Use of Prevena™ Incision Management System following Cardiothoracic and Orthopedic surgery

Seenu Reddy, MD, MBA, FACS
Animesh Agarwal, MD
Important Information

• It is important for providers to consult the treating physician and read and understand all device Instructions for Use, including Safety Information.

• KCI recommends that clinicians participate in device in-service and training prior to use.

• Follow local institutional protocols for infection control and waste disposal procedures. Local protocols should be based on the applicable federal, state and/or local government environmental regulations.

• The following slides include case studies and/or clinical reports based on clinical experience and research. As with any case study, the results and outcomes should not be interpreted as a guarantee or warranty of similar results. Individual results may vary depending on the patient’s circumstances and condition.

• Scientific research was conducted by KCI employees and consultants

NOTE: Specific indications, contraindication, warnings, precautions and safety information exist for Prevena™ Therapy. Please consult the Prevena™ Clinician’s Guide and product instructions for use prior to application. Rx only.

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Objectives

• Identify complications with surgical incisions
• Review scientific and clinical evidence supporting NPWT over various types of incisions
• Examine Prevena™ Therapy Science and Application
• Discuss Prevena™ Therapy System Mechanisms of Action
Overview

Incision Management
Skin is Naturally Under Tension
Standard Closure Techniques for Surgical Incisions\textsuperscript{2-6}

- Sutures
- Staples
- Tissue adhesives
- Paper tape
- Combination of the above

Adjunctive Therapies used over Closure Techniques\textsuperscript{7-15}

- Gauze dressings
- Hydrocolloids
- *Growth factors
- *Cultured skin
- Low energy ultrasound
- NPWT
Dehiscence

- the opening of a surgically closed wound due to stress, strain or infection\textsuperscript{16}

Surgical Site Infection

- A **superficial incisional SSI** must meet one of the following criteria:
  - Infection occurs within 30 days after the operative procedure and involves only skin and subcutaneous tissue of the incision


\textsuperscript{17} http://www.cdc.gov/nhsn/pdfs/pscmanual/9pscscssicurrent.pdf
Seromas and Hematomas

Seroma

- **Definition**: a clinically identifiable collection of serous fluid within a surgical cavity\(^1^8\)
- Well-defined, localized areas of swelling
- Tender to palpation and pressure
- **Adverse Outcomes**:
  - Flap necrosis
  - Wound dehiscence\(^1^9,^2^0\)

Hematoma

- **Definition**: a collection of extravasated blood trapped in the tissues of the skin or in an organ, resulting from trauma or incomplete hemostasis after surgery
- Harden clot becomes palpable to the examiner
- Painful for the patient
- **Adverse Outcomes**:
  - Considerable blood loss
  - Infection\(^2^1\)

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Prevalence of Hospital Acquired Infections

- CDC estimates of Healthcare Associated Infections (HAIs)\(^{22}\)
  - US – 1.7 million infections
  - US – 99,000 deaths
- 17% to 22% are Surgical Site Infections (SSIs)\(^{23-25}\)
- Patients with multiple comorbidities are at higher risk for surgical site complications\(^{26-28}\)
  - Obesity
  - Diabetes
  - Smoking
  - Poor vascularization
  - Poor nutrition

\(^{22}\) Health care acquired infections. Hospitals in pursuit of excellence 2010 January 1.
\(^{25}\) Scott RD, Il. The direct medical costs of health care associated infections in US hospitals and the benefits of prevention. Atlanta, GA: Centers for Disease Control and Prevention; 2009 Mar 1
\(^{27}\) Wilson JA, Clark JJ. Obesity: impediment to postsurgical wound healing. Adv Skin Wound Care 2004 October 1; 17(8):426-35.
\(^{28}\) Abbas SM, Hill AG. Smoking is a major risk factor for wound dehiscence after midline abdominal incision; case control study. ANZ J Surg 2009 April 1; 79(4):247-50
Surgical Site Infection Rates

- Sternotomies - 0 to 3.72%
- C-sections - 2.71 to 7.53%
- Hysterectomies – 1.36 to 5.17%
- Hip arthroplasty – 0.86 to 2.52%
- Knee arthroplasty – 0.88 to 2.26%

