V.A.C.® Therapy Clinical guidelines

A reference source for clinicians

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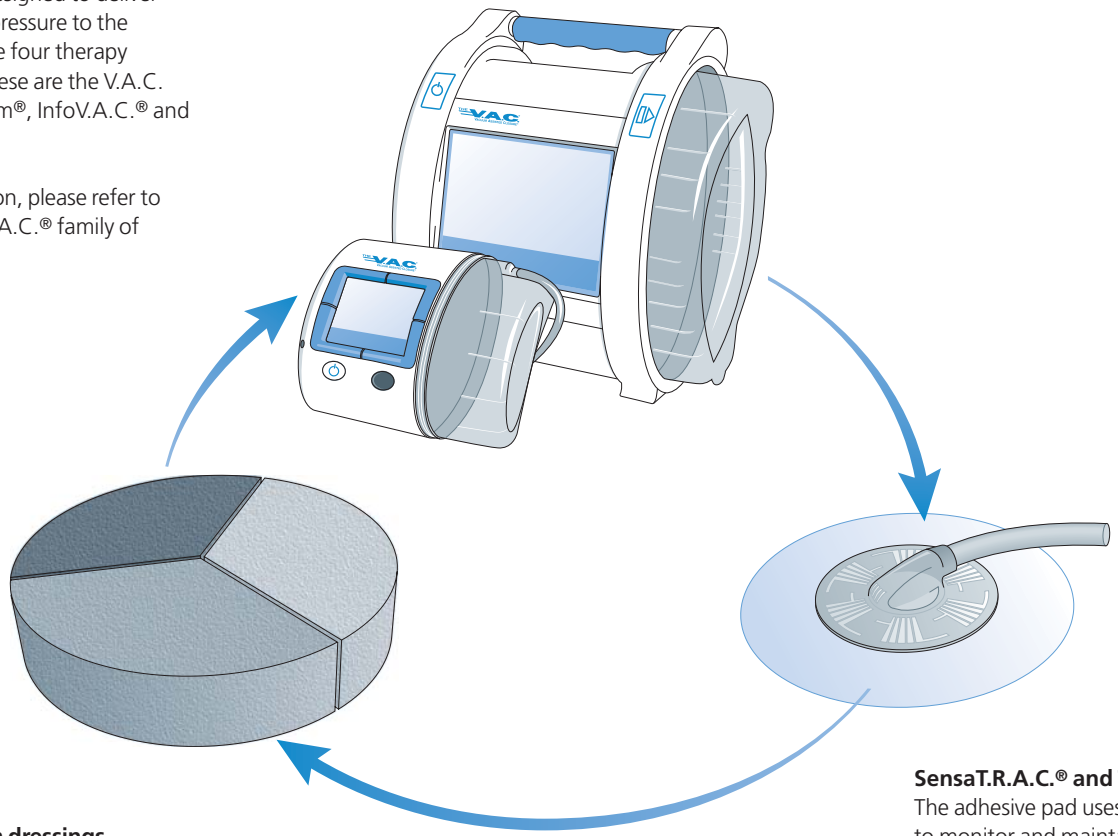
THE INTEGRATED V.A.C.® THERAPY SYSTEM

V.A.C.® Therapy unit
The therapy unit is designed to deliver controlled negative pressure to the wound site. There are four therapy systems available. These are the V.A.C. ATS®, V.A.C. Freedom®, InfoV.A.C.® and ActiV.A.C.®

For further information, please refer to the section on The V.A.C.® family of devices (p4)



Specialist foam dressings
KCI provides three types of foam for use with the V.A.C.® Therapy system:
- V.A.C.® GranuFoam®
- V.A.C. GranuFoam Silver®
- V.A.C.® WhiteFoam Dressing

For further information on dressings and other system components, please refer to the section on V.A.C.® accessories (p7–8)

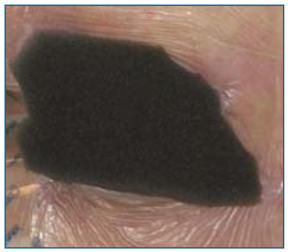
SensaT.R.A.C.® and T.R.A.C.® disposables
The adhesive pad uses T.R.A.C.® technology to monitor and maintain pressure at the wound site. There are two types of pad available. These are the SensaT.R.A.C.® Pad and T.R.A.C.® Pad

For further information on application, please refer to the section on Dressing application technique (p10–11)

QUICK REFERENCE GUIDE

The V.A.C.® Therapy system is indicated for patients with chronic, acute, traumatic, subacute and dehisced wounds, partial-thickness burns, ulcers (such as diabetic or pressure), flaps and grafts. Please refer to the section Wound-specific advice and protocols for further information:

V.A.C.® DRESSING APPLICATION: A STEP-BY-STEP GUIDE

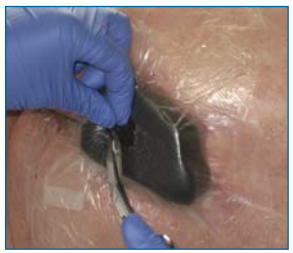


Applying V.A.C.® GranuFoam®

Step 1: V.A.C.® foam application

- Cleanse and prepare the wound according to local protocol.
- Cut the V.A.C.® GranuFoam® Dressing to fit the size and shape of the wound. Gently rub the edges to remove any loose pieces of foam.
- Place the foam in the wound cavity, covering the entire wound base and sides, tunnels and undermined areas.

Do not compress the foam into any areas of the wound (always place it gently).

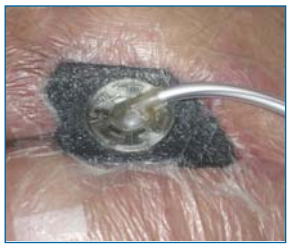


Applying the V.A.C.® Drape (supplied as a single sheet)

Step 2a: V.A.C.® Drape application

If using the Exact Dressing Kit, with specialised drape strips, please follow Step 2b opposite (see Exact Dressing Kit application).

- Size and trim the V.A.C® Drape to cover both the dressing and a 3–5cm border of intact skin.
- Apply the drape over entire wound, including the foam dressing and about 3–5cm of surrounding intact skin.
- Pat around the drape edges to ensure an airtight seal.
- Lift the drape with your thumb and forefinger and cut a 1–2cm round hole.



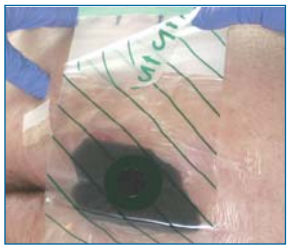
Applying the SensaT.R.A.C.® Pad

Step 3: SensaT.R.A.C.® Pad application

- Apply the SensaT.R.A.C.® Pad directly over the hole in the drape.
- Apply gentle pressure around the pad to ensure complete adhesion.
- Connect the dressing tubing to the canister tubing, ensuring that both clamps are open.
- Press the THERAPY ON/OFF button to activate the V.A.C.® Therapy unit.

For Tips on dressing application refer to p12–14.

The Exact Dressing Kit (supplied with four drape strips, one with a pre-cut hole, a T.R.A.C.® Pad and a medium-sized GranuFoam® Dressing)



Applying the Exact Dressing drape strip with a pre-cut hole

Step 2b: Exact Dressing Kit application

- Peel back the protective cover from the drape with the green tab and a pre-cut hole.
- Apply the drape to cover the foam dressing and extend it on to the surrounding skin by about 3–5cm.
- Trim the drape if necessary.
- Place the remaining drape strips over the exposed foam, overlapping the drape with the pre-cut hole by approximately 3mm.
- Continue until the foam dressing is covered.
- Do not occlude the pre-cut hole in the drape.
- Pat around the edges of the drape to ensure an airtight seal.
- Apply the T.R.A.C.® Pad as described in Step 3 opposite (see SensaT.R.A.C.® Pad application) and activate the V.A.C.® Therapy unit.

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KCI
The Clinical Advantage®

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CONTENTS

These guidelines are not intended as a guarantee of results, outcome or performance of the V.A.C.® Therapy system. They are recommendations to help clinicians to establish patient-specific treatment protocols. As with any application, please consult the patient's lead clinician about individual conditions and treatment, and follow all applicable manuals and reference guides as to product use and operation.

Always consult sections of this booklet and any other product labelling and instructions before placing a V.A.C.® product on a patient.

Contact your local KCI representative if you have any questions about operation or use. For further information visit www.kci-medical.com

Vacuum Assisted Closure (V.A.C.®) is an advanced wound healing therapy that can be readily integrated into the clinician's wound healing practice to help optimise patient care and manage costs. It is a flexible therapy in that it may be used both in hospital and community settings.

The V.A.C.® family of devices (see p4) is used to help promote wound healing through a multimodality action under the influence of continuous and/or intermittent negative pressure in association with wound-site feedback control (T.R.A.C.® Technology). V.A.C.® Therapy is an integrated system incorporating either a polyurethane or a polyvinyl alcohol foam dressing that acts as an interface between the wound surface and the vacuum source. The foam dressing is covered using a transparent, semi-occlusive adhesive drape (V.A.C.® Drape). A SensaT.R.A.C.® Pad (with integrated tubing) is then applied and connected to the V.A.C.® Therapy unit.

Applying V.A.C.® Therapy to the wound helps to promote wound healing by preparing the wound bed for closure, reducing oedema, promoting granulation tissue formation, increasing perfusion and by removing exudate and infectious materials.

V.A.C.® Therapy has been defined as a novel, powerful, non-pharmacological physical wound healing modality capable of modulating the wound healing process (Banwell PE, Téot L. Topical negative pressure (TNP): the evolution of a novel wound therapy. *J Wound Care* 2003; 12(1): 22-28).

TIPS FOR USING V.A.C.® THERAPY

- Ensure that the patient/wound is a suitable candidate for V.A.C.® Therapy.
- Ensure accuracy of diagnosis and address all underlying and associated co-morbidities.
- Ensure appropriate debridement prior to treatment.
- Ensure accurate foam selection and that indication-specific dressings are used as appropriate.
- Do not pack the foam; place it gently in the wound and accurately record in the patient's notes and, if possible on the V.A.C.® Drape, the number of foam pieces used. When using the InfoV.A.C.® or ActiV.A.C.® Therapy systems, the number of foam pieces should also be registered in the device's disposables log.
- Do not place foam directly over exposed vital structures.
- Ensure a good seal has been achieved and maintained.
- Keep therapy on for a minimum of 22 out of 24 hours. Do not leave the V.A.C.® dressing *in situ* if the therapy unit is switched off for more than two hours.
- Monitor continuously, and check and respond to alarms.
- If no response/improvement in the wound is observed within two weeks, reassess the treatment plan.
- Seek advice/support from local KCI personnel.

