Surgical Incision: Keep Your Eye on the Line

Nancy Morgan RN, BSN, MBA, WOC, WCC, DWC, OMS
Wound Care Education Institute
The information in this handout reflects the state of knowledge, current at time of publication; however, the authors do not take responsibility for data, information, and significant findings related to the topics discussed that became known to the general public following publication.

The recommendations contained herein may not be appropriate for use in all circumstances. Decisions to adopt any particular recommendation must be made by the practitioner in light of available resources and circumstances presented by individual patients.

Acknowledgements: This handout and presentation was prepared using information generally acknowledged to be consistent with current industry standards. The authors whose works are cited in the Bibliography Section of this manual are hereby recognized and appreciated.

All product names, logos and trademarks used in this presentation are the property of the respective trademark owners. ® and ™ denote registered trademarks in the United States and other countries.
Surgical Incision: Keep Your Eye on the Line

Objectives: Upon completion of this session participants will be able to:
1) Describe assessment and management of the acute surgical wound including care of the surgical dressing.
2) Identify signs and symptoms of potential healing complications including surgical site infection.

I. Surgical Wounds
A. There are approx 50 million elective surgical incisions made each year in the United States, and another 50 million traumatic wounds.¹²³

B. A surgical incision created under sterile conditions that heals within an expected time frame and without complications is considered an acute wound.³⁴

C. CDC Surgical Wound Classifications - An assessment of the degree of contamination of a surgical wound at the time of the operation; Wound class should be assigned by a person involved in the surgical procedure (e.g., surgeon, circulating nurse, etc.).⁵⁶,³¹
   1. Clean (Class I)⁵⁶: An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tracts are not entered. In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage. Operative incisional wounds that follow nonpenetrating (blunt) trauma should be included in this category if they meet the criteria.
   2. Clean-Contaminated (Class II)⁵⁶: Operative wounds in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix, vagina, and oropharynx are included in this category, provided no evidence of infection or major break in technique is encountered.
   3. Contaminated (Class III)⁵⁶: Open, fresh, accidental wounds. In addition, operations with major breaks in sterile technique (e.g., open cardiac massage) or gross spillage from the gastrointestinal tract, and incisions in which acute, non-purulent inflammation is encountered are included in this category.
   4. Dirty or Infected (Class IV)⁵⁶: Includes old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera. This definition suggests that the organisms causing postoperative infection were present in the operative field before the operation.

D. Wound Healing Process
1. Surgical wounds follow the same phases of healing as all other wounds, however, acute surgical wounds pass through these phases at a quicker rate. The phases include hemostasis, inflammation, proliferation, and maturation.
2. Hemostasis
   a. The healing sequence begins when the surgical procedure causes bleeding, triggering clot formation.
   b. Once the bleeding stops, the clot dissolves allowing additional cells to enter the wound bed, thus leading to the next phase of wound healing.
3. Inflammatory
   a. Subsequent clot breakdown causes the release of growth factors, which attract white blood cells and fibroblasts to the wound bed.
   b. The white blood cells break down any necrotic tissue and engulf and destroy bacteria to clean the wound bed.
   c. This phase is usually fairly limited in acute surgical wounds because there is little necrotic tissue and low bacteria levels.⁷
   d. Normal clinical findings post-operative day 1-4 include: erythema or skin discoloration, edema, pain, increased temperature at incision site, bloody wound exudate initially changing to serosanguineous by day 3 or 4; amount of wound exudate should decrease in amount from moderate to scant by day 4.⁷⁹
4. Proliferative
a. Begins on approximately postoperative day 4, as the inflammatory phase subsides.
b. The two key events are granulation tissue formation and epithelialization; fill and cover.
c. Epithelialization involves migration of epithelial cells across the approximated skin edges; this process begins almost immediately after surgery and is usually complete in 2 or 3 days.\textsuperscript{7,9}
d. Granulation tissue formation involves ingrowth of new blood vessels to replace those damaged by the trauma of surgery and synthesis of collagen and other connective tissue proteins by the fibroblasts to knit the tissue layers together.
e. Because the tissue layers have been surgically approximated and no gaps or dead space exists in the wounds, the amount of granulation tissue required to support the incision is limited and the proliferative phase usually lasts only 2 to 3 weeks.\textsuperscript{7,9}
f. Normal clinical findings include:
   1) Healing Ridge - A deposit of collagen palpated as an induration beneath the skin under the suture line, extending about 1 cm on each side of the incision wound, is evident between day 5 and 9 postoperatively; typically persists till about 15 days post-wounding.\textsuperscript{7,9,10,11,12} This is an expected positive sign. Deficient or nonexistent healing ridge can be predictor of possible dehiscence or infection.\textsuperscript{7,9,10,12}
   2) Wound exudate should change from serosanguineous to serous and gradually disappear over days 4 – 6 postoperatively.\textsuperscript{9}
   3) Exudate amount should decrease from a minimal amount to none. Any increase in amount of wound exudate during days 5-9 postoperatively indicates potential infection.\textsuperscript{9}
   4) Signs of inflammation at incision days 5-9 postoperatively indicate delayed wound healing.\textsuperscript{9}
g. Acute surgical wounds should complete the proliferative phase of wound healing in 4 weeks with the incision line filled with granulation tissue and be resurfaced with epithelial tissue.\textsuperscript{9} Acute surgical wounds that progress at a slower pace or fail to progress can be considered chronic.\textsuperscript{9}

