Veterinarians do not see the large number of chronic, non-healing wounds that our human counterparts attend to, probably because animals are largely exempt from co-morbidities that exist in humans, such as obesity, alcoholism, chronic diabetes and cardiac disease. Cat and dog wounds often heal without complication. Their skin also has a laxity that allows contraction to play a larger role in healing than in species with a tighter skin. However, there are occasions when a wound that does not seem to be healing as expected.

A basic failure of any part of the healing process will delay wound healing. However, many wounds that are perceived to be non-healing are in fact simply just not provided with the right conditions in which to heal. The following list reflects a methodical approach to the more common reasons (apparent or real) for impaired wound healing. These factors should be considered when faced with a non-healing or atypical wound.

**MANAGEMENT FACTORS**

**Tension.** For a wound is healing by second intention, contraction will stop if the tension on the wound edges exceeds the pull of the myofibroblasts. The resultant defect may still epithelialize, but it will need to be assessed carefully for fragility of the epithelial covering.

**Pressure/ischemia.** Skin over bony prominences is particularly prone to ischemia from prolonged pressure due to inadequate bedding, or inappropriately constructed bandages. Ischemia leads to necrosis and development of a decubital ulcer (pressure sore). Relieving pressure is imperative, and a variety of padded doughnuts, slings, beds, whirlpool and physical nursing regimes have been described. There may be value in some topical wound stimulating medications such tripeptide-copper complex.

**Motion.** Areas such as the axilla, inguinal area, lip commissure, footpads and skin over joints are subject to repeated shearing forces, which will disrupt wound healing. We should always anticipate that these areas will be a challenge; immobilization and cage rest should be instituted early in the healing process, and carried through until epidermal integrity is established (even longer for cats, which have a tendency to form indolent wounds).

**Maceration.** Small animal wounds are often highly exudative in the inflammatory and even early repair stages of wound healing. If a dressing is too occlusive, or a bandage layer is non-permeable, or the bandage becomes wet, then wound maceration will occur, setting back healing by several days.

**Desiccation.** Wounds that dry out will sustain damage to delicate migrating epithelium and capillary buds. Dressing materials such as hydrogels, which allow some moisture retention in the wound, can be used in the repair phase, once exudate production has dropped.
**Self-mutilation.** Animals are prone to licking or chewing at their dressings and wounds, and can cause severe disruption to wound healing. There are many ways of preventing self-trauma, such as padded bandages, splints, side braces, Elizabethan collars (reversed as well), wire sutures, and chemical restraint.

**Devitalized soft tissues.** Inadequate surgical debridement of devitalized tissues is devastating for wound healing, and prolongs the inflammatory phase. Contaminated and dirty wounds must be meticulously debrided, both surgically and with intermittent high-pressure lavage. Closing a wound over non-viable tissue and/or detritus is a common reason for delayed healing and dehiscence.

**Eschar.** Failure to remove the hardened scab of dead tissue and dried exudate will act to impede contraction and will also harbor bacteria.

**HOST FACTORS**

**Malnutrition.** Nutritional deficiencies can impair wound healing and interfere with the ability to fight infection. The wound has increased protein and carbohydrate requirements, often in the face of ongoing protein depletion. Hypoproteinemia less than 2g/dL will impede wound healing. Supplemental feeding should be instituted in patients with a negative nitrogen balance, possibly with the addition of arginine, glutamine and DL-methionine (cysteine).

**Uremia.** Uremic animals will take longer to form granulation tissue in their wounds, and epithelialization will also be delayed. Efforts to normalize azotemia should be instituted.

**Endocrinopathy.** Glucocorticoids, with their potent anti-inflammatory effects, will decrease the inflammatory response, slow down granulation tissue formation, and retard epithelialization. These wounds will have a senescence to them and second intention healing is often not successful. The neuropathic and angiopathic effects of chronic diabetes causes huge wound healing problems in people, but is not a clinical issue in veterinary wounds. Hypothyroid patients should also be considered as slow healers, although there are only anecdotal reports. With all these diseases, wound closure should be considered over second intention.

**Corticosteroid medication.** Animals should be tapered off these drugs, or at least reduced down to a minimally acceptable level. A several layer closure should be employed, and sutures should be left in for 3 weeks. Epidermal integrity should be tested before the whole line of skin sutures is removed.