UNIVERSAL PRECAUTIONS

Use gloves and wear a gown and suitable eye protection if splashing or exposure to body fluids is a possibility. Treat all body fluids as if they are contaminated. All steps should be taken under the direction of the lead clinician and in accordance with local protocols.

INDICATIONS

According to FDA clearance, V.A.C.® Therapy is indicated for patients with chronic, acute, traumatic, subacute and dehisced wounds, partial-thickness burns, ulcers (such as diabetic or pressure), flaps and grafts. The use of V.A.C. GranuFoam Silver® may help to reduce infection in the indicated wound types.

CONTRAINDICATIONS

- Necrotic tissue/eschar present.
- Direct placement of V.A.C.® dressings over exposed vital structures (i.e. tendons, ligaments, blood vessels, anastomotic sites, organs and/or nerves).
- Untreated osteomyelitis.
- Non-enterocutaneous or unexplored fistulae.
- Malignancy in the wound.
- Sensitivity to silver (V.A.C. GranuFoam Silver® only).

These are general recommendations. See relevant sections for further information on debridement (p9) and osteomyelitis (p37).

WARNINGS

Precautions should be taken for patients:

- with active bleeding
- with difficult wound haemostasis
- who are taking anticoagulant medication.

Precautions should be taken:

- when placing the V.A.C.® dressing in close proximity to vital structures. Ensure these are adequately protected with overlying fascia, tissue or other protective barriers
- with respect to weakened, irradiated or sutured blood vessels or organs
- in the presence of bone fragments or sharp edges. These could puncture protective barriers, vessels or organs
- with enterocutaneous fistulae, as these require special precautions to optimise V.A.C.® Therapy. Refer to p33 of this guide
- when using V.A.C. GranuFoam Silver®. Refer to p30 for additional precautions.

Notice to users: As with any medical device, failure to follow product instructions or adjusting settings and performing therapy applications without the express direction and/or supervision of a trained clinician may lead to improper product performance and to the potential for serious or fatal injury.

THE V.A.C.® FAMILY OF DEVICES

These V.A.C.® Therapy clinical guidelines are for use with the V.A.C. ATS®, V.A.C. Freedom®, InfoV.A.C.® and ActiV.A.C.® Therapy systems. Not all have the same features or require the same guidelines. Please also refer to the product-specific user manuals.

V.A.C. ATS® Therapy system

For use with T.R.A.C.® disposables

V.A.C. Freedom® Therapy system

For use with T.R.A.C.® disposables

InfoV.A.C.® Therapy system

For use with SensaT.R.A.C® disposables

ActiV.A.C.® Therapy system

For use with SensaT.R.A.C.® disposables

The InfoV.A.C.® and ActiV.A.C.® Therapy systems are designed for use with the SensaT.R.A.C.® dressing system. Additional features include:

- Seal Check™ alarm to help locate leaks
- facility to upload digital photographs and analyse wound surface area
- disposables log to record the date and time of canister changes and the number of pieces of foam used at dressing changes
- settings guide to help initiate therapy.

Certain unique indications, contraindications, precautions and safety tips may apply to individual products within the V.A.C.® family of devices. Please refer to the instructions for each specific product. Some of the products referred to in these guidelines may not be available in specific countries pending regulatory approval.

V.A.C.® THERAPY SYSTEM PRESSURE SETTINGS

The guidelines on therapy settings in this booklet are general recommendations. You may wish to vary the pressure settings to optimise V.A.C.® Therapy based on individual patient need and the lead clinician's guidance.

Adjusting the pressure settings

For recommended pressure settings for specific wound types, refer to the section Wound-specific advice and protocols (p25).

The default setting for V.A.C.® Therapy is 125mmHg on a continuous setting.

The V.A.C.® pressure setting may be raised by 25mmHg increments where there is:

- excessive drainage
- large wound volume
- V.A.C.® WhiteFoam Dressing in the wound or in tunnelled areas
- a tenuous seal (see Maintaining a seal, p12).

The V.A.C.® pressure setting may be lowered by 25mmHg increments where:

- the patient is very elderly, very young or nutritionally compromised
- pain or discomfort is unrelieved by appropriate analgesia
- there is a risk of excessive bleeding (e.g. patients on anticoagulation therapy)
- the circulation is compromised (e.g. peripheral vascular disease)
- there is excessive granulation tissue growth.

Continuous versus intermittent therapy

V.A.C.® Therapy research in porcine models has shown that intermittent therapy (five minutes suction on, two minutes suction off) can stimulate faster granulation tissue formation than continuous negative pressure alone. However, the application of continuous negative pressure stimulates granulation tissue formation significantly faster than the application of simple, non-adherent dressings (Morykwas MJ, Argenta LC, Shelton-Brown EI, McGuirt W. Vacuum-assisted closure: a new method for wound control and treatment: animal studies and basic foundation. *Ann Plast Surg* 1997; 38(6): 553-62).

This research has helped to establish the guidelines for the recommended mode of therapy (continuous or intermittent) and the amount of negative pressure that should be applied to various wounds.

Continuous therapy is recommended for the first 48 hours in all wounds. Although intermittent therapy is usually the preferred option following this, patients may be better served on continuous therapy for the duration of treatment in the circumstances described overleaf.

Indications for continuous therapy

Continuous therapy after the first 48 hours is indicated where:

- patients experience significant discomfort during intermittent therapy
- it is difficult to maintain an airtight seal (for example, perianal or toe wounds)
- there are tunnels or undermined areas, as it helps to hold the wound closed, collapsing the edges and encouraging granulation tissue formation (see The tunnelling technique, p18)
- there are high levels of drainage from the wound after the first 48 hours (it is better to wait until the amount of drainage tapers off before switching to the intermittent mode)
- there are grafts or flaps to prevent shear
- a splinting effect is required (e.g. sternal or abdominal wounds).

Intensity feature

Intensity relates to how quickly the target pressure is reached after the initiation of therapy. The lower the intensity setting the longer it will take to reach the target pressure. It is recommended that patients new to therapy begin at the lowest intensity setting as this allows for a slower, gentler increase of negative pressure and resultant compression of the foam in the wound. The intensity can remain at the minimum setting throughout treatment to enhance patient comfort, especially when using intermittent therapy. Higher intensity settings may be required for larger wounds to obtain and/or maintain a seal.

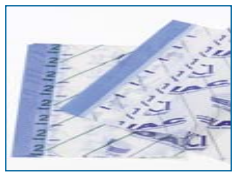
Table 1.1: Additional recommended therapy settings

Wound characteristics/ foam dressing type	Continuous	Continuous or intermittent	Intensity setting
Difficult dressing application	■		Higher
Flaps	■		Lower
Highly exuding	■		Higher
Grafts	■		Lower
Painful wounds	■		Lower
Tunnels or undermining	■		Higher
Unstable structures	■		Either
Minimally exuding		■	Lower
Large wounds		■	Higher
Small wounds		■	Lower
Stalled progress		■	Either
V.A.C.® WhiteFoam Dressing		■	Higher

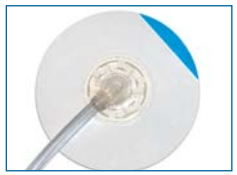
V.A.C.® ACCESSORIES

A number of V.A.C.® disposables are available for use with specific V.A.C.® Therapy systems. These include canisters, tubing, drape, foam dressings and the T.R.A.C.® Pad (the SensaT.R.A.C.® Pad is now available for use with the InfoV.A.C.® and ActiV.A.C.® Therapy systems). In addition, indication-specific V.A.C.® dressings are also available. Refer to p22 or visit the website at www.kci-medical.com for further details.

V.A.C.® canisters



V.A.C.® Drape



SensaT.R.A.C.® Pad

V.A.C.® dressings distributed by KCI are to be used exclusively with V.A.C.® Therapy units. All disposable components of the V.A.C.® Therapy system, including the foam dressings, canister, drape and SensaT.R.A.C.® Pad (with integrated tubing) are latex-free, packaged sterile and for single use only. The decision to use clean versus sterile/aseptic technique depends on the wound pathophysiology, the direction of the lead clinician and local protocol.

Specialist foam dressings

KCI provides three types of foam for use with the V.A.C.® Therapy system. They are:

V.A.C.® GranuFoam®

V.A.C.® GranuFoam® This black, polyurethane (PU) foam dressing has reticulated (open) pores and is considered to be the most effective at stimulating granulation tissue while aiding wound contraction. It is hydrophobic (or moisture repelling), which enhances exudate removal. The foam conduit is fundamental to the integrated V.A.C.® Therapy system.

V.A.C. GranuFoam Silver®

V.A.C. GranuFoam Silver® This PU foam dressing has reticulated (open) pores that have been microbonded with metallic silver to provide a potential antibacterial effect. This allows a continuous, sustained release of silver ions during therapy.

For further information see Infected wounds (p29).

V.A.C.® WhiteFoam Dressing

V.A.C.® WhiteFoam Dressing This white, polyvinyl alcohol (PVA) foam dressing is a dense, open pore foam with a high tensile strength that is ideal for use in tunnels and areas of undermining (see The tunnelling technique, p18). It is hydrophilic (or moisture-retaining) and is packaged pre-moistened with sterile water. Its properties help to reduce the likelihood of adherence to the wound base. V.A.C.® WhiteFoam Dressing is generally recommended for use in wounds where the growth of granulation tissue into the foam needs to be controlled or when the patient cannot tolerate V.A.C.® GranuFoam®.

The greater density of V.A.C.® WhiteFoam Dressing requires higher pressures to provide adequate negative pressure therapy distribution throughout the wound (see p5).

A minimum pressure setting of 125mmHg is recommended when using V.A.C.® WhiteFoam Dressing.