5. Maturation
   a. Remodeling of the tissue and development of tensile strength occurs.
   b. Can last from 1-2 years. Scar tissue gradually reaches a maximum of 80% tensile strength of the original tissue.\textsuperscript{7,9,10}
   c. The first twelve weeks of the maturation phase requires careful attention to the healing site to avoid contracture formation of the wound as it remodels and tensile strength increases.
   d. Assess healing in this phase by evaluating color of the incision. First post-operative year – color gradually changes from bright red or pink to a silvery gray or white.\textsuperscript{7,9} In darker-pigmented skin, the color of the epithelium will be tonally relevant to normal skin, but as with scar tissue in lighter skins, it will be different from surrounding undamaged epidermis.\textsuperscript{13}
   e. The induration and firmness of healing ridge softens.

6. Summary of Positive Clinical Findings of Healing Incision
   a. Incision: Colors of the incision are a progression from red with approximated edges\textsuperscript{7,9,34}
   1) (days 1 – 4) to bright pink
   2) (days 5 – 14) to pale pink
   3) (day 15 – 1 year) Scar tissue: Light-skinned persons will have white or silver scarring, while persons with darkly pigmented skin will progress from pale pink to darker than usual skin color.
   b. Peri-incision: There is edema, erythema or skin discoloration, and patient may have warmth or pain; should resolve by day 5.\textsuperscript{7,9,34}
   c. Exudate: There is minimal/moderate sanguineous to serous exudate (days 1 – 4); this should resolve by day 5.\textsuperscript{7,9,34}
   d. Closure: Epithelial closure should be seen by day 4 along the entire incision. A healing ridge of newly formed collagen can be felt along the whole incision line during days 5 to 9.\textsuperscript{7,9,34}

E. Surgical Wound Closure
1. Primary Intention - surgical incision with little or no loss of tissue. Wound edges closed and approximated with staples, sutures or adhesive strips at time of surgery.\(^9,10\)
   a. Fastest method for wound healing \(^3,14\)
   b. Resurfacing occurs in 24-48 hours
   c. Lower risk of infection, involves little tissue loss, and heals with minimal scarring (Hess and Kirsner, 2003)

2. Secondary Intention - wound edges left open after surgery and allowed to heal with scar tissue \(^9,10\)
   a. Wound heals from bottom up and edges to center; fills with granulation(scar) tissue
   b. Example: wounds grossly contaminated, wounds with extensive tissue loss, unable to approximate wound edges

3. Tertiary Intention (Delayed primary) – After surgery, wound left open initially and after a short period of time, days to weeks, the wound edges are approximated and wound is closed. \(^9,10\) Closed with sutures, staples, or adhesive skin closures after infection gone.
   a. Highly contaminated wounds are kept open for several days to observe for infection.
   b. Provides time to decrease edema or infection
   c. Closed with sutures, staples or adhesive skin closures

II. Wound Closure Methods
A. The choice of a particular wound closure method is based on the patient, wound, tissue characteristics (thickness/tension), suture characteristics, and anatomic location.\(^3,16\) A surgeon's selection may not be specifically based on scientific data, but rather on the preferences that he or she learned from mentors and/or in training.\(^16\)

B. Sutures
2. General classification of sutures includes natural and synthetic, absorbable and nonabsorbable, and monofilament and multifilament.\(^17\)
   a. Allergic reactions to suture materials are rare and have been specifically associated with chromic gut.\(^16\) Chromic acids may provoke a reaction in individuals who are sensitive to chromate.\(^16\)
   b. Antimicrobial coating is also available on some sutures which are theorized as ways of reducing surgical site infections (SSIs) by decreasing bacterial adherence to the suture.\(^16\)
3. Sutures primarily used for: small incisions from surgical procedures, incisions on the face, incisions from skin lesion excisions, incisions requiring multiple layers of closure.
4. Retention sutures
   a. Retention sutures are placed outside of the primary suture line through all layers of the abdominal wall, including the skin.\(^18\) Regular nylon sutures are used and then the sutures are threaded through a short length of plastic or rubber tubing on the outside of the incision. The effect is to alleviate the tension on the primary suture line.\(^18\)
   b. Only controlled study that was performed showed no positive effect in the use of prophylactic retention sutures and use of retention sutures patients had a greater amount of postoperative pain.\(^19,20\) However, these sutures may be useful and are often used in the following patients: \(^18\)
      1) Those with increased tension on the incision
      2) Those who are severely malnourished
      3) Those who are immunocompromised
      4) Those with previous fascial defect
      5) Those with massive contamination
   c. Generally Left in place 14 days or longer.
   d. Removed by surgeon ONLY.
5. Problems with sutures
   a. Surface sutures can negatively impact optimal healing because they provide additional “wounds” to heal alongside the incision.\(^9\)
6. Suture Removal  
   a. Should be removed before the epithelium has migrated into deeper parts of the dermis. Time frames will vary for removal depending on the rate of healing and the nature of the wound.³  
      1) Face: 3 – 5 days  
      2) Trunk, arms, legs, scalp: 7 days  
      3) Hands, feet, over joints, back: 10 -14 days  

