

# PREVENTING WOUND DEHISCENCE: TENSION-RELIEVING AND CLOSURE OPTIONS

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Incisional skin tension is noted by the relative lack of elastic skin bordering the surgical site. On digital examination, the skin is taut and shows little or no mobility when pressed. Skin closures under these circumstances have a greater risk of failure, although determining the probability of failure on a clinical basis is inexact.

Many skin wounds are routinely sutured under variable degrees of skin tension; a portion of such closures is destined to separate or undergo wound dehiscence. On the lower extremities, closure of skin wounds under tension can result in distal limb edema secondary to circulatory compromise and lymphatic stasis. Without prompt intervention, significant tissue necrosis may occur.

The skin of dogs and cats varies both in thickness and elasticity. On the trunk, the skin is thickest dorsally and progressively thins in a ventral direction. The skin along the inner aspect of the extremities tends to be thinner than the lateral skin surface areas. Closure can be more problematic in areas subject to repeated movement. Skin over bony prominences is particularly susceptible to dehiscence from shearing and compressive forces; under these conditions, sutures may serrat through the skin (suture cutout) unless preventive measures are taken. A variety of techniques may be used to reduce incisional skin tension and the complications associated with dehiscence.

Skin has remarkable viscoelastic properties, which allow it to stretch and conform to tension forces. This “inherent elasticity of skin” is demonstrated by grasping and lifting the tissue. It is recognized that skin can stretch beyond its natural elasticity when a stretching or expansion force is applied over time. “Mechanical creep” and “stress relaxation” account for the phenomenon in which skin can continue to stretch and accommodate prolonged application of tension forces, which can prevent dehiscence for some wounds closed under moderate tension (e.g., wounds closed under tension that have notably less incisional tension the day after surgery).

Mechanical creep and stress relaxation occur as intradermal collagen fibers progressively align and

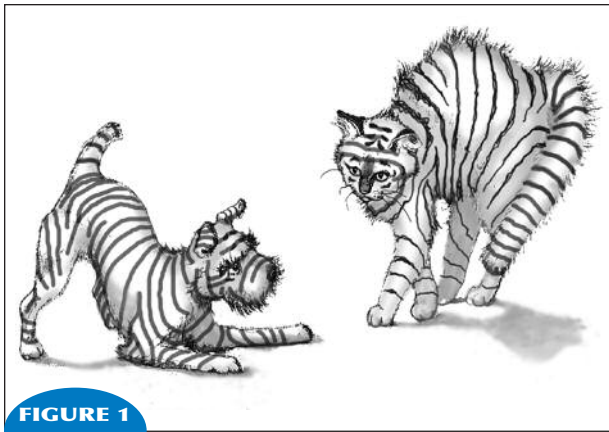
compact parallel to tension (or underlying expansion) forces applied to the skin over time. As collagen fibers deform, tissue fluid and the surrounding mucopolysaccharide molecules are slowly displaced. This process can be accelerated with skin stretching devices.

Management of skin tension is critical for the successful closure of skin wounds. Dehiscence increases the risk associated with infection. Open wound management and subsequent attempts at wound closure can result in significant escalation of medical and surgical costs to the owner.

## DIAGNOSTIC CRITERIA

### Historical Information

- Cases include closure of open wounds secondary to trauma and elective surgical procedures, including tumor removal.
- Lower extremity wounds may be especially troublesome because of the limited circumferential skin available for primary wound closure. Closure of wounds under circumferential skin tension can create a “biologic tourniquet,” resulting in distal limb edema and necrosis secondary to circulatory and lymphatic compromise unless promptly treated.
- Some breeds are more prone to problematic wound closure, including sight hounds (e.g., greyhounds, whippets) and small dogs with limited skin.
- Obese dogs and cats normally have less mobile skin available for primary wound closure.
- Thin, delicate skin wounds closed under tension are more susceptible to dehiscence compared with similar wounds on thicker skin.
- Wound closure over bony prominences (e.g., pressure sores) can be problematic, especially in larger dogs when prolonged compressive and shearing forces are concentrated on these anatomic sites. Debilitated dogs are prone to pressure sores as a result of improper nursing care.
- Debilitated or malnourished animals and patients with Cushing’s disease are more prone to delayed healing and wound dehiscence.