CDC Survey – SSI rates 1992-2004

Collectively, deep incisional and organ space infections can be termed “complex” SSIs.
Complex SSIs are serious infections that typically require rehospitalization, return to the operating room, and intravenous antibiotic therapy.
US Dehiscence Rates\textsuperscript{31}

- Laparotomies – 0.25 to 3.0%
- Cesarean section – 1.6 to 42.3%
- Sternotomies – 0.26 to 2.5%

## Risk Factors That May Compromise Healing

<table>
<thead>
<tr>
<th>Age &gt;65</th>
<th>Hypoalbuminemia</th>
<th>Malignancy</th>
<th>Nicotine use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wound infection</td>
<td>Systemic infection</td>
<td>Hypertension</td>
<td>Type of injury</td>
</tr>
<tr>
<td>Pulmonary disease</td>
<td>Obesity</td>
<td>Length and depth of incision</td>
<td>Radiation therapy</td>
</tr>
<tr>
<td>Peripheral vascular disease</td>
<td>Uremia</td>
<td>Anemia</td>
<td>Steroid use</td>
</tr>
<tr>
<td>Hemodynamic instability</td>
<td>Hyperalimentation</td>
<td>Jaundice</td>
<td>Malnutrition</td>
</tr>
<tr>
<td>Ostomies</td>
<td>Ascites</td>
<td>Diabetes – poor control</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Author</th>
<th>Study Type</th>
<th>Patients</th>
<th>Results/Conclusions</th>
</tr>
</thead>
</table>
| JP Stannard et al             | Randomized Controlled Trial (interim analysis) VAC Therapy vs Standard Post Operative Dressings | - High energy trauma wounds with draining hematomas (31 Control and 13 NPWT)  
- High risk fractures (24 Control and 14 NPWT) | - High energy trauma wounds: drained 1.6 days for NPWT vs. 3.1 days for Control (p=0.03)  
- High risk fractures: drained 1.8 days for NPWT vs. 4.8 days for Control (p=0.02)  
- Study showed decreased drainage following both hematomas and severe fractures |
| JP Stannard et al             | Randomized Controlled Trial NPWT vs. Standard Postoperative Dressings (Control) | 141 NPWT patients vs. 121 Control patients patients with calcaneus, pilon and tibial plateau fractures | - Significant difference in infection rate: 14 NPWT cases vs. 24 Control cases (p<0.02)  
- Significant difference in incidence of dehiscence: 12 NPWT cases vs. 21 Control cases (p<0.03) |
| AH Gommoll et al              | Case Series V.A.C.® Therapy (NPWT) | 35 patients with foot and ankle trauma, revision hip arthroplasty, proximal femoral and tibial fracture fixation treated with NPWT | - Average NPWT time: 3 days  
- No infections occurred in these patients 3 months post operation |
| BZ Atkins et al              | Retrospective Review                | 57 adult sternal wound patients at high risk for infection treated with NPWT | - Based on risk assessment, at least 3 sternal wound infections were anticipated but none were reported in the NPWT-treated patients.  
- NPWT was easy to apply and well tolerated |
| Reddix et al                  | Retrospective Review                | 19 morbidly obese patients (BMI>40) with acetabular fractures treated with NPWT | - No reported complications among these obese patients |
| Reddix et al                  | Retrospective Review                | 235 NPWT patients vs. 66 Control patients with acetabular fractures | - 235 patients with acetabular fractures treated with NPWT vs. 66 patients with acetabular fractures treated with standard postoperative care (Control)  
- Deep wound infections: 3 (1.27%) NPWT vs. 4 (6.06%) Control  
- Dehiscences: 1 (0.0426%) NPWT vs. 2 (3.03%) Control  
- 1.27% infection rate represented a significant decrease compared to other similar size groups (reference rate = 4%; p=0.0282)  
- Application of NPWT decreased the incidence of perioperative incision complications at the authors institution |
Prevena™ Incision Management System Indications for Use
Prevena™ Incision Management System

SMALL & SIMPLE
- One-touch operation (pre-set -125mmHg)
  - Battery-powered, single-patient use
  - Lightweight and portable

SELF-ADHESIVE, PEEL & PLACE DRESSING

Built-in pressure indicator
Prevena™ Incision Management System

Prevena™ Therapy CAN HELP:

- Hold incision edges together
- Protect the incision site from external infectious sources
- Remove fluids and infectious materials from the surgical site
The Prevena™ Incision Management System is intended to manage the environment of surgical incisions that continue to drain following sutured or stapled closure by maintaining a closed environment and removing exudates via the application of negative pressure wound therapy.