Table 1.2: Selecting an appropriate foam dressing

Wound characteristics	V.A.C.® GranuFoam®*	V.A.C.® WhiteFoam Dressing	Either
Deep, acute wounds with moderate granulation tissue present	■		
Full-thickness pressure ulcers (Grade 3 or 4)	■		
Flaps	■		
Extremely painful wounds		■	
Superficial wounds		■	
Tunnelling/sinus tracts/undermining		■	
Wounds that require controlled growth of granulation tissue		■	
Deep trauma wounds			■
Diabetic foot ulcers			■
Dry wounds			■
Post-graft placement (including dermal substitutes)			■
Lower extremity ulcers			■

*Note: These are general recommendations only. The lead clinician's guidance should always be sought, as individual circumstances may vary. *V.A.C. GranuFoam Silver® may be considered for infected wounds.*

OPTIMISING THERAPY

Maximum benefit from negative pressure therapy depends on both effective holistic wound healing strategies and good wound care. For example, the patient must:

- receive an accurate diagnosis and appropriate treatment of underlying causes; for example, the provision of adequate nutrition and pressure relief in the case of pressure ulcers
- be concordant with treatment. Active negative pressure therapy must be maintained for a minimum of 22 out of 24 hours a day. If therapy is turned off for more than two hours a day, the dressing must be removed and replaced with a traditional dressing. Patients with a history of non-concordance or who are unable to adhere to the treatment regimen should be monitored closely throughout V.A.C.® Therapy
- receive clinical evaluation and guidance on a regular basis. Overall outcomes may be improved when a KCI representative is involved in supporting clinicians using V.A.C.® Therapy
- be actively receiving treatment for osteomyelitis, including appropriate debridement (bone if necessary) and antibiotic therapy.

To obtain maximum benefit from negative pressure therapy, the wound must:

- be debrided of all eschar and hardened slough. Devitalised tissue should be removed as thoroughly as possible according to the instructions of the lead clinician
- be supplied by adequate circulation to support the healing process.

Optimising dressing changes

All wounds treated with V.A.C.® Therapy must be monitored at regular intervals. The V.A.C.® dressing should be changed once every 48–72 hours, but no less than three times a week as directed by the lead clinician. For infected wounds, dressings may need to be changed more often. The dressing change interval should be adjusted according to the condition of the wound, the patient's clinical status and the direction of the lead clinician.

The V.A.C.® Drape has an acrylic adhesive coating, which may increase the risk of an adverse reaction. Do not use V.A.C.® Therapy in patients who are allergic or hypersensitive to such adhesives. If signs of allergic reaction develop (e.g. redness, swelling, rash, urticaria or significant pruritus) discontinue use and consult a lead clinician immediately. If bronchospasm or more serious signs of allergic reaction develop, seek immediate medical assistance.

DRESSING APPLICATION TECHNIQUE

V.A.C.® dressing components are disposable and are for single use only. **Universal precautions** should be observed. Follow the direction of the lead clinician and local protocol regarding the use of clean versus sterile/aseptic technique.

The following recommendations offer step-by-step guidelines for dressing application:

1. Prepare the wound for dressing application

- Remove the current dressing, if one is present. If V.A.C.® Therapy is already in place, see Dressing removal (p14).
- Ensure appropriate debridement of eschar or hardened slough if present (see Optimising therapy, p9).
- Achieve haemostasis.
- Thoroughly clean and irrigate the wound according to local protocol using normal saline or solution as directed by the lead clinician.

2. Prepare the periwound area

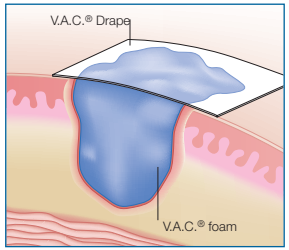
- Clean and dry the periwound tissue; if the skin is moist as a result of perspiration, oil or body fluids, a degreasing agent may be required.
- You may apply a skin preparation such as a liquid surgical adhesive or a liquid barrier film to the periwound tissue.
- For patients with fragile or excoriated periwound tissue, a protective, thin-layered dressing such as V.A.C.® Drape, a hydrocolloid dressing or a vapour-permeable adhesive film dressing may be applied to the periwound area.

3. Apply the V.A.C.® foam

- Note the wound dimensions and cut the foam to dimensions that will allow it to be placed gently into the wound. Use large scissors or a scalpel to cut the foam and gently rub the freshly cut edges to remove any loose pieces of foam. Do not cut or rub the foam over the wound.
- Gently place the foam in the wound cavity, covering the entire wound base and sides, tunnels and undermined areas.
- If the wound is larger than the largest dressing, more than one piece of foam may be required. If you use more than one piece, make sure that all the adjoining edges of foam are in direct contact with each other to ensure an even distribution of negative pressure.

Do not compress the foam into the wound (always place it gently) as this may inhibit reduction of the wound size.
Do not cut or rub the foam over the wound.
Do not cut the foam larger than the wound as this may lead to excoriation and damage to the periwound skin.

- Count the pieces of foam and record the total in the patient's notes – this may also be annotated on the drape with a permanent marker and documented in the device's disposables log when applicable.



V.A.C.® Drape application

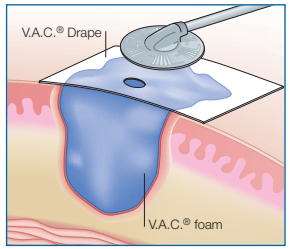
4. Prepare the V.A.C.® Drape

- Size and trim the drape to cover the foam dressing as well as an additional 3–5cm border of intact skin.
- Apply the drape over the entire wound, including the foam dressing and about 3–5cm of surrounding intact skin. Cutting the drape into smaller pieces may aid application. Alternatively, use the Exact Dressing Kit, which is supplied as four drape strips, one with a pre-cut hole (see p22).
- If the skin surrounding the wound site is excessively moist or oily, a medical-grade liquid adhesive may improve adhesion.

Do not stretch the drape or place it onto skin under tension.
Do not discard excess drape, as you may need it to patch difficult areas.
The application of more than two layers of drape may impair moisture vapour transmission rate.

5. Apply the SensaT.R.A.C.® Pad

There is no difference in the application techniques for both the SensaT.R.A.C.® Pad and the T.R.A.C.® Pad.



SensaT.R.A.C.® Pad application

- Lift the drape with your thumb and forefinger and cut a 1–2cm round hole in it that is large enough to allow fluid to pass through the dressing. It is not necessary to cut into the foam. If using the Exact Dressing Kit, place the pre-cut hole over the exposed foam dressing.
- Apply the SensaT.R.A.C.® Pad opening directly over the hole in the drape.
- Apply gentle pressure around the SensaT.R.A.C.® Pad to ensure complete adhesion.
- For wounds that are smaller in dimension (<4cm) than the SensaT.R.A.C.® Pad, a special dressing application is required to protect the periwound tissue (see Dressing small wounds and SensaT.R.A.C.® Pad application, p17).

Do not cut off the SensaT.R.A.C.® Pad and insert the SensaT.R.A.C.® tubing into the foam. This will cause the therapy unit's alarm to sound.
Do not cut a linear slit in the drape because when negative pressure is applied a slit may collapse and close, preventing negative pressure from reaching the wound.
Pay particular attention to the position of the SensaT.R.A.C.® Pad and tubing; avoid placing these over bony prominences or within creases in the tissue.

TIPS FOR DRESSING APPLICATION

Preventing adherence

To prevent the dressing from adhering to the wound bed, you may consider the following:

- applying a single layer of a wide-meshed non-adherent material between the foam dressing and the wound. The non-adherent material must have pores that are wide enough to allow the unrestricted passage of air and fluid
- using V.A.C.® WhiteFoam Dressing because tissue growth into V.A.C.® GranuFoam® may cause adherence
- more frequent dressing changes.

All adjunct dressings must be used according to local protocols and manufacturer's instructions.

Maintaining a seal

Maintaining a seal around the dressing is the key to successful V.A.C.® Therapy.

The following are among the best ways of maintaining the integrity of the seal:

- dry the periwound area thoroughly after cleansing. You may use a skin preparation or degreasing agent to prepare the skin for the drape application (for example, a liquid surgical adhesive or a liquid barrier film)
- for delicate periwound tissue or in areas that are difficult to dress, frame the wound with a skin barrier to enhance the seal. V.A.C.® Gel (gel strips) can be used to cover and protect the periwound area under the V.A.C.® Drape
- ensure the V.A.C.® GranuFoam® Dressing is appropriate for the depth of the wound by either cutting or bevelling it, or use specific thinner V.A.C.® GranuFoam® dressings where indicated
- try to position the dressing tubing on flat surfaces and away from the perineal area, bony prominences or pressure areas. Consider using a repositioning (bridging) technique (see p16)
- secure or anchor the tubing with an additional piece of drape or tape several centimetres away from the dressing/wound. This prevents it from pulling on the wound area, which can cause leaks
- a circumferential drape technique may sometimes be necessary to establish and maintain a seal. Extreme care should be taken not to stretch or pull the drape when securing it; rather, let it attach loosely and stabilise the edges with a self-adhesive elastic wrap
- V.A.C.® Gel may help to maintain a seal around difficult body contours or if orthopaedic hardware is present.

Care must be taken when placing circumferential drapes on patients with neuropathic aetiologies or those with a history of numbness and/or tingling.

CONNECTING THE V.A.C.® THERAPY UNIT AND COMMENCING THERAPY

Remove the canister from the sterile packaging and push it into the V.A.C.® Therapy unit until it clicks into place. Proceed according to the following recommendations:

1. Connect the dressing tubing to the canister tubing. Make sure both clamps are open.
2. Place the V.A.C.® Therapy unit on a level surface or hang it from the foot board or intravenous therapy pole.
3. Press the power button to turn on the V.A.C.® Therapy unit.
4. Adjust the V.A.C.® Therapy unit settings in accordance with the section Wound-specific advice and protocols (see p25). When the InfoV.A.C.® or ActiV.A.C.® Therapy systems are used, the built-in settings guide can be used to obtain information on the manufacturer's recommendations for indication-specific therapy settings.
5. Press the THERAPY ON/OFF button to activate negative pressure therapy. In less than one minute the V.A.C.® dressing should collapse.
6. If you hear or suspect a leak (small leaks may create a whistling noise), you can often fix it by gently pressing around the tubing and wrinkles to seal the drape. You can also use excess drape to patch over leaks. The ActiV.A.C.® and InfoV.A.C.® Therapy systems feature a Seal Check™ function. This causes an audible alarm and displays a bar graph, which can help to locate leaks.

If the canister is not engaged properly the V.A.C.® Therapy unit's alarm will sound.

