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Linear and Area Coverage With Closed Incision Negative Pressure Therapy Management: International Multidisciplinary Consensus Recommendations

Devinder Singh[1] | Timothy Alton[2] | Abtin Alvand[3] | Paulo Roberto Barbosa de Toledo[4] | Abhishek Chatterjee[5] | Ellen Dillavou[6] | Risal Djohan[7] | Alba Viviana Gomez Ortega[8] | Andrew Pieri[9] | Bauer Sumpio[10] | Christian Willy[11] | Boris Zelle[12] | H. John Cooper[13]

[1]Department of Surgery, University of Miami Miller School of Medicine, Miami, Florida, USA | [2]Proliance Orthopaedic Associates, Renton, Washington, USA | [3]Oxford University Hospitals NHS Trust, Nuffield Orthopaedic Centre, Oxford, UK | [4]Department of Orthopedic Trauma, Hospital Quinta D'or, Rio de Janeiro, Brazil | [5]Department of Surgery, Tufts Medical Center, Boston, Massachusetts, USA | [6]Department of Vascular Surgery, WakeMed Hospital System, Raleigh, North Carolina, USA | [7]Department of Plastic Surgery, Cleveland Clinic, Dermatology & Plastic Surgery Institute, Cleveland, Ohio, USA | [8]Fundación Santa Fe de Bogotá, Bogotá, Colombia | [9]Royal Victoria Infirmary, Newcastle upon Tyne, UK | [10]Department of Surgery, Yale University School of Medicine, New Haven, Connecticut, USA | [11]Department of Surgery, Military Academic Hospital Berlin, Berlin, Germany | [12]Department of Orthopaedics, University of Texas Health San Antonio, San Antonio, Texas, USA | [13]Department of Orthopedic Surgery, Colombia University, New York, New York, USA

Correspondence: Devinder Singh (dsingh.md@gmail.com)

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ABSTRACT

Closed incision negative pressure therapy (ciNPT) with foam dressings has received broad recognition for its ability to support incision healing for a variety of surgical procedures. Over time, these dressings have evolved to include linear and 'area' shapes to better conform to different incision types and surface geometries. To address new studies on these configurations and provide guidance for dressing selection, an international, multidisciplinary panel of experts was convened. The panel reviewed recent publications on ciNPT with reticulated open cell foam (ROCF) dressings, shared their cases and experiences and engaged in roundtable discussions on benefits, drawbacks and technical challenges. Topics were ranked by importance and refined into potential consensus statements. These were shared for anonymous feedback, requiring 80% agreement for consensus. This manuscript establishes 12 consensus statements regarding risk factors supporting the use of ciNPT, conditions supporting preference of linear or area ciNPT dressings and tips for practical application of ciNPT with ROCF dressings. While this consensus panel expands on previous publications to aid clinicians' decision-making, further research is needed to refine recommendations and identify the strengths and limitations of ciNPT. Continued multidisciplinary collaboration will ensure ciNPT remains vital for improving surgical outcomes and patient care.

1 | Introduction

Since the introduction of commercially available negative pressure wound therapy devices in the 1990s, there has been a considerable expansion in the diversity of their designs, compositions and medical applications. Extending beyond their initial usage over open wounds, negative pressure devices have grown to include closed incision negative pressure therapy (ciNPT), in which the therapeutic

Summary

- Closed incision negative pressure therapy (ciNPT) can be applied using various sizes and shapes of foam dressing to support healing of a wide array of incision types and anatomical locations.
- To provide guidance on dressing selection and application, an international, multidisciplinary panel of experts reviewed recent studies on ciNPT with foam dressings, shared their experiences and discussed the benefits, drawbacks and technical challenges.
- The panel meeting produced 12 consensus statements regarding risk factors supporting the use of ciNPT, conditions supporting the preference of linear or area ciNPT dressings and tips for the practical application of ciNPT with foam dressings.