b. **HOW TO: Suture Removal Procedure**²¹,²²  
   1) *(Always review and follow your hospital policy regarding this specific skill)*  
   2) Explain procedure to patient and/or family and provide analgesic if required.  
   3) Pediatrics: second person required to assist with infant or young child.  
   4) Use clean gloves to remove dressing if in place. Discard dressing and gloves.  
   5) Wash hands and apply new gloves.  
   6) Clean incision with normal saline or hydrogen peroxide.  
      a) Hydrogen peroxide can be used to remove dried serum encrusted around the sutures.  
      b) Assess incision line for s/s infection or dehiscence. Notify appropriate health care provider if present – Do not remove sutures.  
      c) After assessing the wound, decide if the wound is sufficiently healed to have the sutures removed. If there are concerns, question the order and seek advice from the appropriate health care provider.  
   7) Remove gloves, wash hands, and apply new gloves.  
   8) Pick up one end of the suture with thumb or forceps, and cut as close to the skin as possible where the suture enters the skin. Never snip both ends of the knot as there will be no way to remove the suture from below the surface.  
   9) Gently pull the suture strand out through the knotted side with the forceps.  
      a) To prevent risk of infection, the suture should be removed without pulling any portion that has been outside the skin back through the skin. **“Lead with the Knot”**  
      b) Remove alternate sutures first. Check for skin separation; if none, continue with removal. If wound is not approximated, notify physician before proceeding.  
   10) Continually monitor patient for pain and tolerance to procedure. Stop if patient is experiencing pain, cover incision line with sterile 4x4s, and medicate with analgesic as ordered.  
   11) Continue until all sutures have been removed. Track the number of sutures removed.  
   12) Clean incision after removal of sutures and apply butterfly adhesive bandages and dressing if required.  
   13) Instruct patient that showering is permitted, but that direct spray on the wound should be avoided and that butterfly bandages should be left in place until they fall off.  
   14) Discard trash and used equipment. Document in medical record: procedure, tolerance, pain, number of sutures removed, description of incision line, presence of healing ridge.

C. **Staples**  
1. Staples are composed of high-quality stainless steel and are available in regular and wide sizes.  
2. Uses: closure of wounds under high tension on the trunk, extremities, and scalp, and used to close large incisions in a timely manner.  
3. Pros  
   a. The act of stapling requires minimal skin penetration, and, thus, fewer microorganisms are carried into the lower skin layers.  
   b. Has been shown to be less reactive than traditional suturing material.  
   c. Increased speed of closure; may shorten the closure time by 70-80%.¹⁶,¹⁷  
4. Cons
a. Staples are more expensive than traditional sutures and require great care in placement, especially in ensuring the eversion of wound edges.

b. Require special staple remover.

c. Removal tends to be more painful than suture removal.

d. Scarring is more distinct than with regular sutures.

5. HOW TO: Remove Medical Staples21

a. (Always review and follow your hospital policy regarding this specific skill)

b. An order to remove the staples, and any specific directions for removal, must be obtained prior to the procedure. Check order regarding removal of all or alternate staples.

c. Explain procedure to patient and/or family and provide analgesic if required.

d. Pediatrics: second person required to assist with infant or young child.

e. Use clean gloves to remove dressing if in place.

f. Discard dressing and gloves. Wash hands and apply new gloves.

g. Clean incision with normal saline or hydrogen peroxide.

1) Assess incision line for s/s infection or dehiscence. Notify physician if present – Do not remove staples.

h. Remove gloves, wash hands, and apply new gloves.

i. Place curved edge of the staple remover under midline of staple.

j. Squeeze the handles of staple remover together until both ends of staple pull out of skin. Do not pull up while depressing handle on staple remover or change the angle of your wrist or hand.

k. To remove: Gently move the staple side to side and lift the staple away from the skin.

1) Remove alternate staples first. Check for skin separation; if none, continue with removal. If wound is not approximated, notify physician before proceeding.

2) Continually monitor patient for pain and tolerance to procedure. Stop if patient experiencing pain, cover incision line with sterile 4x4s, and medicate with analgesic as ordered.

l. Continue until all staples have been removed. Track the number of staples removed.

m. Clean incision after removal of staples and apply butterfly adhesive bandages and dressing if required.

n. Instruct patient that showering is permitted, but that direct spray on the wound should be avoided and that butterfly bandages should be left in place until they fall off.

o. Discard trash and used equipment. Document in medical record: procedure, tolerance, pain, number of staples removed, description of incision line, presence of healing ridge.