- Applied in OR
- To clean closed incisions
- 2-7 days

The Prevena™ Incision Management System will not be effective in addressing complications associated with the following:
  - Ischemia to the incision or incision area
  - Untreated or inadequately treated infection
  - Inadequate hemostasis of the incision
  - Cellulitis of the incision area
Optimum Use Conditions

- The **Prevena™ Incision Management System** should not be used:
  - To treat open or dehisced surgical wounds
  - On patients who have excessive amounts of exudate (> 45mL)
- The **Prevena™ Incision Management System** should be used with caution in the following patients:
  - Patients with fragile skin surrounding the incision as they may experience skin or tissue damage upon removal of the **Prevena™ Incision Dressing**
  - Patients who are at an increased risk of bleeding from the incision associated with the use of anticoagulants and/or platelet aggregation inhibitors
- **Contraindications**
  - Sensitivity to Silver
## Summary of Prevena™ Therapy System Warnings & Precautions

<table>
<thead>
<tr>
<th>Warnings</th>
<th>Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>If active bleeding develops suddenly or in large amounts during therapy, or if blood is seen in tubing or canister, discontinue therapy and seek immediate medical assistance</td>
<td>Standard precautions for infection control should be applied, regardless of diagnosis or presumed infection status</td>
</tr>
<tr>
<td>If infection develops, discontinue therapy until infection is treated</td>
<td>Circumferential dressing application should typically be avoided; in necessary cases, extreme care should be taken not to stretch or pull the dressing when securing it</td>
</tr>
<tr>
<td>If defibrillation is required in the area of dressing placement, therapy dressing should be removed</td>
<td>Therapy dressing should not come in contact with EKG or other electrodes or conductive gels during electronic monitoring or when taking electronic measurements</td>
</tr>
<tr>
<td>If canister becomes full of fluid other than blood, indicated by Maximum Capacity Alert or visual inspection, discontinue therapy and seek immediate medical assistance</td>
<td>Application of products containing silver (ie, therapy dressing) may cause temporary tissue discoloration</td>
</tr>
<tr>
<td>Therapy should not be used in patients with known allergy or hypersensitivity to acrylic adhesives or silver</td>
<td>Only use therapy dressings and canisters from sterile packages</td>
</tr>
<tr>
<td>Therapy unit should not be taken into an MR environment; therapy dressing can typically remain on patient with minimal risk</td>
<td>All system components are for single use only</td>
</tr>
<tr>
<td>Therapy dressing contains silver, which may impair visualization with certain imaging modalities</td>
<td>Do not pull or stretch the adhesive border of therapy dressing during application</td>
</tr>
<tr>
<td>Therapy dressing or unit should not be taken into a hyperbaric oxygen chamber</td>
<td></td>
</tr>
</tbody>
</table>

*Please consult the Prevena™ System Clinician Guide and Instructions for Use for details on each of these Warnings and Precautions.*
Hands on Application

Prevena™ System Application

Always consult the Prevena™ Incision Management System Clinician Guide for use and detailed instructions prior to application.
Prevena™ System Application Overview

**APPLICATION EASY AS 1-2-3**

1. Apply dressing
2. Connect dressing to canister, insert canister into device
3. Power on

Illustration of basic application. Please consult the Prevena™ Incision Management System “Clinician Guide” for detailed information on product use and application.

Always consult the Prevena™ Incision Management System Clinician Guide for use and detailed instructions prior to application.
Preparing for Prevena™ Dressing Application

• Clip or shave peri-incisional area of all hair pre-op where the dressing will be applied to improve dressing adhesion and seal integrity

• Clean and dry peri-incisional area post-operatively

• Be sure there are no drains under the dressing or drape
  - While the concomitant use of surgical drains is allowable with the Prevena™ Therapy, the system must not be used as an outlet or reservoir for the drain.