mechanisms are applied over a clean, surgically closed incision to support healthy healing of the damaged soft tissue below. The components of ciNPT include a collapsible material such as foam or gauze dressing, a transparent drape to create a seal and tubing connecting the dressing to a vacuum pump. ciNPT is typically differentiated from traditional negative pressure wound therapy in that it also contains a skin-interface layer, which is intended to protect intact skin from irritation. Since surgically closed incisions are frequently linear, ciNPT dressings have conventionally also been linear, covering the incision and only a few centimetres on either side. This approach, particularly, with reticulated open cell foam (ROCF) dressings, has successfully supported incision healing and reduced surgical site complications (SSCs) in a wide range of incision types and anatomical locations. The positive impact of ROCF ciNPT dressings on rates of surgical site infections (SSIs) is specifically robust and broadly acknowledged in previous studies [1–8]. In 2019, the design of ciNPT was again expanded to introduce ROCF dressings with wider coverage, extending beyond the incision to include a greater area of surrounding tissue. The design of these 'area' dressings expanded the therapeutic effects of ciNPT to bolster a wider footprint of traumatised tissue beneath the incision and surrounding tissue in the surgical field.

Each permutation of ciNPT was coupled with expert consensus publications that served to guide new users through the changes and optimal application settings. In 2017, an international panel of experts representing multiple surgical specialties identified key risk factors for SSC and attempted to create an algorithm to identify conditions in which ciNPT should be used [9]. In 2022, an expert panel of plastic surgeons convened to create recommendations on the use of the wider area dressings, including a distinction between scenarios in which ciNPT should be considered for use and those in which ciNPT is fully recommended [10]. Since then, new studies on the linear and area ROCF ciNPT dressings have continued to be published. As more information has become available, there arose a need for updated recommendations that consider recent data, address specific advantages or concerns with ciNPT and differentiate between scenarios in which linear or area ciNPT dressings might be selected.

To achieve these goals, a new international and multidisciplinary panel of experts was assembled. The specific objectives were to discuss and understand the application of ciNPT with ROCF dressings in different surgical disciplines, review the clinical utility of linear or area ciNPT dressings and examine the decision-making process for choosing ciNPT and addressing challenges. The objective of the panel was to create a new set of clinical recommendation consensus statements, which would be published as a reference for other clinicians seeking to implement ciNPT within their practice.

2 | Methods

To capture a broad perspective on the use of ciNPT, experts were invited from North America, South America and Europe to participate in the panel. Areas of expertise included plastic surgery, orthopaedic joint and trauma surgery and vascular surgery. Panel members were selected based on the criteria of having experience applying ciNPT with linear and/or area ROCF dressings and having a history of publications or presentations documenting their use of negative pressure therapy. The selection criteria were formulated by industry (Solventum) personnel to include a broad range of expertise and diverse points of view. Before the start of the meeting, the panellists were asked to prepare their thoughts and experiences with ciNPT in a presentation and they were briefed on the process of reaching a consensus and producing a publication.

The meeting took place over two days on 8–9 September 2023 in Chicago, Illinois. During the discussion, the mechanism of action and recent publications were reviewed. The panellists presented their cases and individual experiences using ciNPT with ROCF dressings and two moderators (Drs. Singh and Cooper) led roundtable discussions during and after each presentation to share benefits, drawbacks, technical challenges and other pertinent information. To examine how a clinician might select linear or area ciNPT dressings for their case, the panel divided into two groups to identify which circumstances would benefit from one dressing form over the other. Finally, the panel identified important evidence that they would like to see from future studies.

The consensus-building protocol was defined before the meeting took place, following a modified Delphi methodology. The process included an organisation of topics discussed during the panel meeting, which were then ranked by importance and condensed into potential statements for agreement. The language was refined with direction from the panel moderators and a final version was shared for anonymous feedback from the panel. Panel members were asked to review the statements and indicate whether they agreed with the text in its entirety, without modifications. A threshold of 80% agreement was required for the establishment of consensus.