**FIGURE 1**

Skin tension can be minimized by making incisions like the stripes on a tiger. (From: Ogilvie GK, Moore AS: *Managing the Veterinary Cancer Patient*. Yardley, PA, Veterinary Learning Systems, 1995, p 2; used with permission)

- Licking, pawing, and rubbing of wounds closed under tension can increase the probability of dehiscence. In many cases, wounds closed under tension are uncomfortable and patients will attempt to lick or chew the area.

### Physical Examination Findings

- At the time of wound closure, there is little or no natural skin laxity: Grasping, lifting, or pushing the skin toward the wound reveals limited movement. Lateral skin margins may be digitally apposed only with significant effort.
- Skin defects resulting from trauma may have significant swelling or contusions; edema causes dermal collagen fibers to separate, which reduces skin elasticity. Elastic retraction of the skin margins is exaggerated in the presence of significant inflammation.
- After examination of the wound and neighboring skin, primary wound closure may be determined to be problematic (e.g., closure would compromise normal ambulation or range of motion).

### Laboratory Findings

- Laboratory findings are normal in most patients.
- Malnourished, sick, and debilitated patients require a detailed workup, including a baseline serum chemistry profile, complete blood count, and urinalysis.
- Patients suspected of having Cushing's disease require further diagnostic testing, including a corticotropin response test.

### Other Diagnostic Findings

- In the presence of infection, a representative sample

should be submitted for aerobic culture and sensitivity testing.

### Summary of Diagnostic Criteria

- A complete physical examination should be performed on all patients.
- Debilitated, sick, and malnourished animals require additional diagnostic testing and supportive care.
- Open wounds should be assessed for the availability of loose elastic skin to close the defect. Traumatized skin may be contused or swollen, and the elastic retraction of skin margins may further reduce the availability of sufficient skin for closure under minimal tension.
- In the presence of infection, bacterial cultures should be submitted.
- Skin tension varies according to body region and skin thickness.
- Skin tension differs among breeds and individual patients.
- Closure of wounds under tension may prompt patients to lick or chew the area.

### Diagnostic Differentials

- Increased skin tension may be exaggerated by edema and secondary elastic retraction of the skin margins at the time of wound assessment.
- Tumor resection with appropriate surgical margins may result in problematic wound closure.
- Intra- and postoperative edema may further aggravate incisional tension.
- Postoperative accumulation of blood (hematoma) or serum (seroma) can enhance overlying skin tension.
- Postoperative self-mutilation can result in additional swelling and suture line failure.

## TREATMENT RECOMMENDATIONS

### Initial Treatment

- Skin tension should be assessed before surgery. The lines of tension around a prospective surgical area can be determined (Figure 1). Neighboring skin can be "lifted and shifted" to help determine the best option to close the wound.
- The options for shifting apposing skin borders in different positions should be assessed to take advantage of local and regional skin elasticity to facilitate suture closure.
- In open wounds, the degree of soft tissue trauma in the area should be assessed. Because edema and elastic retraction of the skin exaggerate wound size

assessment and closure, open wound management may be advisable initially (delayed closure).

- Resolution of edema and skin contusions (usually within 5 to 7 days) facilitates closure: Skin can regain much of its normal inherent elasticity, which improves the likelihood of successful surgical closure of the defect.
- If wound closure cannot be accomplished without significant tension, consideration should be given to leaving a portion—if not all—of the wound to heal by second intention. This is particularly important for problematic lower extremity wounds.
- Wounds that fail to heal by contraction and epithelialization can later be closed with skin flaps or free grafts.
- The use of tension-relieving surgical techniques, including release incision(s) or Z-plasty, should be considered when marginal to moderate incisional tension is present.
- The use of an intradermal suture pattern should be considered before using skin sutures on wounds under mild skin tension. Alternatively, vertical mattress (tension) sutures alternated with simple interrupted sutures are useful to close skin incisions under mild tension.
- Sutures are best placed 10 mm from the skin borders; sutures placed closer are at greater risk of suture cutout.
- Reverse cutting needles are preferred. Atraumatic needles also may be used for suturing, although passage through the dermis is more difficult.
- Skin staples are not ideal for closing wounds under moderate tension: Staples occasionally deform, resulting in partial dehiscence.