After initiating therapy, it is crucial to palpate distal pulses to ensure circulatory patency and to question the patient about the presence of numbness and/or tingling sensations. If these are present, stop therapy and loosen the drape. Instruct patients to discontinue therapy and to contact their clinician if numbness, tingling or increased pain occur during therapy.

Ensuring dressing integrity

It is recommended that a clinician or patient (if treated at home) visually checks the dressing every two hours to ensure that the foam is firm and collapsed in the wound bed while therapy is active. If not, follow the advice below:

- make sure the display screen reads THERAPY ON. If not, press the THERAPY ON/OFF button to activate therapy
- make sure the clamps are open and the tubing is not kinked
- identify air leaks by listening with a stethoscope or moving your hand around the edges of the dressing while applying light pressure. When using InfoV.A.C.® or ActiV.A.C.® Therapy systems, the Seal Check™ function will assist in locating leaks. Refer to user manual for details on how to use this function
- if you find that the seal is broken and the transparent dressing (e.g. drape) has come loose, patch with strips of adhesive drape as needed.

DRESSING REMOVAL
Gently remove an existing V.A.C.® dressing according to the following procedure:

1. Consider the strategies outlined under Pain management (see p38).
2. Raise the tubing connectors above the level of the therapy unit.
3. Close the clamp on the dressing tubing.
4. Separate the canister tubing and the dressing tubing by disconnecting the connector.
5. Allow the therapy unit to draw the exudate in the canister tube into the canister then close the clamp on the canister tubing.
6. Press the THERAPY ON/OFF button to deactivate the V.A.C.® Therapy unit.
7. Allow the foam to decompress. This can take between 15 and 30 minutes. Gently stretch the drape horizontally and slowly pull up from the skin. Do not peel. Consider simultaneous saline irrigation. Gently remove foam from the wound. Count and check that the number of foam pieces removed matches the number of pieces inserted. Inspect the wound thoroughly to ensure that all V.A.C.® dressing components have been removed.
8. Discard disposables in accordance with local protocol.

Managing dressing adherence
If previous dressings were difficult to remove, consider introducing normal saline into the dressing.

1. Press the THERAPY ON/OFF button to deactivate the V.A.C.® Therapy unit and clamp the canister tubing.
2. Ensure the clamp of the dressing tube is open.
3. Disconnect the canister tubing from the dressing tubing.
4. Introduce 10–30ml of normal saline into the dressing tubing. For best results, leave *in situ* for 15–30 minutes to allow it to soak underneath the foam.
5. Gently remove the dressing.

If significant discomfort is experienced during dressing changes you may, on the advice of the lead clinician, consider introducing 1% lidocaine solution down the tubing. Instil the lidocaine solution as recommended above and wait 15–30 minutes before gently removing the dressing.

If the dressing adheres to the wound base, consider the techniques outlined under Preventing adherence (*see* p12).

CHANGING THE CANISTER AND Y-CONNECTOR
The V.A.C.® canister should be changed as follows when full (the alarm will sound). On average this should be done once every 3–5 days, or at least once a week to control odour:

1. Follow Universal precautions, as the system may contain body fluids.
2. Close the clamps on both the canister and the dressing tubing.
3. Disconnect the canister tubing from the dressing tubing.
4. Remove the canister from the unit and dispose according to local protocol.
5. Remove the new canister from its sterile packaging and push it into the V.A.C.® Therapy unit until it clicks into place.
6. Connect the dressing tubing to the canister tubing and ensure both clamps are open.

If using a Y-connector to treat multiple wounds (see p16), this should also be changed at least once a week, or more frequently as indicated:

- if the Y-connector is due to be changed, disconnect the Y-connector from the canister tubing and dispose of it according to local protocol
- If the Y-connector is not yet due to be changed, disconnect the canister tubing from the Y-connector and leave the Y-connector connected to the dressing tubing.

DISCONNECTING FROM THE V.A.C.® THERAPY UNIT
If a patient needs to be disconnected from the unit, the duration of disconnection should be for as short a time as possible and for no more than a total of two hours a day.

To disconnect for short periods of time:
1. Close the clamps on the canister and dressing tubing.
2. Turn the therapy unit OFF.
3. Disconnect the dressing tubing from the canister tubing.
4. Cover the ends of the tubing with gauze or other absorbent dressing and secure or, if available, use a tubing cap.

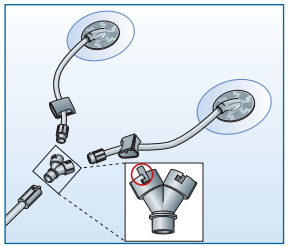
To re-connect:
1. Remove the gauze or tubing cap from the ends of the tubing.
2. Reconnect the dressing tubing and the canister tubing.
3. Open both clamps.
4. Turn the therapy unit ON. The previous therapy settings will resume.

TREATING MULTIPLE WOUNDS

By applying a Y-connector to the canister tubing, one V.A.C.® Therapy unit may be used to treat multiple wounds on the same patient simultaneously.

Y-connector use

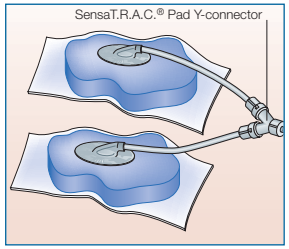
A Y-connector can be used to connect the dressing tubing from two wound sites. It should be noted that T.R.A.C.® technology senses only one wound site – the side with the post (see insert) – even when multiple sites are being treated. Avoid using a Y-connector to connect wounds that would be optimally treated with different pressure settings.



Y-connector (insert shows connector with post)

The Y-connector should be changed at least once a week when the canister is changed, or more frequently as indicated. Dispose of the Y-connector, the canister tubing and the canister in accordance with local protocol.

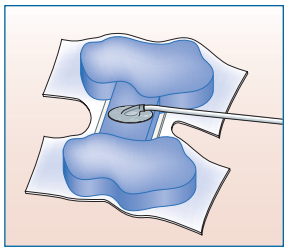
Do not connect infected wounds with non-infected wounds using a Y-connector. Do not connect different wound types in which cross-contamination may occur.



SensaT.R.A.C.® Pad and Y-connector application

The bridging technique

Wounds that are in close proximity to one another on the same patient and of similar pathologies may also be treated with one V.A.C.® Therapy unit, using a technique known as 'bridging'. The advantage of bridging is that it requires only one piece of tubing, which is more convenient for the patient. Bridging is a term that can also refer to a repositioning technique (i.e. when a foam bridge is used to avoid pressure damage on weight-bearing surfaces). See Dressing foot wounds (p19).



Bridging technique

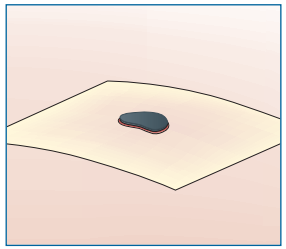
The following recommendations offer step-by-step guidelines for bridging:

1. Protect intact skin between the two wounds with a piece of V.A.C.® Drape or other skin barrier such as a hydrocolloid dressing or a vapour-permeable adhesive film dressing.
2. Place foam dressing in both wounds, then connect the two wounds with an additional piece of foam, forming a bridge. All foam pieces must be in direct contact with each other.
3. Ensure that exudate from one wound is not drawn across the other wound by placing the SensaT.R.A.C.® Pad and tubing in a central location.
4. Do not bridge wounds of different aetiologies or bridge an infected wound to a non-infected wound.

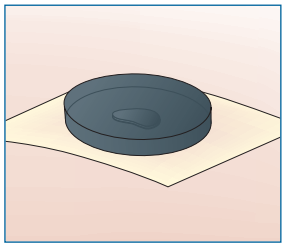
DRESSING SMALL WOUNDS AND SENSAT.R.A.C.® PAD APPLICATION

For wounds that are smaller in dimension (<4cm) than the SensaT.R.A.C.® Pad, it is important to prevent the periwound tissues from coming into contact with the foam dressing or SensaT.R.A.C.® Pad. The following dressing application is required to protect the periwound tissue:

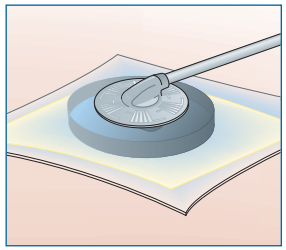
1. Frame the wound with gel strips or a thin hydrocolloid dressing, allowing sufficient coverage around the wound to protect the periwound skin from contact with the SensaT.R.A.C.® Pad (i.e. 3–5cm).
2. Cut the foam to fit the size of the wound and gently place the foam in the wound cavity.
3. Cut a larger piece of foam dressing – approximately 4–6cm in diameter – and place it on top of the first piece of foam dressing ('mushroom technique').
4. Apply the V.A.C.® Drape over the foam dressing. Cut a 1–2cm round hole in the drape and apply the SensaT.R.A.C.® Pad opening directly over the hole in the drape.
5. Connect the dressing tubing to the canister tubing and turn the therapy unit ON.



Protect the periwound skin and gently place a small piece of foam dressing in the wound



Apply the second larger piece of foam dressing on top

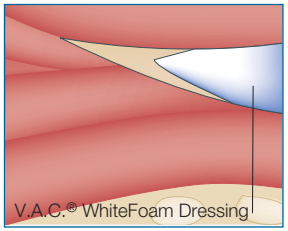


Cover the foam pieces with drape to seal the wound and apply the SensaT.R.A.C.® Pad

THE TUNNELLING TECHNIQUE

V.A.C.® WhiteFoam Dressing is ideal for use in tunnels and areas of undermining. Always cut the foam wider at one end than the other. This will ensure that the opening to the tunnel remains open until the distal portion of the tunnel has closed.

Therapy pressure settings should be increased by 25mmHg in the presence of a tunnel and continuous therapy should always be used until the tunnel has completely closed.



Pull the V.A.C.® WhiteFoam Dressing out 1–2cm, leaving the distal portion of the tunnel clear of foam

Do not place foam into blind or unexplored tunnels.

Initial dressing application

1. Determine the length and width of the tunnel using a measuring device of your choice.
2. Cut the foam to a size that accommodates the tunnel's dimensions, plus 1–2cm into the wound bed. Gently place the foam into the tunnel all the way to the distal portion. The foam in the tunnel should touch the foam in the wound bed.