• Do not cut or alter the dressing
Research Supporting

Prevena™ Therapy
Mechanism of Action

Always consult the Prevena™ Incision Management System Clinician Guide for use and detailed instructions prior to application
Science of Incisional NPWT

- The following is a summary of scientific studies on Incisional NPWT
- Results have not been verified in human studies
- Findings are not to be considered as clinical claims
Summary of the Science

**Immediate Impact**
- Decreased lateral tension
- Increased appositional strength
- Normalized stress distribution

**Intermediate Term Impact**
- Improved Incisional quality (mechanical strength)

**Longer Term Impact**
- Improved Incisional quality (histology)
Impact of Prevena™ Incision Management System

Immediate Impact  Intermediate Term Impact  Longer Term Impact
2D Finite Element Computer Modeling Showed Reduced Lateral Tension

Lateral tension around suture line was reduced approximately 50%

Immediate Impact → Intermediate Term Impact → Longer Term Impact

32. Wilkes et al., Surgical Innovations, 2011
Bench Study of Appositional Forces

Immediate Impact

Intermediate Term Impact

Longer Term Impact

32. Wilkes et al., Surgical Innovations, 2011
In This Bench Top Model, Appositional Forces Were Increased

Force required to stretch incision 10 mm

With Prevena™ Therapy:
Suture line has 51% stronger approximation
Staple line has 43% stronger approximation

Immediate Impact
Intermediate Term Impact
Longer Term Impact

32. Wilkes et al., Surgical Innovations, 2011
Summary of the Science

**Immediate Impact**
- Decreased lateral tension
- Increased appositional strength
- Normalized stress distribution

**Intermediate Term Impact**
- Decreased edema
- Decreased hematoma/seroma
- Lymphatic involvement

**Longer Term Impact**
- Improved incisional quality
- Mechanical strength
- Genomics
- Histology
Immediate Impact  Intermediate Term Impact  Longer Term Impact
Porcine Incisions Following 5 Days of Prevena™ Therapy

Immediate Impact

Intermediate Term Impact

Longer Term Impact


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Porcine Incisions Following 5 Days of Prevena™ Therapy

Incision after 5 days

Incision following 5 days of treatment with Prevena™ Therapy

Incision tensile strength trended 6-10 fold greater after 3 days of Prevena™

Immediate Impact  Intermediate Term Impact  Longer Term Impact

Data courtesy of Dr. Yaszay
Mechanical Testing of Porcine Tissue

- 4 cm long full thickness dorsal incisions
- 2-0 Prolene™ (Ethicon, Inc.) interrupted suture closure
- 10 days of treatment:
  - SOC (ABDs, chg Day 5)
  - Prevena™ Therapy (5 days, chg to ABD)
- Sutures removed when healed
- No treatment from Day 10 to nx

35. Lessing et al., Poster presented at 2010 Wound Healing Society Annual Meeting, April 2011
In a Porcine Study, Incision Apposition Was Increased

Histology 40 Days

N = 3 per group

Immediate Impact  Intermediate Term Impact  Longer Term Impact

35. Lessing et al., Poster presented at 2010 Wound Healing Society Annual Meeting, April 2011
Summary of the Science

Immediate Impact
- Decreased lateral tension
- Increased appositional strength
- Normalized stress distribution

Intermediate Term Impact
- Decreased edema
- Decreased hematoma/seroma
- Lymphatic involvement

Longer Term Impact
- Improved incisional quality
- Mechanical strength
- Genomics
- Histology
Clinical Evidence Supporting NPWT over Various Types of Incisions
Cardiothoracic Procedures

Incident rate of surgical site complications
Use of NPWT post surgery
Cardiothoracic Surgical Site Complications

• CABG Surgeries
  – 1,081 CABG surgeries per million adults per year

• CABG most common SSI
  – Infection of the sternum
  – Mediastinitis
  – Donor site infection


Donor Site Infections\textsuperscript{36}

• Included in CABG SSI infection rates
• Arm and leg donor site infection
  – Potential amputation concerns
• Groin Incision Considerations
  – Warm
  – Moist
  – Optimal area for bacterial growth