### Alternative/Optional Treatments/Therapy

- Surgical grade cyanoacrylate skin glue can be used to supplement suture closure.
- Skin stretchers are highly effective in reducing wound closure tension before elective surgery: Skin pads applied to the perimeter of the surgical area are connected to opposing pads with elastic cables that adhere to the pad surface; cable tension is progressively increased three to four times/day over a 24- to 48-hour period. Skin stretchers are most useful for defects involving the head, neck, and trunk and can also be used to offset mild to moderate postoperative skin tension. They are least effective for mid- to lower extremity skin defects.
- Walking sutures have been advocated to reduce incisional tension when closing large wounds.

### Supportive Treatment

- Bandages, splints, and slings can restrict motion to

## CHECKPOINT

Technique selection varies according to individual experience and personal preference.

prevent dehiscence and trauma that may further aggravate incisional tension.

- Successful closure of pressure sores requires protective padding around the closure site. Soft, padded bedding, including sheepskin, is important to prevent dehiscence and future recurrence of pressure sores.
- Restricting activity levels (e.g., by confining the patient to a small room, run, or cage) is strongly advised until healing is complete.
- Elizabethan collars and body braces can be used to prevent self-mutilation.
- To prevent increased incisional tension associated with seroma or hematoma formation, active and passive drains should be used to control surgical or traumatic dead space.

### Patient Monitoring

- Patients should be observed to ensure that they do not disturb the surgical site and to ensure that activity levels are minimized.
- Close, periodic monitoring of the incision throughout the day is warranted unless a protective bandage covers the surgical site.
- The extremity below the site of wound closure should be monitored for swelling. The central toes should be exposed anytime a bandage is applied to the extremities and examined periodically postoperatively to ensure that distal limb edema is not overlooked.

### Home Management

- Patients should not be discharged until incisional tension and the risk of wound dehiscence is no longer considered to be a serious threat.
- Owners must comply with exercise restriction and measures to prevent self-mutilation.
- Owners must be attuned to signs of early incisional dehiscence (e.g., suture cutout, stretching, or deformation; early incisional gap formation; swelling; discharge).
- Owners may be required to maintain and monitor surgical drainage systems.
- Medication dispensed must be used as directed.

### Milestones/Recovery Time Frames

- Many cases of incisional dehiscence are noted within 5 days after wound closure.

- Small areas of incisional separation may be acceptable and may heal by second intention without further surgical intervention.
- Incisional tension may decrease after surgery; this can be detected by close digital examination of the relative laxity of the skin (i.e., the ability to slightly shift or move skin around the surgical incision).
- Suture removal may be scheduled for 14 to 21 days after closure, depending on the health status of the patient and progression of healing.

### Treatment Contraindications

- Lower extremity wound closures are particularly concerning because of the risk of creating a biologic tourniquet if circumferential tension is excessive. Wound closure may be contraindicated if tension is considered problematic. Under these circumstances, healing by second intention or the use of a skin flap or graft may be considered.
- Distal limb swelling must be addressed as an emergency: It is *mandatory* that all sutures be removed at the site of a biologic tourniquet.
- Body areas requiring flexion and a reasonable range of motion can be problematic for wound closure under tension. Motion combined with wound closure under tension increases the probability of dehiscence. Furthermore, successful healing may result in an unacceptable reduction in range of motion. Alternative closure options (e.g., skin stretchers, flaps,

grafts, release incisions) may be advisable depending on the magnitude of the defect.

## PROGNOSIS

### Favorable Criteria

- Unimpeded healing.
- No loss of range of motion or function of the involved body region.
- Minimal postoperative swelling.
- Progressive decrease in wound tension as a result of measures taken or the natural process of mechanical creep and stress relaxation.

### Unfavorable Criteria

- Catastrophic failure of the suture line, resulting in wound dehiscence.
- Progressive separation or suture cutout.
- Infection or fluid accumulation at the surgical site.
- Excessive tension that restricts regional function.
- Distal limb edema, which indicates excessive incisional circumferential tension proximally.

## RECOMMENDED READING

- Pavletic MM: *Atlas of Small Animal Reconstructive Surgery*, ed 2. Philadelphia, WB Saunders, 1999.
- Swaim SF, Henderson RA: *Small Animal Wound Management*, ed 2. Philadelphia, Williams & Wilkins, 1997.