Subsequent dressing changes

As the drainage begins to diminish and the presence of granulation tissue is noted, subsequent dressing changes must be altered in the following way:

1. Determine the length and width of the tunnel as above.
2. Cut the V.A.C.® WhiteFoam Dressing so that it is wider at one end than the other.
3. Place the foam gently into the tunnel all the way to the distal portion.
4. Pull out the foam1–2cm and ensure that some tunnel foam touches the foam in the wound bed. This specific placement leaves the distal portion of the tunnel clear of foam and enables the distribution of higher pressures to collapse the edges together, allowing the wound to granulate from the distal portion forward.
5. Initiate continuous therapy at previous settings.
6. Repeat this procedure at subsequent dressing changes until the tunnel has closed.

Be sure to mark on the dressing and record in the patient's notes the exact number of pieces of foam that have been placed into all aspects of the wound, as well as the placement of any adjunct dressings such as non-adherent or silver-impregnated dressings. If appropriate, register in the disposables log the number of foam pieces and additional layers used.

WOUND UNDERMINING

Always use continuous therapy in the presence of wound undermining.

Initial dressing application

1. Gently place the V.A.C.® WhiteFoam Dressing in all undermined areas, beginning at the distal portion.

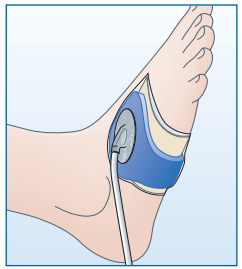
Subsequent dressing changes

Monitor the amount of exudate and the presence of granulation tissue at each dressing change. When the volume of exudate decreases and the presence of granulation tissue is noted, subsequent dressing changes must be altered in the following way:

1. Place the foam gently into the undermined areas all the way to the distal portion.
2. Pull the foam out 1–2cm, leaving some foam in the wound to communicate with the foam in the wound bed. This specific placement leaves the distal portion of the undermined area clear of foam, allowing the distribution of higher pressures to collapse the free areas of undermining together, encouraging the wound cavity edges to granulate from the distal portion forward.
3. Initiate continuous therapy at previous settings.

DRESSING FOOT WOUNDS

For wounds on the plantar surface or heel of the foot, it is best to use a repositioning (bridging) technique to ensure that no additional pressure is applied as a consequence of the placement of the tubing. This involves using a foam bridge to allow placement of the SensaT.R.A.C.® Pad and tubing on the dorsum of the foot. Consider the use of a specialised heel dressing (see p22).



'C' cut for wounds on the plantar surface

Follow these recommendations for dressing application:

1. Place the foam gently into the wound.
2. Apply the V.A.C.® Drape or another occlusive barrier from the wound edge to the anterior aspect of the foot.
3. Cut another piece of foam in the shape of a letter 'C'.
4. Place the C-shaped piece of foam around the foot, extending from the wound to the lateral aspect, and ensure that it is in contact with the foam dressing in the wound.
5. Apply the V.A.C.® Drape or another occlusive barrier over the dressing and extend it round to the anterior aspect of the foot, covering both the wound and the C-shaped piece of foam to obtain a seal.
6. Cut a 1–2cm round hole in the drape on the anterior aspect of the foot and apply a SensaT.R.A.C.® Pad directly over the hole in the drape.
7. Appropriate offloading of the foot is essential to maximise the therapeutic benefits of V.A.C.® Therapy.

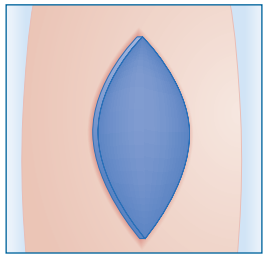
WOUND EDGE REAPPROXIMATION AND DRESSING TECHNIQUE

In open wounds without significant tissue loss, such as open abdominal wounds, infected Caesarean section wounds and fasciotomy wounds, V.A.C.® Therapy may be used to encourage reapproximation of the wound edges.

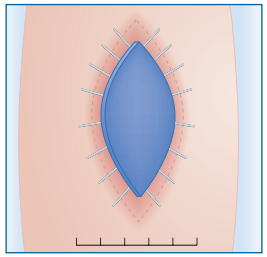
Topical negative pressure applied to the wound uses the visco-elastic properties of the skin adjacent to the wound to aid closure by stretching it forward and advancing the wound edges. An analogy has been made to the technique of tissue expansion used by plastic surgeons, and the effect has been described as 'reverse tissue expansion' (Banwell PE, Musgrave M. Topical negative pressure therapy: mechanisms and indications. *International Wound Journal* 2004; 1(2): 95).

Initial dressing application should include gently placing the V.A.C.® GranuFoam® Dressing into the wound and using higher pressure settings (minimum 150mmHg) to encourage the removal of excessive debris.

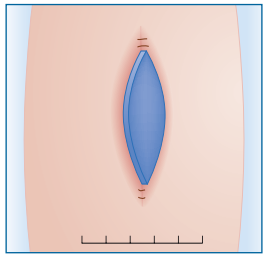
For subsequent dressing applications the foam should be cut progressively smaller to allow controlled reapproximation of the wound edges.



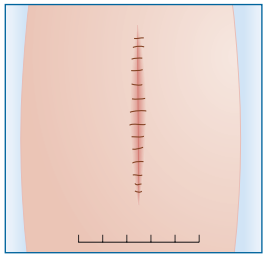
Initial foam application, after which progressively smaller pieces of foam are used



Sutures or staples may be used to secure the dressing



Controlled reapproximation of the wound edges allows for gradual closure



Complete closure is achieved

DRESSINGS AND FAECAL INCONTINENCE

Faecal incontinence is not a contraindication for V.A.C.® Therapy. Many incontinent patients with sacrococcygeal or perineal wounds can benefit from V.A.C.® Therapy. There are a number of ways to combat or control potential leakage of faeces into the wound dressing.

Prior to commencing V.A.C.® Therapy, please review the suggestions below:

- use a rectal collection system (such as a faecal bag or rectal catheter)
- frame the wound with V.A.C.® Drape, a flexible skin barrier or other skin preparation that will help prevent the dressing from coming off due to contact with faeces. The barrier layer helps to create a dam between the anus and the area likely to come into contact with faeces
- in certain circumstances, the lead clinician may consider the suitability of a diverting colostomy and will discuss this with the surgical members of the team.

INDICATION-SPECIFIC DRESSINGS

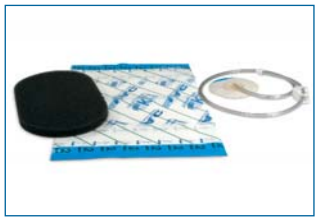
A range of dressings has been specially designed for use on specific wound types that are difficult to dress. It includes the following:

V.A.C.® GranuFoam® Hand Dressing Kit

V.A.C.® GranuFoam® Heel Dressing Kit

V.A.C.® GranuFoam® Abdominal Dressing Kit

V.A.C.® GranuFoam® Round Dressing Kit for pressure ulcers



V.A.C.® GranuFoam® Thin Dressing Kit for more shallow wounds

V.A.C.® GranuFoam® Extra Large Dressing Kit for large wounds

V.A.C.® GranuFoam® Medium Exact Dressing Kit with pre-cut hole for ease of dressing application

HEALING PROGRESS

The wound appearance should begin to change colour and become a deeper red as perfusion increases. Wound dimensions should begin to decrease as the active state of healing progresses. Weekly wound measurements should be taken and documented according to local protocol for subsequent comparison and to assess effectively the progression of healing. The InfoV.A.C.® Therapy system has a facility to upload digital photographs, which can be used to monitor wound healing progression.

Volume and appearance of exudate

The exudate volume should gradually decrease over time. The colour of the exudate may change from serous to serosanguineous and some sanguineous drainage may also be noted during negative pressure therapy. This is due to the increased blood perfusion and disruption of capillary buds as granulation tissue formation increases.

A rapid increase in bright, red blood in the tubing and/or canister requires immediate investigation and discontinuation of therapy until bleeding is controlled.

Duration of treatment

The duration of treatment depends on the lead clinician's goal of therapy, wound pathology and size, and the management of patient co-morbidities. For chronic wound types, V.A.C.® Therapy may be used for an extended period of time as long as satisfactory progress continues.

When to discontinue V.A.C.® Therapy

V.A.C.® Therapy should be discontinued when the goal of therapy has been met. In some cases this will be full closure of the wound; in others the wound may be closed surgically. Generally, although individual circumstances will vary, therapy should be stopped if the wound shows no progress for one to two consecutive weeks and all efforts to encourage wound healing have failed.

WOUND DETERIORATION

A steady decrease in wound dimensions should be noted every week. If this does not occur, comprehensive assessment and troubleshooting interventions should be implemented immediately (see below).

Minimal changes in wound size

When there is little or no change in the wound for one to two consecutive weeks, and patient concordance and dressing application technique are not the cause, the following may be useful:

- cut the foam slightly smaller than the wound edges for wounds with little depth to enhance inward epithelial migration. Be sure not to allow the wound edges to roll downwards during V.A.C.® Therapy
- provide a 'therapeutic pause' by interrupting V.A.C.® Therapy for 1–2 days, then resume

- change the therapy settings from continuous to intermittent, or vice versa
- evaluate nutritional status and supplement as necessary
- make sure the patient is receiving adequate pressure relief. For example, a patient with an ischial pressure ulcer may be sitting up for too long.

Rapid deterioration of the wound

If a wound has been progressing well at each dressing change but then deteriorates rapidly within 48 hours, consider the following interventions and, where necessary, seek the guidance/expertise of a relevant specialist:

- assess for wound infection according to local protocol and, if necessary, obtain a microbiology culture or biopsy and treat accordingly
- examine the wound and debride as necessary. Debride the wound edges if they appear non-viable or rolled under as this may inhibit the formation of granulation tissue and the migration of epithelial cells over an acceptable wound base
- examine the bone and debride as necessary. Assess for osteomyelitis
- check the therapy hour meter to ensure that the actual number of therapy hours received matches the number of recommended therapy hours (22 hours a day). If the number of therapy hours is less than 22 each day, find out why there is a therapy deficit and remedy the situation
- check for small leaks with a stethoscope, or by listening for a whistling noise or moving your hand around the edges of the dressing while applying light pressure. Patch if necessary
- clean wound more thoroughly during dressing changes
- change dressing more often, ensuring that it is being changed every 48 hours if possible. Waiting longer than 48 hours may allow exudate to block the foam pores adjacent to the wound.