# Clinical Data Supporting Negative Pressure Wound Therapy Over Sternal Incisions

<table>
<thead>
<tr>
<th><strong>Author</strong></th>
<th>BZ Atkins et al (Surg Innov 2009 June 1;16(2):140-6)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study Type</strong></td>
<td>Retrospective Review Using InfoV.A.C.® Therapy System and GranuFoam™ Dressings</td>
</tr>
<tr>
<td><strong>Patients</strong></td>
<td>57 adult sternal wound patients at high risk for infection treated with NPWT</td>
</tr>
</tbody>
</table>
| **Results/Conclusions** | • No complications were observed (anticipated 3 sternal wound infections based on risk assessment)  
  • NPWT was easy to apply and well tolerated |
### Use of Prevena™ Therapy following Cardiothoracic Surgery

<table>
<thead>
<tr>
<th>Author</th>
<th>Colli A. First experience with a new negative pressure Therapy on surgical incisions after cardiac surgery in high risk patients. J Cardiothorac Surg 2011 December 6;6(1):160</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study Type</td>
<td>Case Series</td>
</tr>
<tr>
<td>Patients</td>
<td>• 10 patients</td>
</tr>
</tbody>
</table>
| Results/Conclusions | • All wounds and surrounding skin showed complete wound healing and an absence of skin lesions following removal of the dressing.  
• There were no cases of infection.  
• No device-related complications were observed  
• No other wound complications occurred during the 30-day follow-up period. |
Prevena™ Therapy Case Study
CABG Through Median Sternotomy Incision

Clinical Cases

NOTE: As with any case study, the results and outcomes of this patient should not be interpreted as a guarantee or warranty of similar results. Individual results may vary depending on the patient’s circumstances and condition. Unless otherwise specified, any economic value or savings reported is based on data provided by the facility/clinician and the observations/experience of the clinician involved in the case. Savings are estimates only and specific to this individual case. Savings may not be typical and may vary.

NOTE: Specific indications, contraindications, precautions and safety tips exist for this product and therapy. Please consult a physician, product instructions, and safety tips prior to application.
Case Study #1

• A 67-year-old female patient presented with dyspnea on exertion and angina with activity.
• Medical history included previous cholecystectomy and myocardial infarction.
• Labs revealed creatine levels of 1.6mg/dL, chronic kidney disease Stage III, and normal hematocrit.
Case Study #1

Clean, closed surgical incision

Application of Prevena™ Therapy

Incision was well-approximated on postoperative Day 10
Case Study #2

- A 48-year-old male returned to the hospital for complex sternal reconstruction after an aortic valve replacement two years prior.
- Medical history included smoking, disrupted sternum with sternal fracture, and implantation of a prosthetic heart valve.
- Patient weighed 260 lbs with a body mass index of 36.
Case Study #2

Application of Prevena™ Therapy

Incision was well-approximated on postoperative Day 14
Case Study #3

- A 64-year-old male presented with dyspnea on exertion and angina with minimal activity.
- Medical history included severe, poorly controlled diabetes, poor nutrition with a low preoperative albumin, COPD, and appearance older than his stated age.
- Labs revealed a low albumin level of 3.1 and an HgBA1c of greater than 8, indicative of poorly controlled diabetes. In addition, his admitting glucose levels were 290mg/dl.
Case Study #3

Application of Prevena™ Therapy

Prevena™ Therapy was applied for 5 days

Incision was well-approximated at dressing removal on postoperative Day 5
Orthopedic Procedures

Incident rate of surgical site complications
Use of NPWT post surgery
Orthopedic Trauma Surgical Site Complications

• Stabilizing the bone
• Boney fragments within the wound
• 33-50% potential infection rates\(^{34}\)
• Osteomyelitis

Treating Osteomyelitis\textsuperscript{47}

- Difficult to treat
- Combination therapy
  - antibiotics 6 weeks or more
  - parenteral therapy 1-2 weeks
- Resection of infected bone is recommended where possible

Clinical Data Supporting Negative Pressure Wound Therapy Over Incisions

<table>
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<tr>
<td>Study Type</td>
<td>Randomized Controlled Trial NPWT (using InfoV.A.C.® Therapy and GranuFoam™ Dressings) vs. Standard Postoperative Dressings (Control)</td>
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• Study showed decreased drainage following both hematomas and severe fractures  
• Significant difference in infection rate: 14 NPWT cases vs. 24 control cases (p<0.02)  
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## Clinical Data Supporting Prevena™ Therapy

