischemia.

Conclusions

We have devised a new therapeutic technique for chronic wounds that combines iNPWT with a drainage accessory. Especially in wounds that are likely to be subjected to strong displacement forces after surgery, diNPWT is considered one of the most useful tools.

Acknowledgments

We thank the doctors, nurses, and other staff at Tohoku University Hospital for their cooperation in analyzing and treating the patients in this study. The authors also thank Angela Morben, DVM, ELS, from Edanz Group (https://en-author-services.edanz.com/ac) for editing the draft of this manuscript.

Conflicts of interest

The authors have indicated no significant interest in commercial supporters.

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