3 | Results

From the expert panel discussions, 34 statements were identified to go before the members for a vote. Of these, 27 (79%) reached the consensus threshold (Tables 1–3). For readability and conciseness, these statements were ultimately condensed into 12 consensus statements. These recommendations fell into three categories: risk factors supporting the use of ciNPT with any type of ROCF dressings, conditions supporting the use of

TABLE 1 | Risk factors considerations for use of ciNPT with ROCF dressings consensus statement survey results.

Consensus statement	Agree	Disagree	Consensus reached
ciNPT is recommended when patient risk factors ≥ 2	12 (92%)	1 (8%)	**Yes.**
ciNPT is recommended when patient risk factors ≥ 3	13 (100%)	0 (0%)	**Yes**
ciNPT is recommended in patients with current nicotine use	10 (77%)	3 (23%)	No
ciNPT is recommended in patients with peripheral vascular disease	10 (77%)	3 (23%)	No
ciNPT is recommended when incision risk factors ≥ 2	13 (100%)	0 (0%)	**Yes**
ciNPT is recommended when incision risk factors ≥ 3	12 (92%)	1 (8%)	**Yes**
ciNPT is recommended for high-tension incision closures	13 (100%)	0 (0%)	**Yes**
ciNPT is recommended for incisions with a high risk of seroma formation	13 (100%)	0 (0%)	**Yes**
ciNPT is recommended for incisions after high-energy trauma	11 (85%)	2 (15%)	**Yes**
ciNPT is recommended for incisions with a high risk of compromised perfusion	12 (92%)	1 (8%)	**Yes**
ciNPT is recommended for repeated incisions or revision surgeries	13 (100%)	0 (0%)	**Yes**
ciNPT is recommended over incisions between surgical stages for fracture repair	10 (77%)	3 (23%)	No
ciNPT is recommended for cases in which delayed incision healing would postpone adjuvant therapy	11 (85%)	2 (15%)	**Yes**
ciNPT may be offered for elective use for incisions in which scarring is a concern	11 (85%)	2 (15%)	**Yes**
The panel recommends using validated incision risk scoring systems to assist with the decision to apply ciNPT	12 (92%)	1 (8%)	**Yes**
ciNPT is recommended when there are signs of hypoperfusion near the incision	12 (92%)	1 (8%)	**Yes**

Note: The bold text emphasizes where consensus has been reached.

linear or area ciNPT dressings and practical application advice for effectively using ciNPT with ROCF dressings.

3.1 | Risk Factors to Consider When Selecting ciNPT

3.1.1 | Consensus Statement 1

ciNPT with ROCF dressings is recommended when there are two or more patient-related or incision-related risk factors for SSC and for closed incisions that (1) are under high tension, (2) have a high risk of seroma, (3) follow high-energy trauma, or (4) are repeated incisions or revision surgeries.

The 2017 consensus publication by Willy et al. identified 12 patient-related risk factors, 10 general incision-related risk factors and 20 operation-related risk factors that would elevate the risk of SSC [9]. As a general consideration, the panel recommended that the presence of two or more of these factors would warrant applying ciNPT to support complication-free incision healing. Additionally, specific conditions were singled out as particularly benefiting from ciNPT. Incisions under high tension have an elevated risk of dehiscence, scarring and ischemia in some severe cases. Placement of ciNPT dressings across the closed incision provides additional support across both sides of the incision, as demonstrated in biomechanical studies [11] and animal incision models [12–14]. The use of ciNPT has been associated with fewer seromas, fewer aspirations and reduced seroma volume in flap donor sites [15], mastectomies [16, 17], lymphadenectomy [18], arthroplasty [19, 20] and hernioplasty [21]. Closed incisions for surgeries for high-energy trauma or repeated reopening of the incision are frequently surrounded by tissue with high levels of inflammation, interrupted vascularisation and lymphatic drainage and an increasingly fragile skin envelope. The panel recommends that ciNPT be used in these scenarios to protect and maintain an optimal environment for incision healing.

3.1.2 | Consensus Statement 2

ciNPT with ROCF dressings is recommended when there is an elevated risk of compromised perfusion or signs of hypoperfusion are visible near the incision.