6. Absorbable Skin Staples

a. The INSORB® stapling device, a patented skin closure modality, places a proprietary absorbable staple entirely underneath the top layer of skin.16,17,23

b. Designed as an alternative to sutures for closure of surgical wounds.

c. These devices are U-shaped absorbable staples composed of a polylactic/polyglycolic copolymer, which maintains 40% of its strength at 14 days and are essentially absorbed within 90 to 120 days.17,23

d. Care of Patients with INSORB® Absorbable Staples23

1) It is normal to observe a raised incision line postoperatively.23 This desirable wound eversion will gradually flatten in a few weeks as the wound heals.23

2) It is normal to observe dressings that may be ‘wetter’ or ‘heavier’ at the first post-operative dressing change.23 This type closure technique allows the wound to naturally drain in the immediate post-operative period.23

3) INSORB® Staple is a subcuticular absorbable staple, so there is no need to remove them.23

D. Tissue Adhesive
1. Tissue adhesives such as Octyl-cyanoacrylate (Dermabond®) and N-butyl-2-cyanoacrylate (Indermil®) form a polymer on contact with fluid to form a 3-dimensional, strong, flexible bond, with uses comparable to those of 5-0 monofilament nylon suture.16
   a. The use of cyanoacrylates requires that the wound be completely reapproximated before its application. 25
   b. In full-thickness wound closure, a layer of buried sutures is generally required prior to the application of the adhesive. 25
   c. If the adhesive seeps into the wound bed, healing is impaired. 25
2. Used for:
   a. clean, dry linear incisions or laceration16,17
   b. simple lacerations in children and uncooperative patients, preferable to stitches in children since no needles are used16,17
   c. closure of incisions under casts or in cases in which follow-up is difficult16,17
   d. to reinforce incisions closed with suture or staples, as they provide an antimicrobial and waterproof coating16,17,25
   e. fixation of implants, tissue adhesion, closure of cerebrospinal fluid leaks and embolization of blood vessels17
   f. facial wounds, groin wounds, hand surgery, blepharoplasty, laparoscopic wounds, hair transplantation and lacrimal punctum closure17
3. Contraindications:17
   a. Presence of infection, gangrene or ulceration, bleeding or oozing from the incision, incisions under tension requiring sutured approximation or edematous wound edges, partial-thickness skin loss, burns, animal bites, mucosal surfaces or across mucocutaneous junctions, areas of high moisture or dense hair, and areas of high tension, such as joints.
   b. Patients at risk for delayed wound healing (diabetics or patients with collagen vascular diseases) and in those allergic to OCA
4. Benefits: lower infection rate, less operating room time, good cosmetic results, lower costs, ease of use, immediate wound sealing, faster return to athletic and work activities, elimination of needle-stick injuries and eliminating the need for post-operative suture removal.17
5. No follow up is necessary in uncomplicated incisions or lacerations.
   a. The film falls off on its own after 1-2 weeks. Generally, it takes 7-14 days for 2-octylcyanoacrylate to flake off, and prolonged retention, either on the surface or within the edges of the wound, could lead to allergic reactions.26,27
6. Cochrane Review Tissue adhesives for closure of surgical incisions findings: “Although surgeons may consider the use of tissue adhesives they must be aware that adhesives may take more time to apply and that if higher tension is needed upon an incision, sutures may minimize dehiscence.”24
7. Tissue adhesive Tips:
   a. Before application, the skin must be defatted with alcohol or acetone.25
   b. The film should be kept dry for the first 24 hours, then showering is allowed but prolonged soaking or swimming should be avoided.
   c. Case reports have described eyelashes and lips having to be pried free from dried 2-octyl cyanoacrylate. In such a case, petroleum jelly or acetone can be used, which weakens the polymerization.25 Using water and alcohol, which speed up the exothermic reaction that polymerizes 2-octyl cyanoacrylate, is discouraged. 25
   d. No additional bandaging is required, and the patient is advised to not perform wound care at home. 25
   e. Creams and ointments should not be used over the incision as these will loosen the adhesive and cause wound dehiscence.3
E. Other Surgical Closure Techniques17
   A. Surgical adhesive tapes
B. Surgical zipper
C. Laser tissue bonding

III. Surgical Drains and Tubes
A. Drains and/or tubes are often placed near surgical incisions in the post-operative patient, to remove pus, blood or other fluid, preventing it from accumulating in the body.29

1. Drain/tube type is based on the needs of patient, type of surgery, type of wound, how much drainage is expected and surgeon preference.29

B. Surgical drains are indicated for decompression in areas with:28

1. A large potential dead space
2. Necrotic or infected tissue
3. Uncertain hemostasis
4. Fistula
5. Significant amount of fluid accumulation

C. Active drains - These low-pressure suction devices continuously remove fluids against gravity via a closed drainage system.28,30

1. The drain is attached to a collapsible reservoir that exerts negative pressure to pull accumulated fluids from the wound bed.30
2. The collection reservoir expands as it collects drainage.
3. The reservoir is emptied when half-full to maintain maximum function. To unclog blood or tissue shreds, the tubing is gently milked or stripped, away from the patient’s body.28
4. A dry gauze dressing is sometimes used around the surgical site. It is changed daily or as needed.
5. Jackson-Pratt™
   a. Soft pliable tube with multiple perforations with a drainage collection unit shaped like a bulb29
   b. Creates low negative pressure vacuum, designed so that body tissues are not sucked into the tube29
   c. Used when small volumes of exudate (100 – 200 mL / 24 hours) are expected.
   d. Drain is held in place with a suture.
   e. Removed with a surgeon’s order, usually when the drainage has decreased to less than 20cc in 24hrs
6. Hemovac Drain
   a. Used for larger amounts of exudate (up to 500 mL / 24 hours)
   b. Drainage collection unit is shaped like a disc.
   c. Drain is held in place with a suture.
   d. Removed with a surgeon’s order, usually when the drainage has decreased to less than 20cc in 24hrs