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<th>Author</th>
<th>Pachowsky et al (Int Orthop 2011 E-pub July 15)⁵⁵</th>
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<tbody>
<tr>
<td>Study Type</td>
<td>Prospective randomized controlled trial (RCT)</td>
</tr>
<tr>
<td></td>
<td>• Ultrasound used to measure volume of seromas on PO days 5 and 10</td>
</tr>
<tr>
<td>Patients</td>
<td>19 consecutive patients receiving total hip arthroplasty were randomized:</td>
</tr>
<tr>
<td></td>
<td>• Group A (n=10): Control, standard dry wound coverage</td>
</tr>
<tr>
<td></td>
<td>• Group B (n=9): Prevena™ Therapy (removed postoperative [PO] day 5)</td>
</tr>
</tbody>
</table>

**Incidence of seroma and seroma mass at day 10**

- **Patients with seroma**: 4.0 (44%) for Prevena™ Therapy (n=9) vs 9.0 (90%) for Standard dressing (n=10), p=0.021
- **Seroma mass**: 1.97 mL for Prevena™ Therapy (n=9) vs 5.08 mL for Standard dressing (n=10)
Prevena™ Therapy Case Study
Right Total Hip Arthroplasty

Clinical Cases

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NOTE: Specific indications, contraindications, precautions and safety tips exist for this product and therapy. Please consult a physician, product instructions, and safety tips prior to application.
Case 1: 35 y/o F 450lb Left Acetabular Fx
Case 1: 7 days
Case 1: 6 weeks
Case 2: 45 y/o 600lb M Left Acetabular Fx
Case 2: 7 days
Case 3

- 36 y/o R Tibial Plafond Fracture
- Lateral Extensile Approach
  - Open Area Medially
Case 4 - 15 y/o Obese Male
Status Post Open Reduction and Internal Fixation Acetabular Fracture

A. IntraOp
B. Prevena™ Therapy Placement
C. Prevena™ Therapy drawn down
Case 4 (cont.) 7 Days after Prevena™ Incision Management System Was Placed and Result Was Favorable
Case 5 - 26 y/o Male with Heel Degloving and Open Medial Ankle Joint

Decreased tension on wound is the goal
Case 5 (cont.) - Prevena™ Incision Management System Can Be Placed on Difficult-to-Seal Wounds

A. IntraOp  
B. and C. Prevena™ Therapy Placement  
D. Prevena™ Therapy drawn down

Unfortunately was from out of town and patient followed up elsewhere.
Case 6 - 37 y/o Male Status Post Open Reduction and Internal Fixation of Open Monteggia Fracture Dislocation Came in Dehisced 4 Weeks Later Referred To Me
Case 6 (cont.) - Revised Open Reduction and Internal Fixation (Malaligned) with Excision of Open Wound
Case 6 (cont.) - Case Placement and Draw Down of Prevena™ Incision Management System
Case 6 (cont.) 7 Days Later Incision Dehisced at the Same Site – Rest of Wound Sealed

Prevena™ Incision Management System can help seal wounds. However surgeons still need to take care of underlying problems. In this case, poor skin overlying and probably overzealous closure.
Results

• All patients had multiple comorbidities, including obesity, diabetes, and hypertension.
• Mean incision length was 16 cm.
• Mean duration of Prevena™ Therapy was 5.5 days.
• At follow-up (1-3 months), all incisions were intact with good reapproximation of skin.
• There were no cases of sternal wound dehiscence, wound infection or additional required procedures.
Questions
References


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References

25. Scott RD, II. The direct medical costs of health care associated infections in US hospitals and the benefits of prevention. Atlanta, GA: Centers for Disease Control and Prevention; 2009 Mar 1
28. Abbas SM, Hill AG. Smoking is a major risk factor for wound dehiscence after midline abdominal incision; case control study. ANZ J Surg 2009 April 1; 79(4):247-50
34. Kilpadi DV, Cunningham M. Evaluation of lymph involvement upon application of Prevena™ Incision Management in a porcine model
35. Lessing et al., Poster presented at 2010 Wound Healing Society Annual Meeting, April 2011
38. BZ Atkins et al (Surg Innov 2009 June 1;16(2):140-6)
References

49. AH Gommoll et al (J Orthop Trauma 2006 November 1;20(10):705-9)
53. www.cdc.gov/nchs/ppt/icd9/att_TJR_oct04.ppt
56. Pachowsky et al (Int Orthop 2011 E-pub July 15)