Adequate perfusion of damaged tissues is a requisite factor for the incision healing cascade that, when compromised, elevates the risk of delayed healing or dehiscence. Although ciNPT is not intended to treat hypoperfusion, some evidence suggests that incisions with indicators for poor perfusion may benefit from placement of ciNPT upon closure of the incision in the operating

TABLE 2 | Selection of linear versus area ciNPT dressings consensus statement survey results.

Consensus statement	Agree	Disagree	Consensus reached
Linear ciNPT dressings are recommended when there is need for visibility of or access to, the surrounding tissue.	9 (69%)	4 (31%)	No
Linear ciNPT dressings are recommended when area dressings would interfere with mobility requirements.	9 (69%)	4 (31%)	No
Area ciNPT dressings are recommended when there are large, undermined areas around the incision.	13 (100%)	0 (0%)	**Yes**
Area ciNPT dressings are recommended over fat graft recipient sites.	10 (77%)	3 (23%)	No
Area ciNPT dressings are recommended when there is a high risk of edema.	12 (92%)	1 (8%)	**Yes**
Area ciNPT dressings are recommended when there is a high risk of lymphedema.	12 (92%)	1 (8%)	**Yes**
Area ciNPT dressings are recommended after closure with flaps.	11 (85%)	2 (15%)	**Yes**
Area ciNPT dressings are recommended over nonlinear, intersecting or branching incisions.	11 (85%)	2 (15%)	**Yes**
Area ciNPT dressings are recommended over new incisions that cross over previously healed incisions.	11 (85%)	2 (15%)	**Yes**
Area ciNPT dressings are recommended over surgical sites with a thin soft-tissue envelope.	11 (85%)	2 (15%)	**Yes**
Area ciNPT dressings are recommended where there is a need to reduce seroma space.	13 (100%)	0 (0%)	**Yes**

Note: The bold text emphasizes where consensus has been reached.

TABLE 3 | Tips, tricks, and practical applications of ciNPT with ROCF dressings consensus statement survey results.

Consensus statement	Agree	Disagree	Consensus reached
ciNPT should be included in SSI prevention bundles for high-risk patients.	13 (100%)	0 (0%)	**Yes**
Caution should be taken when using non-occlusive dressings, which could cause loss of vacuum with ciNPT.	13 (100%)	0 (0%)	**Yes**
Hydrocolloid dressings are recommended to aid in creating a vacuum seal in difficult locations.	12 (92%)	1 (8%)	**Yes**
For large areas, the use of more than one ciNPT device can aid in maintaining negative pressure.	10 (77%)	3 (23%)	No
Delicate areas at risk of blistering should be protected with drape or occlusive dressings.	12 (92%)	1 (8%)	**Yes**
Small blisters that may form at the edge of foam dressing do not typically require early removal of ciNPT dressings.	13 (100%)	0 (0%)	**Yes**
The appearance of large blisters at the edge of the ciNPT drape should be quickly addressed with removal of ciNPT dressings and/or protection with occlusive dressings.	13 (100%)	0 (0%)	**Yes**

Note: The bold text emphasizes where consensus has been reached.

room. For example, a 20-patient study using laser Doppler flowmetry to assess perfusion after cardiac surgery found that perfusion of the peri-incisional tissues was significantly higher after 4 days of ciNPT compared to controls [22]. The effect was even starker in cases where the interior mammary artery was harvested, causing perfusion to decrease by 25.7% in controls, yet the ciNPT group increased by 100%. In a randomised controlled trial with 17 abdominoplasty patients, Renno et al. used laser Doppler spectrophotometry and indocyanine green (ICG) angiography to assess the peri-incisional tissues after application of ciNPT or control [23]. By Postoperative Day 3, both the oxygen saturation and perfusion were significantly higher in the ciNPT group. A third study by Chien et al. tracked perfusion via ICG angiography in various skin flap reconstructions, finding that perfusion decreased during surgery but was significantly elevated after only 24 h of ciNPT [24].