D. Passive Drains
1. Passive drains provide an exit for fluids, blood, or necrotic debris that interfere with wound healing or provide a source for bacterial proliferation.28,30
   a. Soft tube that applies no suction. Passive drains enable fluid to escape by gravity and capillary action.28,30
   b. The passive drain is usually inserted into or near an incision or wound.
   c. Often used when drainage is expected to be too viscous to pass through an active drain.
2. The Penrose drain is the most commonly used drain. It is a length of tubing made of flexible, soft rubber and causes little tissue reaction.
   a. A sterile safety pin or holder is often connected to prevent migration into the wound.
   b. Split or fenestrated (pre-cut notch) dry gauze dressings are placed over the passive drain to contain drainage. Dressings are changed when saturated, with care, so the drain is not accidentally extracted when gauze is removed.
   c. Removed with a surgeon’s order. May be pulled out in stages with daily advancement of the Penrose.

IV. Incision Line Complications
A. Surgical Site Infection (SSI)
1. Surgical site infections (SSIs) are infections of the incision or organ or space that occur after surgery.\textsuperscript{31} The Centers for Disease Control (CDC) provides guidelines and tools to the healthcare community to help end surgical site infections.

2. Statistics
   a. Estimated Healthcare Associated Infections (HAI) SSI infections in United States 157,500 per year.\textsuperscript{35}
   b. Estimated 8,205 deaths associated with SSI each year.\textsuperscript{36}
   c. Estimated 11\% of all deaths in intensive care units are associated with SSI.\textsuperscript{36}
   d. SSI are the most common health care associated infection and account for $3.2 billion in attributable cost per year in acute care hospitals.\textsuperscript{37}
   e. Estimated additional 11 days of hospitalization for each SSI per patient.\textsuperscript{37}
   f. SSI are the most frequent cause (20\%) of unplanned readmissions after surgery.\textsuperscript{38}

3. The National Healthcare Safety Network, of the Centers for Disease Control and Prevention (CDC), is the nation’s most widely used health care-associated infection tracking system. Since 2009, infection data has been reported to the NHSN to track the national progress of the reduction of HAIs. https://www.cdc.gov/nhsn/index.html

4. Clinical symptoms of surgical site infection\textsuperscript{9,33}
   a. Hemopurulent or seropurulent drainage from the wound, especially foul smelling drainage or pus 48 hours following surgery.
   b. Increase in amount of exudate after post-op day 4.
   c. Signs and symptoms of wound infection including erythema, edema, elevated temperature, and increased pain along the incision after day 4.
   d. Signs and symptoms of systemic infection including elevated temperature, elevated white blood cell count, and confusion in the older adult.
   e. Concern if there is any redness/inflammation around the wound lasting several days, if the inflamed tissue is warmer than the surrounding area and if pain is noted. Mark the edge of inflammation with a marker and measure to support communication between staff members as to whether the “redness” has increased or decreased.
   f. Offensive smelling discharge is a clear indication of infection. Discharge due to infection is most common around 5 to 10 days post-surgery.

B. CDC definitions for surgical site infection
1. Superficial Incisional SSI\textsuperscript{31}
   a. Infection occurs within 30 days after the operation.
   b. Infection involves only skin or subcutaneous tissue of the incision and at least one of the following:
      1) Purulent drainage, with or without laboratory confirmation, from the superficial incision.
      2) Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.
      3) Superficial incision is deliberately opened by surgeon, unless incision is culture-negative and at least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat.
      4) Diagnosis of superficial incisional SSI by the surgeon or attending physician.

2. Deep Incisional SSI\textsuperscript{31}
   a. Infection occurs within 30 days after the operation if no implant is left in place or within 1 year if implant is in place and the infection appears to be related to the operation.
   b. Infection involves deep soft tissues (e.g., fascial and muscle layers) of the incision and at least one of the following:
      1) Purulent drainage from the deep incision, but not from the organ/space component of the surgical site.
2) A deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (>38ºC), localized pain, or tenderness, unless site is culture-negative.

3) An abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination.

4) Diagnosis of a deep incisional SSI by a surgeon or attending physician.

3. Organ/Space SSI
   a. Infection occurs within 30 days after the operation if no implant is left in place or within 1 year if implant is in place and the infection appears to be related to the operation
   b. Infection involves any part of the body, excluding the skin incision, fascia, or muscle layers, that is opened or manipulated during the operative procedure and at least one of the following:
      1) Purulent drainage from a drain that is placed into the organ/space
      2) Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space.
      3) An abscess or other evidence of infection involving the organ/space that is found on direct examination, during invasive procedure, or by histopathologic examination or imaging test.
   4) Diagnosis of an organ/space SSI by a surgeon or attending physician.

C. Dehiscence
   1. Definition: the rupturing of opposed or sutured margins following a surgical procedure. Wound dehiscence can either be partial involving only the superficial layers of the skin, or a complete dehiscence involving deeper tissues. Complete dehiscence leads to evisceration.