Changes in wound colour

If the wound assessment reveals dark discoloration:

- rule out mechanical trauma. Relieve the wound of excessive pressure due to prolonged sitting, excess foam in the wound, or pulling or stretching of the V.A.C.® Drape over the foam. Remember to roll the drape over the foam; do not stretch it over the foam
- decrease pressure by 25mmHg
- check whether the patient is taking anticoagulant medication; if so, evaluate recent clotting times of laboratory values
- thin the depth of the foam before applying the dressing, to prevent overpacking.

If the wound appears white, excessively moist or macerated:

- check the therapy hour meter to ensure that the actual number of therapy hours received matches the number of recommended therapy hours. Find out why there is a therapy deficit and remedy the situation
- consider increasing the pressure in increments of 25mmHg to encourage the removal of excessive exudate.

The following advice involves complex technical interventions that clinicians must be appropriately qualified to carry out. The specific directions of the lead clinician should always be followed, as individual patient circumstances may vary.

ACUTE/TRAUMATIC WOUNDS

V.A.C.® Therapy is particularly suitable for use with acute/traumatic wounds, including partial-thickness burns and orthopaedic wounds.

Aims and objectives

- Remove infectious materials/excessive fluid.
- Stimulate granulation tissue formation.
- Assist flap and skin or bioengineered tissue graft take.

Table 5.1: Recommended therapy settings for acute/traumatic wounds

Initial cycle	Subsequent cycle	Target pressure V.A.C.® GranuFoam®	Target pressure V.A.C.® WhiteFoam Dressing	Dressing change interval
Continuous first 48 hours	Intermittent (5 min ON/ 2 min OFF) for rest of therapy	125mmHg	125–175mmHg Titrate up for more drainage	Every 48–72 hours, but no less than 3 times a week. For infected wounds, dressings may need to be changed more frequently

Special considerations

- The role of V.A.C.® Therapy in the primary treatment of exposed fractures is controversial. However, in the presence of exposed bone with minimal periosteal stripping, V.A.C.® Therapy may rapidly stimulate the formation of granulation tissue, eliminating the need for complex reconstructive surgery. Good results may be obtained with appropriate patient selection determined by specialist referral.
- Regardless of the above, V.A.C.® Therapy is an excellent temporising treatment after debridement in that it minimises secondary infection, encourages the formation of granulation tissue and cleans the wound prior to definitive surgical closure, flap or graft.
- The presence of orthopaedic hardware is not a contraindication to the use of V.A.C.® Therapy, which may stimulate sufficient granulation tissue to cover metalwork. However, clinicians should exercise extreme caution when observing the quality of granulation tissue and remain alert to any sign of infection that may indicate underlying osteomyelitis. In such cases the advice of the local bone infection expert should be sought.

Ensure vital structures such as exposed tendons, ligaments, blood vessels, anastomotic sites, organs and nerves are adequately protected with overlying fascia, tissue or other protective barriers prior to the application of V.A.C.® Therapy.

ABDOMINAL WOUNDS

Abdominal wounds (open abdomen) must be assessed and classified (see Swan M and Banwell PE. *Topical Negative Pressure: Advanced management of the open abdomen*. Oxford Wound Healing Society, 2003). The authors suggest that abdominal wounds may be classified into three separate groups: superficial (fascia intact); deep (with exposed bowel or omentum); or complex (deep with presence of fistulae). All these wounds may be suitable for V.A.C.® Therapy.

Clinicians need to decide whether closure of the wound is by primary closure, delayed primary closure or closure by accelerated granulation tissue formation and split skin grafting. With deep wounds, management is based on whether delayed primary closure is possible. If it is, the aim is to use V.A.C.® Therapy to encourage reverse tissue expansion, closing the wound in a progressive fashion with either skin alone or skin and fascia (see Wound edge reapproximation and dressing technique, p20). If delayed primary closure is not possible, V.A.C.® Therapy may be used to assist tissue granulation in preparation for skin grafting. The use of V.A.C.® Therapy in the management of complex wounds requires specialist expertise. For additional precautions, please refer to Enterocutaneous fistulae (p33).

Aims and objectives

- Stimulate granulation tissue formation and draw wound edges together.
- Control abdominal contents.
- Remove exudate and infectious materials.

Table 5.2: Recommended therapy settings for abdominal wounds

Cycle	Target pressure V.A.C.® GranuFoam®	Target pressure V.A.C.® WhiteFoam Dressing	Dressing change interval
Continuous for duration of therapy	125mmHg	150mmHg Titrate up for more drainage	Every 48–72 hours, but no less than 3 times a week. For infected wounds, dressings may need to be changed more frequently

Special considerations

- Medium or large V.A.C.® GranuFoam® dressings are recommended for superficial wounds (i.e. those with intact fascia).
- Foam must never be placed directly over exposed bowel. This must be protected with one or more layers of a fine-meshed non-adherent material, interposed between the foam dressing and the underlying bowel. It is recommended that for deep or complex wounds (i.e. for those with exposed bowel where primary closure is not possible and/or repeat abdominal entries are necessary), a specialised abdominal dressing should be used (see p22). This interposed, fenestrated foam dressing protects the underlying bowel and prevents adherence of the bowel to the under surface of the anterior abdominal wall. This allows earlier closure of the fascia (European Wound Management Association. *Position Document: Topical negative pressure in wound management*. London: MEP Ltd, 2007).

- If enterocutaneous fistulae are present, the open abdominal wound should be classified as complex (see Enterocutaneous fistulae, p33).
- The placement and size of the foam is critical for optimal results and to achieve reverse tissue expansion (see Wound edge reapproximation and dressing technique, p20).

Special precautions should be taken in patients with ongoing or high potential for haemorrhage and/or enteric leak.

STERNAL WOUNDS

The use of V.A.C.® Therapy in the management of sternal wound infections requires specialist expertise. For further information please refer to *V.A.C.® Therapy™ Clinical Guidelines for Deep Sternal Wound Infections. A reference source for clinicians.* KCI Europe Holding BV, 2006. Please ask your KCI representative for a copy of these consensus guidelines.

PRESSURE ULCERS

In the management of full-thickness pressure ulcers (grades 3 and 4), V.A.C.® Therapy can be used either as a definitive treatment or to optimise the wound bed prior to surgical closure.

Aims and objectives

- Stimulate granulation tissue formation.
- Provide a closed, moist wound environment.
- Remove exudate and infectious materials.
- Precondition wound for surgical closure.

Table 5.3: Recommended therapy settings for pressure ulcers

Initial cycle	Subsequent cycle	Target pressure V.A.C.® GranuFoam®	Target pressure V.A.C.® WhiteFoam Dressing	Dressing change interval
Continuous for first 48 hours	Intermittent (5 min ON/ 2 min OFF) for rest of therapy	125mmHg	125–175mmHg Titrate up for more drainage	Every 48–72 hours, but no less than 3 times a week. For infected wounds, dressings may need to be changed more frequently

Special considerations

- All patients require a detailed medical assessment and any factors that might influence aetiology and/or healing must be addressed, particularly the provision of adequate nutrition and appropriate pressure relief.
- V.A.C.® Therapy is not a debriding tool and is not a substitute for effective surgical and/or enzymatic debridement.

- If the patient's skin cannot tolerate frequent dressing changes it may not be necessary to remove the entire V.A.C.® Drape. Instead, cut the drape around the foam, remove the foam, irrigate the wound as directed by the lead clinician, then replace the foam and reseal with an additional strip of drape. The drape over the periwound area may be left for one further dressing change.
- The application of more than two layers of drape may impair its moisture vapour transmission rate.
- Care must be taken to prevent further trauma and/or pressure when placing V.A.C.® tubing, particularly over bony prominences.

For more detailed information on the use of V.A.C.® Therapy for the management of pressure ulcers, please refer to Banwell P and Harding K (Eds). *Vacuum Assisted Closure™ Therapy: Science and Practice. A practical resource for clinicians.* London: MEP Ltd, 2006. Please ask your KCI representative for a copy of these guidelines.

LOWER EXTREMITY ULCERS

The aims and objectives of V.A.C.® Therapy in the management of lower extremity ulcers are the same as for pressure ulcers (see p27).

Table 5.4: Recommended therapy settings for lower extremity ulcers

Initial cycle	Subsequent cycle	Target pressure V.A.C.® GranuFoam®	Target pressure V.A.C.® WhiteFoam Dressing	Dressing change interval
Continuous for first 48 hours	Intermittent (5 min ON/ 2 min OFF) for rest of therapy	50–125mmHg*	125–175mmHg Titrate up for more drainage	Every 48–72 hours, but no less than 3 times a week. For infected wounds, dressings may need to be changed more frequently

**The higher pressures within the stated target pressure range are preferred. In cases of intolerance, using lower pressure is an option but ensure that active exudate removal occurs.*

Special considerations

- In chronic ulcers where a diagnosis is uncertain, tissue biopsy for histological analysis is recommended.
- It is important to identify any underlying ulcer aetiology and to use relevant measures to address underlying disease processes.
- If the patient's skin cannot tolerate frequent dressing changes it may not be necessary to remove the entire V.A.C.® Drape (see Special considerations, bullets three and four above).

DIABETIC FOOT ULCERS

V.A.C.® Therapy is increasingly being used in the management of diabetic foot ulcers.

Aims and objectives

- Stimulate granulation tissue formation.
- Provide a closed, moist wound environment.
- Remove exudate and infectious materials.
- Precondition wound for surgical closure.

The recommended therapy settings are the same as for lower extremity ulcers (see Table 5.4 opposite). For more detailed information on the use of V.A.C.® Therapy in the management of diabetic foot ulcers, please refer to Banwell P and Harding K (Eds). *Vacuum Assisted Closure™ Therapy: Science and Practice. A practical resource for clinicians.* London: MEP Ltd, 2006. Please ask your KCI representative for a copy of these guidelines.

Special considerations

- As with any treatment for diabetic foot ulceration, success depends on accurate diagnosis and the management of underlying disease in combination with effective debridement of non-viable tissue and effective pressure offloading.
- Early identification and prompt treatment of infection is essential to prevent complications. In patients with diabetes this may be difficult, as classic signs such as pain, erythema, heat and purulence may be absent.
- Special dressing techniques should be adopted (see Dressing foot wounds, p19).