Furthermore, the panel noted that even in cases in which ciNPT was not initially applied upon closure in the operating room, early signs of hypoperfusion could warrant a delayed application of ciNPT. This aligns with a case study published by Gabriel et al., in which the surgeon opted to place ciNPT after noting that the distal end of a flap closure became discoloured on Postoperative Day 5 [25]. After 7 days of ciNPT, the incision remained closed without discoloration or other signs of vascular compromise, leading to complete closure.

3.1.3 | Consensus Statement 3

ciNPT with ROCF dressings is recommended when delayed incision healing would postpone adjuvant therapy.

An important consideration when determining whether to use supportive devices such as ciNPT, even in the absence of other SSC risk factors, is whether the potential development of SSC would delay medically necessary adjuvant care. Incision breakdown resulting in the delay of radiotherapy or chemotherapy for cancer, for example, could increase the risk of cancer recurrence, worsen the prognosis and lower survival rates [26]. Implementing proactive measures to reduce the risk of SSC could have an outsized positive impact on an otherwise low-risk patient. In a meta-analysis examining the prophylactic effect of ciNPT on SSC rates, Song et al. found that breast cancer surgery incisions managed with ciNPT resulted in significantly fewer total wound complications and lower rates of SSI, dehiscence and necrosis [3]. The consequences of such outcomes were emphasised by a study by Ockerman et al., in which patients undergoing oncoplastic mastectomy with ciNPT experienced lower rates of SSC and a shorter time to initiation of adjuvant therapy than controls [27]. Procedures involving additional manipulation, such as mastectomy with immediate reconstruction, may warrant further consideration for intervention with ciNPT, as they can have a higher rate of complication than a delayed approach [28].

3.1.4 | Consensus Statement 4

ciNPT with ROCF dressings may be offered for elective use for incisions in which scarring is a concern.

The panellists observed that after the removal of ciNPT dressings, the scar appearance on healed skin frequently showed minimal discoloration with smoother textures. In some practices, patients with incisions in highly visible locations elected for ciNPT for postoperative care due to the perceived scar improvement. These observations are backed by evidence: several studies have shown improved appearance of scars associated with the use of ROCF ciNPT dressings, as measured using various scoring methods with long-term follow-ups. Abatangelo et al. reported better scores with ciNPT on the Vancouver Scar Scale (VSS) for abdominal incisions for bariatric surgery on Postoperative Day 90 [29]. Three other studies observed improved scar appearance up to 1 year after surgery with ciNPT, compared to standard dressings. Boriani et al. reported improved Stony Brook Scar Evaluation Scale scores at Postoperative Days 7, 15, 30 and 365 after circumferential thigh lift [30]. Fang et al. reported better vascularity, pigmentation and pliability of deep inferior epigastric perforator donor sites using the VSS at 3, 6 and 12 months after surgery [31]. Improved height was also observed at Months 3 and 6, though this was not significantly different at Month 12. Ferrando et al. published the most thorough scar assessments at 1-year follow-up after oncologic breast surgeries [32]. Scars were evaluated using the Observer Scar Assessment Scale, the Manchester Scar Scale and the Patient Scar Assessment Scale, showing significantly better outcomes for all three scoring systems with ciNPT compared to controls.

3.1.5 | Consensus Statement 5

The panel recommends using validated incision risk scoring systems to assist with the decision to apply ciNPT.

Incision risk scoring systems are tools used by clinicians to assess the likelihood of complications related to surgical incisions. These systems support informed decisions by quantifying the risk factors associated with wound healing, infection and other postoperative issues. By evaluating patient-specific variables, such as age, comorbidities and surgical technique, these scoring systems aim to provide an objective estimate of the patient's risk of SSC. The use prevalence of these tools varies by specialty, institution and individual preference. The panel recommends that, when possible, surgeons should refer to highly validated scoring systems such as those endorsed by professional medical societies. Examples of validated incision scoring systems include the American College of Surgeons National Surgical Quality Improvement Program surgical risk calculator [33] and the Society of Thoracic Surgeons Adult Cardiac Surgery Database operative risk calculator [34, 35]. The panel recommends that incisions of patients indicated for a high risk of SSC be managed with ciNPT.