2. Most dehiscence occurs 4–14 days following surgery.

3. Causes
   a. Surgical error; Excessive tension on the sutures
   b. Mechanical stress, improper lifting
   c. Sutures removed too early
   d. Vascular compromise
   e. Infection
      1) 1 – 3% of patients with surgical site infections experience wound dehiscence and mortality rates associated with dehiscence have been reported between 14% and 50%.
   f. Postoperative factors, such as intra-abdominal pressure, e.g. excessive coughing, recurrent vomiting and constipation
   g. Postoperative hematomas
   h. Skin weakness caused by corticosteroids or other medications

4. Risk Factors
   a. Age ≥ 50, male gender
   b. Emergency operation; long operative times
   c. Postoperative coughing
   d. Hypertension
   e. Steroid use
   f. Cancers, ascites, chronic pulmonary disease, jaundice, anemia
   g. Systemic and local wound infection
   h. Obesity, hemodynamic instability, and protein malnutrition
   i. Highest Risk factors include: age>70, ascites; vascular surgery; surgery on the esophagus, stomach, or large bowel; coughing; and wound infection

5. Indications of dehiscence
   a. Opposed sutured margins open or separated at any point along the incision site
   b. Broken sutures (non-healed opposing margins)
   c. Redness at the incision site
   d. Patient experiencing pain at the incision site; a sudden pulling pain
   e. Gaping wound, change in wound contour
f. Viscera visible at the skin surface

g. Abnormal serous or sero-sanguineous discharge

h. Tachycardia

i. Deficient or nonexistent healing ridge

6. Assessment and Documentation

a. Anatomical position of the wound and type of surgery performed

b. Wound dimensions; also, if partial or full dehiscence

c. Type of tissue in wound bed

d. Exudate level and type

e. Level of pain using an appropriate measurement tool

f. Odor

g. Signs of infection

h. Condition of surrounding skin

7. HOW TO: Manage dehisced incision

a. Requires evaluation by the primary-care provider, usually the surgeon

b. The wound is managed the same as any other open wound; moist wound healing, nutritional and circulatory support, and removal of cause.

c. Topical therapy goals: eliminate necrotic tissue, control bioburden, and maintain an optimal environment for granulation tissue formation and epithelial migration.

d. Products: alginates, absorptive adhesive foams, anti-microbial or silver dressings, Negative Pressure Wound Therapy

D. Evisceration

1. Separation of all the wound layers with internal organs, usually the bowel, protruding through the open wound - a complication that can lead to peritonitis and septic shock.

2. Usually the first sign of an impending problem is the sudden discharge of serosanguineous fluid but some patients present with sudden evisceration following an episode of coughing or retching.

3. Wound evisceration requires QUICK INTERVENTION to prevent potentially fatal shock; the wound is usually closed in the operating room.

4. HOW TO: Manage surgical abdominal wound evisceration

a. Place patient in low fowler’s position (less than/equal to 20 degrees) with the knees bent (decreases tension on abdominal muscles).

b. Cover any exposed tissues with a moistened dressing soaked in warm sterile normal saline to keep exposed tissues moist.

1) Keep eviscerated organs saturated and warm since organ dehydration and heat loss occurs rapidly with an open abdominal cavity.

2) Re-saturate dressings as needed to prevent dressings from becoming dry and adhering to abdominal organs/tissue resulting in additional cellular destruction and necrosis.

c. Do not attempt to push exposed viscera back into the abdomen.

d. Depending upon the care setting, call 911 or notify physician /NP immediately.

e. Remain with the patient to monitor for shock and vital signs until patient is seen by a physician/NP or ambulance arrives.

f. Documentation

1) Note when the problem occurred, the patient’s activity preceding the problem, his condition, and the time the physician was notified.

2) Describe the appearance of the wound or eviscerated organ; amount, color, consistency, and odor of any drainage; and nursing actions taken.

3) Record the patient’s vital signs, his response to the incident, and the physician’s actions.

5. 30% of wounds that eviscerated and then closed result in hernia formation.

V. Incision Line Management

A. Post-Op
1. If the incision closed by primary intention, the incision is usually covered with a sterile dressing for 24 to 48 hours. Reinforce if breakthrough drainage occurs. A postoperative dressing should be removed earlier than the recommended 48 hours if there are clear signs of complications. These signs may include: signs of excessive inflammation, which may suggest infection; specific wound pain or pressure reported by the patient that is difficult to control with analgesia; evidence of wound separation (partial or full thickness dehiscence); excessive exudate; strikethrough or leakage; or evidence of periwound skin stripping or blisters.

2. For clean and clean-contaminated procedures, additional prophylactic antimicrobial agent doses should not be administered after the surgical incision is closed in the operating room, even in the presence of a drain.

3. Topical antimicrobial agents should not be applied to the surgical incision for the prevention of SSI.

4. Use sterile technique for dressing changes first 48 hours.

5. After 48 hours, incisions can be cleansed with mild soap and water if epithelial resurfacing is complete.

6. When there is no drainage or chance of infection on suture line, may leave open to air.

B. Surgical Dressings

1. The main purposes of a surgical dressing, when used to cover a wound healing by primary intention, are to absorb drainage, provide sterile environment, and barrier to further trauma.

2. Recent 2016 Cochrane Review of Surgical dressing for prevention of surgical site infection found:
   a. No clear evidence to suggest that one dressing type was better than any other at reducing the risk of surgical site infection, nor that covering wounds with any dressing at all reduced the risk of surgical site infection.
   b. Additionally, there was no clear evidence that any dressing type improves scarring, pain control, patient acceptability or ease of removal.