INFECTED WOUNDS

V.A.C.® Therapy may be used as an integrated therapy for infected acute and chronic wounds (i.e. in conjunction with antibiotic therapy and/or debridement). It is also possible to continue V.A.C.® Therapy if a wound becomes infected during treatment. For deep sternal wound infections, specific guidelines have been published (see Sternal wounds, p27).

Aims and objectives

- Remove exudate and infectious materials.
- Stimulate granulation tissue formation.

Table 5.5: Recommended therapy settings for infected wounds

Cycle	Target pressure V.A.C.® GranuFoam®	Target pressure V.A.C.® WhiteFoam Dressing	Dressing change interval
Continuous for duration of infection	125mmHg	150mmHg Titrate up for more drainage	Every 48–72 hours, but no less than 3 times a week. For infected wounds, dressings may need to be changed more frequently

Special considerations

- Depending on microbiological status, it may be appropriate to consider the use of antibiotics.
- If the micro-organism count is 10^5 colony-forming units (CFUs) per gram or more, dressing change frequency should be increased. Regular dressing change intervals (every 48–72 hours) can be resumed when the CFU count has decreased to levels lower than 10^5 or clinical signs of infection have subsided. Clean the wound thoroughly at every dressing change.
- If the patient's skin cannot tolerate frequent dressing changes it may not be necessary to remove the entire V.A.C.® Drape (see Special considerations, bullets three and four, p28).
- At the discretion of the lead clinician, stop therapy if there is no improvement in the wound or if it begins to deteriorate.
- In the case of specific infection (e.g. methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococcus (VRE) and human immunodeficiency virus (HIV)) use standard protocols and carefully dispose of all V.A.C.® components.
- Consider the use of V.A.C. Instill® for wounds that are severely infected. V.A.C. Instill® combines automated fluid instillation and drainage with V.A.C.® Therapy. Use of V.A.C. Instill® requires specialist expertise in a hospital environment.
- Consider the use of V.A.C. GranuFoam Silver® for infected wounds or wounds at risk of infection. For maximum effectiveness, the foam dressing should be in direct contact with the wound surface. Avoid the use of a non-adherent interposed layer as this may compromise the effectiveness of the V.A.C. GranuFoam Silver® Dressing.

Additional precautions for when using V.A.C. GranuFoam Silver® include:

- Do not use topical solutions or agents that may have an adverse reaction with silver.
- Do not allow the V.A.C. GranuFoam Silver® Dressing to come into contact with electrocardiogram or other electrodes, conductive gels during electronic monitoring or when taking electronic measurements. In addition, products containing silver may impair visualisation with certain imaging modalities.
- Be aware that application of products containing silver may cause temporary tissue discoloration.

OTHER POSTOPERATIVE WOUNDS

V.A.C.® Therapy is suitable for the treatment of a variety of large and small wounds arising from postoperative complications and infections, for example after breast and orthopaedic surgery or following coronary artery bypass graft procedures. In such cases the principles of management are adequate surgical debridement and antibiotic therapy followed by the immediate application of V.A.C.® Therapy.

Aims and objectives

- Stimulate granulation tissue formation.
- Remove exudate and infectious materials.
- Promote wound edge reapproximation (see p20).

For therapy settings, see Table 5.2 (p26).

MESHED GRAFTS AND DERMAL SUBSTITUTES

Apply V.A.C.® dressing immediately after graft placement and begin therapy as soon as possible. In general, the pressure setting that was used to prepare the recipient bed before grafting should be continued after grafting, but continuous therapy should be used to provide a constant bolster.

Aims and objectives

- Assist flap and skin or tissue graft take.
- Provide bolster and stability for skin grafts (split and full thickness).
- Minimise shearing forces.
- Remove fluid from dead space.
- Improve tissue perfusion.

Table 5.6: Recommended therapy settings for meshed grafts and dermal substitutes

Cycle	Target pressure V.A.C.® GranuFoam®*	Target pressure V.A.C.® WhiteFoam Dressing	Dressing change interval
Continuous for duration of therapy	75–125mmHg	125mmHg Titrate up for more drainage	Remove dressing after 4–5 days when using either foam (drainage should taper off before removal)

**75mmHg can be used in areas that will not be subjected to shear forces if the patient has persistent pain with higher pressures. 125mmHg can be used in highly contoured areas or areas where shear forces are present. The higher pressure may help to hold the graft more firmly in place.*

The following procedure is recommended when applying V.A.C.® GranuFoam® post-graft:

1. Select a single layer of a wide-meshed non-adherent material (not required for V.A.C.® WhiteFoam Dressing).
2. Cut the non-adherent material to the size of the grafted area plus a 1cm border (i.e. so it extends about 1cm outside the staple line), and place it over the graft.
3. Cut the V.A.C.® GranuFoam® to the same size as the non-adherent layer and place it gently on top. V.A.C.® WhiteFoam Dressing may also be used for fixation of skin grafts. When using V.A.C.® WhiteFoam Dressing, a non-adherent interposed layer is not required.
4. Prepare and apply the V.A.C.® Drape (see step 4 of Dressing application technique (p11).
5. Apply the SensaT.R.A.C.® Pad (see step 5 of Dressing application technique (p11).
6. Set negative pressure to the desired level, as indicated in Table 5.6.

Expect more drainage in the tubing and canister in the first 24 hours of V.A.C.® Therapy post-graft. Following this, the drainage usually tapers off significantly. In general, significant drainage in the tubing post-graft may indicate a complication underneath the foam. If there is any sign of infection, remove the V.A.C.® dressing and assess the wound.

FLAPS

Higher pressures should be used, especially with large, bulky flaps, to help bolster the flap.

Aims and objectives

- Improve perfusion preoperatively in a surgically planned flap.
- Improve perfusion of compromised flaps.

Table 5.7: Recommended therapy settings for flaps

Cycle	Target pressure V.A.C.® GranuFoam®	Target pressure V.A.C.® WhiteFoam Dressing	Dressing change interval
Continuous for duration of therapy	125–150mmHg	125–175mmHg Titrate up for more drainage	72 hours postoperatively, then every 48–72 hours, but no less than 3 times a week. For infected wounds, dressings may need to be changed more frequently

The following is recommended when applying a V.A.C.® dressing post-flap:

1. Suture the flap in place using about a third fewer sutures than usual. The greater spacing will allow V.A.C.® Therapy to remove fluid through the suture line.
2. Place a single layer of V.A.C.® Drape or other semi-occlusive barrier, such as a hydrocolloid dressing or vapour-permeable adhesive film dressing, over the intact epidermis on top of the flap and on the opposite side of the suture line. Place a wide-meshed non-adherent interposed layer over the exposed suture line.

3. Select an appropriate size of V.A.C.® GranuFoam® to cover the entire flap, including the suture line and 2–3cm beyond it.
4. Prepare and apply the drape over the foam according to Step 4 of Dressing application technique (see p11). Apply a SensaT.R.A.C.® Pad and tubing.
5. Initiate therapy on the continuous setting as indicated in Table 5.7.

If the flap needs to be inspected during therapy, cut the V.A.C.® GranuFoam® in half before applying it and place the drape in strips, with one strip directly over the area where the two halves of foam meet. Removing this strip of drape allows the clinician to separate the foam gently to inspect the underlying tissue. After inspecting the flap, simply reseal with an additional strip of drape and continue therapy.

If the recipient bed is exuding heavily, follow the dressing procedure above, but after Step 2 cut a thin strip of V.A.C.® WhiteFoam Dressing and place it under the flap, between the sutures, to wick fluid from the interior of the flap. Make sure the V.A.C.® WhiteFoam Dressing and the V.A.C.® GranuFoam® Dressing touch directly.

ENTEROCUTANEOUS FISTULAE

In certain circumstances, V.A.C.® Therapy may help to promote healing in wounds with an enterocutaneous fistula. However, specialist management is required. If the lead clinician wishes to commence V.A.C.® Therapy, it is recommended that further advice/support from local KCI personnel is sought. V.A.C.® Therapy is not recommended or designed for fistula effluent management or containment but as an aid to wound healing.

The aim of therapy depends on whether the fistula being treated is considered acute or chronic. For acute fistulae, the aim is complete closure. For chronic fistulae, a temporisation manoeuvre is required, as the aim is to segregate the fistula from the abdominal wound, allowing time for the patient's overall health to stabilise and sufficient healing to take place to enable subsequent surgical repair.

Tips for practical fistulae management

General issues

- To heal complex fistulae where there is exposed bowel, patients must be referred to a specialist centre where an appropriately experienced surgeon can be involved in treatment.
- Interposed tissue and/or one or more layers of a fine-meshed non-adherent material should always be placed between exposed bowel and the foam dressing.

An early sign of initial approximation of the fistula is a reduction in the amount of effluent.

Effluent in the tubing
If effluent is noted in the tubing after pressure is initiated:
1. Increase pressure in increments of 25mmHg for 20 to 30 minutes and then check for effluent.
2. If effluent is still present, continue to increase the pressure and observe up to a maximum of 200mmHg until there is no effluent in the tubing.
3. If effluent continues to flow into the tubing after all measures have been tried, remove the V.A.C.® dressing and consider reapplication. Not all wounds are appropriate for V.A.C.® Therapy and alternative treatment should also be considered.

Safety and pressure
A frequently asked question is whether the higher pressures required to approximate the fistula exert too much pressure on the bowel. This is not the case, as application directions include placement of one or more layers of a fine-meshed non-adherent material, which also provides a protective barrier against higher pressures.

V.A.C.® THERAPY UNIT CONSIDERATIONS

Keep therapy on
- Never leave negative pressure off for more than two hours in any 24-hour period.
- Remove V.A.C.® dressings if subatmospheric pressure is terminated or is off for more than two hours a day.

V.A.C.® dressing use
All V.A.C.® dressings distributed by KCI are to be used exclusively with V.A.C.® Therapy units, and vice versa.

All components of the V.A.C.® Therapy system are packaged sterile. The decision to use clean versus sterile/aseptic technique depends on wound pathophysiology, the lead clinician's directions and local protocol. All components of V.A.C.® Therapy, including the foam dressings, canister, drape and SensaT.R.A.C.® Pad (with integrated tubing), are latex free.

Dressing changes
- Thoroughly clean the wound according to the lead clinician's instructions before applying the dressing.
- Routine dressing changes should occur every 48–72 hours, but no less than three times a week. For infected wounds, dressings may need to be changed more frequently.
- Always replace used components with sterile V.A.C.® disposables from unopened packages.
- During dressing applications, apply a skin preparation such as a liquid surgical adhesive or a liquid barrier film to the periwound tissue to enhance the drape's adhesiveness.