**Chemotherapy.** The effect of cytotoxic agents on traumatic wounds has not been well documented, although their mechanism of action on rapidly dividing cells would suggest them to be detrimental to wound healing.

**Old age.** It often appears that elderly animals heal more slowly than younger patients, and this has been documented in humans and in elderly rats. It appears that a normal consequence of aging is lack of skin perfusion, fragility of skin and increased susceptibility to infection. The impact of ischemia on wound healing is also exacerbated by old age. Older patients require...
meticulous nursing care, a high plane of nutrition, and attention must be paid to ensuring a good blood supply to the wound.

**WOUND FACTORS**

**Radiation therapy.** will markedly delay wound-healing, and wounds in irradiated tissue can be challenging! Complications may be controlled with finer fractionation, reduced dose and a skin-sparing source of ionizing radiation. The best option for these wounds involves bringing in a robust blood supply from outside the irradiated zone. There will be a higher complication and revision rate with these surgeries.

**Neoplasia.** should always be suspected when faced with a non-healing wound. Cancerous lesions can appear erosive rather than proliferative (e.g., squamous cell carcinoma). Biopsy should be performed routinely with delayed healing or an atypical wound appearance.

**Foreign body.** Draining tracts, recurring, and partially responsive wounds are typical of a foreign body. These wounds will have granulomatous lining and a rounded epithelial edge - a wound trying to heal. Discharge varies from serous to purulent. Foreign bodies can result from penetrating stick injuries, plant awns, gauze swabs, teeth, etc. Devitalized bone and non-absorbable suture material can also act as a foreign body. These wounds can be biopsied, cultured, radiographed, and ultrasounded. Most useful is contrast sinography, contrast CT, or MRI. Due to their migratory nature, finding foreign bodies are challenging; exploration should be planned, thorough and meticulous. Be prepared for disappointment. Once a foreign body has been removed, the remaining tract can either be dissected out, or treated as an open wound and allowed to heal by second intention.

**Exposed bone.** Shearing and severe degloving injuries can be slow to heal, due to the extra time taken for granulation tissue to migrate across the bone. Bone can be drilled or scraped after several days of wound management to provide a moisturizing clot, but has not been shown to promote fibroplasias.

**Infection** seriously impacts wound healing. Macerated tissue culture (rather than surface swab) is indicated. Aerobic, anaerobic, mycobacterial and fungal cultures should be performed, along with biopsy for histopathology. Infected wounds generally respond to aggressive open wound management and appropriate systemic antibiotic therapy. Mycobacterial infections generally require a combination of prolonged antibiotic therapy and radical surgery. Although uncommon, *Actinobacillus, Actinomyces* and *Nocardia* can cause granulomas in small animals and are probably under diagnosed.

**Spider/snake bite.** Envenomization can cause severe localized necrosis and pain. In many cases, the victim may develop a necrotic lesion which may expand up to several inches over days or weeks. Aggressive debridement and initial open wound management is indicated, to ensure no ongoing necrosis. The wounds are then best reconstructed by enhancing blood supply, as second intention healing may take several months.

**Poor perfusion.** Severe trap or crush injuries, and some shear and bite wounds, may sustain such trauma that the remaining poor blood supply markedly compromises healing. These cases
respond best to removal of devitalized tissues and an early reconstruction that restores blood supply to the region. This may involve a skin flap, pedicled muscle flap, or microvascular free tissue transfer.

SUMMARY

Most small animal wounds can be encouraged to heal if the above contributory factors are recognized and can be addressed. It is always critical to get a most accurate history of the patient and the wounding episode, if known. The most common reason by far for failure to heal is inappropriate management of the wound. Check through the management list first to ascertain if the wound has been not dressed appropriately or the patient not nursed in the proper manner. Educate the owners in the importance of wound care and management – get them involved. Take regular photos of the wound (e.g., every 2 weeks). Approach the wound in the order that these factors have been presented above. At the same time, check off underlying host factors that may be playing a role in delaying wound healing; perform blood work, address nutritional requirements, etc. Finally, if the wound is still not responding, consider biopsy and culture (aerobic, anaerobic, fungal, mycobacterial), and imaging of the area, especially if the wound is atypical in appearance.