3. The choice of dressing depends on wound type, position, patient preference and size/depth.
   a. When placing a dressing, careful consideration should be given to dressing orientation and tension and how patient movement postoperatively may affect this.

   b. Tape Considerations
      1) Applying soft cloth tape parallel to the incision appears to be associated with fewer skin tension injuries than taping perpendicular to the incision.
      2) Apply the tape without tension to clean dry skin, gently but firmly stroking the surface to maximize adhesion.
      3) Tape should extend at least one-half inch beyond the dressing.
      4) Tape should not be pulled or stretched when applied.

   c. Low-adherent postoperative dressings or vapor-permeable polyurethane film dressings are usually used for uncomplicated surgical wounds with or without an incorporated, absorptive, central 'island' pad.
      1) A 2003 review of dressings recommended three layers: a non-adhering layer, an absorptive layer and an occlusive dressing.
      2) N.I.C.E. guidelines recommend: Do not use gauze, or moist cotton gauze or mercuric antiseptic solutions to manage surgical wounds that are healing by secondary intention. Use an appropriate interactive dressing to manage surgical wounds that are healing by secondary intention.

   d. Use of Montgomery straps, skin sealants, or hydrocolloid frames around the wound and underneath the tape can eliminate skin stripping around incision wounds, a problem that can develop from frequent dressing changes.
      1) Montgomery Straps - Medical-grade adhesive tape panels to hold frequently changed dressings in place. Eliminates the need for surgical tape during dressing changes. Used to facilitate frequent dressing changes and prevent skin trauma.
      2) Hydrocolloid frame
a) Cut hydrocolloid or adhesive wafer into strips.
b) Place strips around outside perimeter of wound to create a box/square shape.
c) After placing dressing onto the wound, secure tape to platform and wound, with no tape touching skin.

4. Incisional Negative Pressure Wound Therapy (iNPWT)
   a. AKA closed incision negative pressure therapy (ciNPT)
   b. There is emerging body of literature suggests that applying Negative Pressure Wound Therapy (NPWT) prophylactically to a clean, closed surgical incision (CSI) may accelerate the healing of incisions and decrease the incidence of wound-healing complications, such as infection or dehiscence.\textsuperscript{10,52,53}
   c. Actions of iNPWT
      1) Protection of the incision site from external infectious sources and help in holding incision edges together\textsuperscript{10,52,53}
      2) Removes fluids and infectious materials from the surgical site\textsuperscript{10,52,53}
      3) Hematoma and seroma reduction\textsuperscript{10,52,53}
      4) Increase in tissue perfusion\textsuperscript{10,52,53}
      5) Creation of lateral tension around the wound edges\textsuperscript{10,52,53}
   d. Indications iNPWT
      1) Surgical patients with high-risk lower extremity fractures\textsuperscript{10} over orthopedic hardware, tendons, bone, and Gor-Tex sheets\textsuperscript{55}
      2) Cardiothoracic surgery\textsuperscript{10}
      3) Patients at risk for delayed healing (obese patients, prolonged incisional drainage)\textsuperscript{10}
      4) Surgeons should consider using ciNPT for patients at high risk for developing Surgical site occurrences (SSOs) or who are undergoing a high-risk procedure or a procedure that would have highly morbid consequences if a surgical site infection (SSI) occurred.\textsuperscript{54}
   e. There is insufficient evidence to support favoring one iNPWT system over another, or the desired duration of therapy, since studies have reported positive results with different systems that provide differing levels of topical negative pressure over a varied number of days.

5. Once the incision has completely epithelialized, the skin’s bacterial barrier is re-established, and dressing over the incision is usually considered optional.\textsuperscript{3}
   a. Patients may elect to wear a light, dry dressing to protect the incision and prevent staples/sutures from rubbing against their clothing.\textsuperscript{3}
   b. The presence of a dressing also allows patients to gradually accept changes in body image related to the surgery/surgical incision.\textsuperscript{3}

6. For acute wounds that are left open for delayed closure or secondary healing, wound dressing that provide for moist wound healing are appropriate.
   a. For wounds with a higher volume of exudate, an alginate rope dressing followed by absorptive adhesive foam will provide effective management of wound drainage plus an effective bacterial barrier; this dressing can also be changed every 2 to 3 days.\textsuperscript{7,9}

7. A postoperative wound dressing should not be arbitrary, nor based solely on the initial cost of the dressing. Effective wound management will expedite and optimize healing, and reduce rates of complications that adversely affect patients’ quality of life and healthcare costs.\textsuperscript{46}

C. Best Practices Incision Management
   1. Keep the frequency of dressing changes to a minimum to avoid disrupting healing tissue.
   2. Use sterile saline for wound cleansing up to 48 hours after surgery.
   3. Do not use topical antimicrobial agents for surgical wounds that are healing by primary intention.
   4. After the initial postoperative phase (3–5 days), use an aseptic, non-touch technique for changing and removing dressings.
   5. \textbf{HOW TO} clean incision line
      a. Follow procedure for dressing change.
b. Wash hands and put on gloves.
c. Pour cleansing solution into irrigation tray. Moisten 4 x 4’s in solution, squeeze out excess.
d. For linear wound/incision:
   1) Gently wipe wound from top to bottom, Use a new 4 x 4 for each downward stroke.
   2) Work outward from the incision in lines running parallel to it.
e. For an open wound:
   1) Gently clean the wound in full or half circle beginning in the center and working toward the
      outside.
   2) Use a new 4 x 4 for each circle.
   3) Clean at least 1” (2.5 cm) beyond the end of the new dressing or 2” (5 cm) beyond the wound
      margins if you are not applying a dressing.
f. Use of Spray cleanser
   1) Hold bottle approximately one inch from wound bed.
   2) Aim nozzle at wound and squeeze bottle, directing stream of cleanser along the base and sides
      of the wound.
   3) Gently pat wound dry with clean 4 X 4’s.
g. Dispose of waste in trash bag. Remove gloves and discard.