3.2 | Selection of Linear Versus Area ciNPT Dressings

3.2.1 | Consensus Statement 6

Area ciNPT dressings are recommended when there are large, undermined areas around the incision.

Undermining is sometimes present beneath a closed incision, whether as a result of injury (as in traumatic injury), the surgical procedure (i.e., abdominoplasty) or as an intentional strategy to reduce tension across the incision. In such cases, applying dressings only to the superficial closed incision and immediate surrounding area leaves the larger surgical footprint of traumatised tissue unmanaged. To support the entire surgical site, selection of the broader area ciNPT dressings is recommended. Multiple studies have shown success using area ciNPT dressings after surgeries with extensive undermining, including breast reconstruction [36–38] and sternal dehiscence reconstruction [39], each observing complication rates lower than those reported in the literature. In the singular comparative study, Akhter et al. found that patients undergoing mastectomy with immediate reconstruction experienced significantly fewer SSCs when managed with area ciNPT dressings compared to controls [36].

3.2.2 | Consensus Statement 7

Area ciNPT dressings are recommended when there is a high risk of edema or lymphedema.

The emergence of edema or lymphedema is a common postoperative complication resulting from inflammation or disruption of normal fluid drainage pathways. Both conditions can be uncomfortable or painful, limit mobility and in severe cases threaten blood supply to the extremities. Several studies have linked ciNPT dressings with reduced edema and improved lymphatic clearance. Redfern et al. reported a significant reduction in edema and swelling requiring intervention when using ciNPT after elective primary hip or knee arthroplasty [40]. This was despite the ciNPT group having higher comorbidities including higher rates of hypertension, cancer, heart disease and tobacco use. Two studies reported improved lymphatic clearance with ciNPT over controls after lymphadenectomy, a procedure with high rates of lymphatic disruption. Poirier et al. reported significantly less lymphedema at Postoperative Days 8–30 and 31–365 with ciNPT compared to controls [41], while Jorgensen et al. found that 36% of patients managed with ciNPT demonstrated lymphedema, compared to 51% in the control group [42].

3.2.3 | Consensus Statement 8

Area ciNPT dressings are recommended after closure with flaps and nonlinear, intersecting or branching incisions, new incisions that cross over previously healed incisions and surgical sites with a thin soft-tissue envelope.

The panel recommended the use of area ciNPT dressings in cases where the physical integrity of the surrounding tissue is weakened or incision deterioration would be especially difficult to repair. Intersecting and nonlinear incisions can result in uneven distribution of tension and narrow pedicles or sharp angles (e.g., Wise pattern mammaplasty) vulnerable to vascular dysfunction, resulting in dehiscence or tissue loss. In such cases, area ciNPT dressings may be most appropriate to protect and support the incision and underlying tissues, taking care to avoid placing the adhesive edge of the drape over fragile skin. This could be especially beneficial in the case of staged reconstructions, as in high-energy fractures, which may be first stabilised temporarily with soft tissue management and later revisited for orthopaedic repair and closed with a flap. This was explored by Zelle et al., who retrospectively reviewed the outcomes of their institution's policy of using ciNPT for open reduction and internal fixation cases at high risk for SSC [43]. Despite having a higher percentage of staged operations, the ciNPT group had a significantly shorter average duration of external fixation, lower rates of infection and shorter hospital stays than the control group.

For surgeries in anatomical locations with thin skin envelopes, such as the ankle or elbow, there is limited tissue available to reposition or protect critical internal structures from infection should surgical site breakdown occur. As such, the use of ciNPT is recommended to help bolster the incision and surrounding fragile skin. The efficacy of this approach was demonstrated by a study of 28 total ankle arthroplasties, a procedure reported to have SSC rates ranging 20%–28% [44]. After 7 days of ciNPT, the study's authors observed a 0% complication rate and no delay in the patients' normal postoperative courses, despite high-risk patients being included in the study group.

3.2.4 | Consensus Statement 9

Area ciNPT dressings are recommended when there is a need to reduce seroma space.