Dressing adherence
If the dressing adheres to the wound:
- introduce sterile water or normal saline into the dressing tubing and leave *in situ* for 15–30 minutes, then gently remove the dressing (see Managing dressing adherence, p14)
- for future dressing changes, consider placing a wide-meshed non-adherent interposed layer on the wound bed before placing the foam in it.

Do not compress the foam into any areas of the wound. Forcing foam dressings into the wound is contrary to approved KCI guidelines, and KCI questions whether such practice may increase the risk of serious adverse health consequences.

WOUND CARE CONSIDERATIONS

Monitoring the wound

- Inspect the dressing frequently to ensure that the foam is collapsed and that negative pressure is being delivered in a consistent manner.
- For wounds with large amounts of exudate, or in the presence of oedema, target pressures may need to be increased by 25–75mmHg until the amount of drainage tapers off (see Adjusting the pressure settings, p5).
- Monitor the periwound tissue and exudate for signs of infection or other complications. Infection can be serious and, with or without V.A.C.® Therapy, can lead to many adverse complications, including pain, discomfort, fever, gangrene, toxic shock and septic shock. Extra care and attention should be given if there is any sign of possible infection or related complications. Signs of possible infection include fever, tenderness, redness, swelling, itching, rash, increased warmth in the wound or periwound area, purulent discharge or a strong odour. Signs of systemic infection or complications may include nausea, vomiting, diarrhoea, headache, dizziness, fainting, sore throat with swelling of the mucous membrane, disorientation, high fever (>38.8°C), refractory hypotension, orthostatic hypotension and erythroderma (a sunburn-like rash).
- If there is any sign of serious infection or complications, discontinue V.A.C.® Therapy until the infection or complication has been diagnosed and correct treatment has been initiated.

Wound odours

Wounds treated with V.A.C.® Therapy have a unique odour due to the interaction of the foam and wound fluids, which contain bacteria and proteins. The type of bacteria and proteins present may be responsible for the type and strength of the odour. It is imperative that the wound is thoroughly cleaned during each dressing change to decrease bacterial load and minimise odour.

If you determine that the V.A.C.® Therapy unit is the source of the odour please contact your KCI representative and ask for the unit to be replaced. Using a KCI canister with gel (see www.kci-medical.com) can greatly reduce odours.

If malodour remains after thorough cleaning of the wound, this may also be a sign of possible infection (see Monitoring the wound, above).

ANATOMICAL CONSIDERATIONS

Unstable body structures

Use continuous (not intermittent) therapy over unstable structures, such as an unstable chest wall or non-intact fascia, to minimise movement and help stabilise the wound bed.

Spinal cord injury

If the patient experiences autonomic hyperreflexia (a sudden elevation in blood pressure or heart rate in response to stimulation of the sympathetic nervous system), discontinue V.A.C.® Therapy to help minimise sensory stimulation.

Body cavity wounds

Underlying structures must be covered by natural tissues or synthetic materials that form a complete barrier between the underlying structures and the V.A.C.® foam.

Exposed tendons

Healthy exposed tendons should be protected to prevent desiccation and minimise trauma by moving available muscle or fascia over them or, if you are using V.A.C.® GranuFoam®, by a non-adherent interposed layer. Subject to the lead clinician's discretion, V.A.C.® WhiteFoam Dressing may sometimes be applied directly over the tendon without a non-adherent interposed layer.

Exposed nerves and blood vessels

Exposed nerves and blood vessels should be protected by moving available muscle or fascia over them or, if you are using V.A.C.® GranuFoam®, by one or more layers of a fine-meshed non-adherent material.

Osteomyelitis

V.A.C.® Therapy is contraindicated with untreated osteomyelitis. V.A.C.® Therapy should not be started until:

- the wound has been thoroughly debrided of all necrotic, non-viable tissue, including infected bone
- appropriate antibiotic therapy has been initiated.

Clinicians must determine how much debridement is indicated for each patient, based on individual assessment. The choice of antibiotic therapy, duration of treatment and timing of the initiation of V.A.C.® Therapy should be determined by the lead clinician.

Orthopaedic hardware

Orthopaedic hardware, such as pin sites, can be incorporated into the V.A.C.® dressing and may not have to be removed in the presence of an infected wound. Serial quantitative cultures should be taken to monitor progress.

OTHER CONSIDERATIONS

Pain management

Patients receiving V.A.C.® Therapy may experience a reduction in pain as the wound begins to heal. However, some patients experience discomfort during treatment or dressing changes. In line with the World Union of Wound Healing Societies' (WUWHS) guidelines, a validated pain scoring tool should be used and pain scores should be documented where appropriate before, during and after dressing-related procedures (WUWHS. *Principles of Best Practice: Minimising pain at wound dressing-related procedures. A consensus document*. London: MEP Ltd, 2004).

In addition, the following strategies should be considered:

- if the patient complains of discomfort throughout therapy, consider changing to V.A.C.® WhiteFoam Dressing
- ensure the patient receives adequate analgesia during treatment
- if the patient complains of discomfort during the dressing change due to adherence, consider premedication, the use of a non-adherent interposed layer before foam placement and/or the instillation into the tubing of a topical anaesthetic agent such as 1% lidocaine before dressing removal (see Managing dressing adherence, p14)
- a sudden increase or change in the character of the pain requires investigation.

V.A.C.® Therapy and hyperbaric oxygen therapy

When patients treated with V.A.C.® Therapy are receiving regular hyperbaric oxygen treatments, the medical director of the hyperbaric chamber can authorise the disconnection of the canister tubing from the dressing tubing so that the oxygen and higher pressure in the chamber can enter the wound. In such cases the following procedure is recommended:

1. Do not take the V.A.C.® Therapy unit into the chamber. The unit should be considered a fire hazard in this environment.
2. The dressing tubing and canister tubing clamps should both be closed before disconnection, and the connector at the end of the dressing tubing should be covered by a 4x4 gauze or other absorbent dressing to contain any secretions from the tubing.
3. Once in the chamber with the gauze in place, the dressing tubing clamp can be opened.
4. Cover the entire dressing and tubing with a moist towel.

Following hyperbaric oxygen treatment and once the patient is outside the chamber, reconnect the V.A.C.® Therapy unit and recommence therapy. Check the dressing for air leaks and ensure that the seal is intact.

Active negative pressure therapy must be maintained for a minimum of 22 out of 24 hours a day. If therapy is turned off for more than two hours a day, the dressing must be removed and replaced with a traditional one.

V.A.C.® Therapy and imaging

When a patient is undergoing X-ray, magnetic resonance imaging (MRI), fluoroscopy or dye tests, the V.A.C.® dressing and tubing can be left *in situ*. However, the lead clinician may choose to remove the V.A.C.® dressing prior to imaging to prevent shadow casting in the area of the wound. V.A.C. GranuFoam Silver® contains metallic silver, which may impair visualisation with certain imaging modalities. The following special considerations should be taken into account when patients require MRI:

1. The V.A.C.® Therapy unit must not be taken into the MRI suite as it could cause injury to the patient or caregiver, or damage the equipment.
2. The V.A.C.® dressing can remain on the patient provided the therapy unit is not disconnected for more than two hours.
3. There are no metallic components in V.A.C.® GranuFoam® or V.A.C.® WhiteFoam Dressing, the V.A.C.® Drape or in the SensaT.R.A.C.® Pad and the tubing that would require removal prior to MRI. See individual dressing instructions for use in the MRI environment.

V.A.C.® Therapy and HIV/AIDS

HIV infection is not a contraindication for the use of V.A.C.® Therapy. The dressings and canisters must be disposed of in accordance with the facility's policies and regulations.

V.A.C.® Therapy and paediatric patients

The following special precautions should be taken in neonates, infants, children and adolescents:

1. When using V.A.C.® Therapy consider the size and weight of the patient. Paediatric patients may have a risk of excessive fluid loss and dehydration and should be closely monitored. When monitoring fluid output, consider the volume of fluid in both the tubing and canister. The 1000ml canister should not be used for this patient group. To prevent excessive fluid loss, the canister volume may be further reduced by pre-filling it to a certain extent with sterile water or saline. Recommended canister-rest volumes are 25ml for neonates (birth to 1 month), 50ml for infants (1 month to 2 years), 100ml for children (2 years to 12 years) and 150ml for adolescents (12 years to 21 years).
2. Periwound tissue may be very fragile in neonates and infants. Particular care should be taken not to damage periwound skin.
3. The use of V.A.C.® WhiteFoam Dressing with V.A.C.® Therapy is recommended in neonates, infants and children to prevent granulation tissue ingrowth in the foam. For individuals over the age of 12 years, V.A.C.® GranuFoam® is frequently the foam of choice.
4. The continuous pressure setting should be used in the above populations, where extra stimulation of granulation tissue formation is not usually required. Additionally, the continuous pressure setting is recommended for optimal patient comfort.
5. Pressure settings should be adjusted when applying V.A.C.® Therapy. The recommendation is to use pressures of 50–75mmHg in neonates and infants, 75–100mmHg in children and 75–125mmHg in adolescents.

Management of patients transferring to the community with V.A.C.® Therapy
In addition to the contraindications, warnings and precautions for the use of V.A.C.® Therapy (see p3), consider the following points before recommending V.A.C.® Therapy for patients transferring to the community:

- assess the patient's clinical condition. Ensure there is adequate haemostasis and that there is a low risk of active or large amounts of bleeding at the wound site
- check the suitability of the home environment. The patient or family member/caregiver must be able to read and understand the safety information, be able to respond to alarms and to follow instructions for use. Ensure adequate support is available and provide appropriate patient information leaflets
- assess the patient's wound for exposed vessels, anastomotic sites, organs and nerves. Ensure these vital structures are adequately protected prior to the application of V.A.C.® Therapy (see p37)
- provide the appropriate equipment. The 1000ml canister is not intended for use in the home
- ensure that the lead clinican is familar with the V.A.C.® Therapy instructions for using each specific product. The product-specific materials should be reviewed carefully with the patient, family member/caregiver. Contact your local KCI representative if you have any questions about operation of use. For further information visit www.kci-medical.com

Patients with an increased risk of bleeding should be treated and monitored in a care setting that is deemed appropriate by the lead clinician.