VI. Incision Line Assessment & Documentation

A. Frequency
   1. Assessment and documentation frequency will vary based upon post-op status and care setting.
   2. Postanesthesia care unit (PACU) - Dressings and drains, including casts and plastic bandages, must be
      assessed for bleeding or other drainage on admission and hourly thereafter.
   3. Med-Surg Unit Acute Care – admission and minimum every 8 hours.

B. Dressing
   1. For assessment of incision if dressing is present document:
      a. Location of Dressing
      b. Type of Dressing
      c. How Dressing is secured - tape, binder, transparent dressing
      d. Evaluation of the status of the dressing (whether it is intact and whether drainage is or is not
         leaking, any tension or pulling noted).
      e. The status of the area surrounding the dressing (that can be observed without removing the
         dressing).
      f. Pain assessment.
      g. The presence of possible complications

C. Incision
   1. Location of incision
   2. Measure the length of the incision and width of the approximated edge in centimeters
      a. If dehiscence occurs, depth is added to the length × width measurement.
   3. Color of incision
      a. Days 1-4 Red, edges approximated
      b. Days 5-9 Red, progressing to bright pink
      c. Days 10-14, Bright pink
      d. Day 15 – years, Pale pink, progressing to white or silver in light-skinned patients; pale pink,
         progressing to darker than normal skin color in darkly pigmented skin
   4. Tissue
      a. Presence or absence of epithelial resurfacing - (should be present by day 4 along entire incision)
      b. If the incision line is open, documentation of the tissue in the wound bed should be recorded to
         note: quality, type and amount; epithelial tissue; granulation tissue; presence of slough or necrotic
         tissue; tunneling or undermining present.
D. Closure
   1. Type of closure materials present (e.g. sutures, staples, tape, wires, butterfly bandages, or tissue adhesives).
   2. Number of closure materials (e.g. 14 staples).

E. Approximation of incision - assess disruption of the approximated edge (gaps in the suture line). Drains:
   1. Type
   2. Location
   3. Condition
   4. Securement of drain

F. Exudate
   1. Color, amount, consistency and odor
      a. Days 1-4 moderate to minimal bloody or sanguineous, progressing to serosanguineous and serous
      b. Days 5 – years none should be present

G. Surrounding Tissue - Description of the peri-wound tissues should include:
   1. Color
      a. Days 1-4 erythema present
      b. Bruising – include color, size, location
   2. Temperature
      a. Days 1-4 warmth and pain present
   3. Presence/location of edema or induration
      a. Acute inflammatory response & edema; should be present 1 – 4 days following surgery.
      b. Presence of the healing ridge; should be present 5-9 days following surgery.
   4. Skin condition around suture/closure materials – moist, crusty, edema, erythema, exudate, macerated, denuded, weepy, etc.
   5. Peri-incisional skin breakdown
      a. Epidermal stripping
      b. Rash or lesions
   6. Closed/hyperkeratotic wound edges

H. Pain Assessment
   1. Type, location, frequency and quality of pain at the wound site or as a result of treatment.
   2. Pain severity using patient self-report, observation of non-verbal cues and/or a pain scale (e.g. Wong Baker FACES Scale, Visual Analog Scale).
   3. Onset & duration of pain and precipitating / alleviating factors.
   5. Impact of pain on function, sleep and mood.
   6. Autonomic dysreflexia and/or increased spasticity in clients with a spinal cord injury.

I. Other
   1. Assess for signs of internal or external hemorrhage (hematoma) especially for surgery in the post nasal passages, lungs, spleen, liver, stomach & uterus.
   2. Time since surgery (in days).
   3. Actions taken for follow-up or referral as necessary.
   4. Primary and secondary dressing, as appropriate.

J. Example Documentation: 
   Postop day 6 for a 12-cm midline abdominal incision with Steri-Strips present. Incision is completely reepithelialized with no exudate present. Incision is bright pink with healing ridge palpable along anterior 10 cm of incision. Posterior 2 cm of incision is soft and boggy to touch with no healing ridge palpable and erythema present. Physician notified of possible impaired healing. Dry gauze 2 x 2-inch dressing applied to posterior aspect of incision for protection of site.
References


32. Awad SS. Adherence to Surgical Care Improvement Project Measures and post-operative surgical site infections. Surg Infect 2012 Aug. 22


50. 3M Medical Tape, Tips for Trouble Free Taping. Accessed online 7/13 at http://multimedia.3m.com/mws mediawebserver?mwsId=SSSSSu7zK1fslxtU4