Although ciNPT has been associated with a decrease in seroma incidence and volume, its mechanism of action remains unclear. The aetiology of seroma formation involves the disruption of lymphatic and vascular drainage and the accumulation of fluids within a dead space. Investigating this using a swine incision model, Suh et al. found that applying ciNPT did not collapse the space, nor did it remove a greater volume of fluid via its vacuum, but rather increased perfusion and tensile strength of the incision [14]. This was confirmed by Kilpadi et al., who after applying ciNPT for 4 days to a swine incision model, traced radiolabeled nanospheres from the dead spaces and found them accumulated in the lymph nodes, not the ciNPT canister [45]. With this potential mechanism in mind, the use of area ciNPT dressings can be a crucial proactive tool to mitigate seroma formation if there is substantial dead space located near the closed incision.

3.3 | Practical Application Tips for Utilising ciNPT Dressings

3.3.1 | Consensus Statement 10

ciNPT should be included in SSI prevention bundles for high-risk patients.

The association between ciNPT and significantly reduced rates of SSI has been documented across a wide range of incision types [1–8] and its prophylactic use for cases with elevated risk of infection has been recognised by previous expert panels [9, 10] and the World Health Organization [46]. This panel reached unanimous agreement that SSI bundles, which are quickly expanding into widespread use, should include ciNPT. The recommendation is supported by multiple clinical studies reporting that SSI bundles utilising ciNPT for high-risk patients significantly reduced SSI rates after caesarean section [47], total joint arthroplasty [48], lymphadenectomy [49] and cardiothoracic surgery [50]. Benrashid et al. compared the use of an SSI bundle with or without ciNPT after inguinal incisions, finding that the addition of ciNPT further reduced SSI rates compared to the bundle alone [51]. Using a decision tree analysis, Saunders et al. determined that using ciNPT within SSI bundles for high-risk hip or knee arthroplasty patients would produce cost savings if the expected SSI rate was greater than 1% [52].

3.3.2 | Consensus Statement 11

Caution should be taken when using non-occlusive dressings, which could cause loss of vacuum with ciNPT. Hydrocolloid

dressings are recommended to aid in creating a vacuum seal in difficult locations.

One of the most common challenges encountered when implementing ciNPT is creating and maintaining a vacuum, especially if inexperienced staff are involved in its application or subsequent care. Care should be taken to avoid placing non-occlusive dressings overlapping with the edge of the ciNPT adhesive drape. A better alternative is hydrocolloid dressing, which can be used to contour difficult areas and help to create a strong seal.

3.3.3 | Consensus Statement 12

Delicate areas at risk of blistering should be protected with drape or occlusive dressings. Small blisters that may form at the edge of foam dressing do not typically require early removal of ciNPT dressings. The appearance of large blisters at the edge of the ciNPT drape should be quickly addressed with the removal of ciNPT dressings and/or protection with occlusive dressings.

The panel wanted to address the appearance of blisters, which has been a vexing problem for users of ciNPT. Blisters can range from minor discomforts to serious adverse events, may significantly reduce patient satisfaction with postoperative care and in some cases, necessitate the discontinuation of ciNPT. Turning to the literature to understand how to address blisters is also difficult to interpret. Multiple meta-analyses have attempted to assess the prevalence of blister formation during ciNPT and the results are varied. This, in part, is likely due to the variety of commercially available ciNPT dressings that may contain components more or less likely to cause blister formation. For example, five studies reported increased blistering associated with incisions managed using multilayer ciNPT with a silicone adhesive wound contact interface [53–56]. When narrowing the field only to ROCF ciNPT dressings, which use a fabric contact layer containing 0.019% ionic silver, blisters are a rarer occurrence. Four comparative studies reported no blisters with ROCF ciNPT dressings [32, 57–59]. Ruhstaller et al. reported no significant difference between ROCF ciNPT and control dressings. Increased blisters were reported in two studies [40, 60]. However, this was not associated with an increase in pain or reduction in patient satisfaction and did not result in early termination of ciNPT [60]. Redfern et al. reported that blisters were resolved with topical antibiotics by the 6-week follow-up [40]. Only one study reported severe blistering with ROCF dressings; one total knee arthroplasty patient exhibited severe blisters associated with the clear adhesive drape [61]. The patient was readmitted for intravenous antibiotics to ensure no subsequent infection and went on to complete incision healing.

4 | Discussion

The recommendations published in this guideline document are intended to use new literature and clinical experience to build upon previous expert opinions on the use of ciNPT with ROCF dressings and the appropriate application of the linear and area ciNPT dressing formats. There now exists a wide range of commercially available options for surgeons to implement ciNPT into their practice and with that opportunity comes a need to discern which modalities best suit the patient and their specific circumstances. The panel aimed to create recommendations to help identify cases with high confidence that ciNPT would benefit the patient. It is interesting to note that no consensus was reached regarding situations in which linear ciNPT dressings are preferable over area dressings. It may be insightful to acknowledge that the linear dressings are the smaller, more familiar and more widely accessible dressing format and therefore might be thought of as the 'default' ciNPT dressing when the larger area dressings are not specifically required.

Expert opinion plays a crucial role in the clinical sciences, complementing existing empirical evidence. First, expert recommendations can supplement areas in which high-quality evidence is lacking, providing practical guidance on the use of new or underexamined techniques and filling knowledge gaps [62]. Documentation of expert opinion also provides insight that even well-designed studies might omit. By combining a diverse group of panellists, the resulting expert recommendations can consider additional factors that can be overlooked elsewhere, including experience, intuition and contextual understanding to address complex issues [63]. Using expert opinion alongside existing clinical evidence can lead to more comprehensive decision-making by health care practitioners.

5 | Limitations

These recommendations are of course limited in that they are derived from expert opinion, which is highly influenced by individual experiences and contexts. Although efforts were made to recruit experts representing various geographical regions and areas of expertise, there were no participants from Africa, Asia or Australia and all panel members were surgeons. Insight that could be provided by infectious disease specialists or nurses, for example, was, therefore, not included in this consensus panel. The circumstances under which consensus was achieved may not always be generalisable across all scenarios. Steps taken to counteract bias included anonymising the consensus votes and requiring a rigorous 80% agreement or higher to reach consensus. Adherence to a pre-established protocol prevents manipulation of the process to reach a certain outcome.

Industry personnel were involved in inviting the panel members, facilitating travel and venue logistics and compensating the participants for their time, which could create opportunities for bias. However, there were no economic incentives dependent on the meeting's outcome and guidance was provided at the meeting explaining that industry staff would not participate in discussions or influence the consensus process. The final vote on agreement or disagreement with the consensus statements was anonymous, alleviating real or perceived pressure on panellists' votes to find consensus.

It should be noted that these consensus statements specifically apply to the application of ciNPT with ROCF dressings, which do not encompass all types of commercially available ciNPT devices. As previously indicated, some clinical outcomes of ciNPT can differ significantly between dressing components, pressure settings or other variations of use.

6 | Conclusion

The evolution of ciNPT with ROCF dressings has significantly advanced wound care, offering tailored solutions for various surgical scenarios. The expert panel's consensus statements provide valuable guidance for clinicians, emphasising the importance of selecting the appropriate dressing type based on specific patient and incision-related factors. While expert opinion enhances clinical decision-making, it is crucial to acknowledge its limitations and the need for ongoing research to refine these recommendations further. The continued collaboration of multidisciplinary experts will ensure that ciNPT remains a vital tool in improving surgical outcomes and patient care.

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Ethics Statement

The authors have nothing to report.

Consent

The authors have nothing to report.

Conflicts of Interest

Authors Singh, Alton, Alvand, Barbosa, Chatterjee, Djohan, Gomez, Pieri, Sumpio, Willy, Zelle and Cooper had consulting agreements with Solventum Corporation (Maplewood, MN) at the time of the expert panel meeting.

Data Availability Statement

Data available on request from the authors.

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