Wound treatment in Birds

Anne Fowler BSc (Vet) (Hons), BVSc, MACVSc (Avian Health)

Avian Reptile and Exotic Pet Hospital, Wildlife Health and Conservation Centre, 415 Werombi Rd, Camden, NSW 2570

Introduction

Wounds develop on birds for a variety of reasons. There may be the surgical wounds that we, as veterinarians create. However, we may also be addressing wounds from other causes such as predation, self-trauma, etc. This presentation will cover how skin heals and highlight the differences between bird and mammalian skin. A brief overview of the TIME principle will be given before a discussion of the suitable dressings that can be used for the treatment of wounds in birds.

Structure of bird skin

Bird skin differs from mammalian skin in several ways:

- the *stratum corneum* is thinner;
- the *stratum granulosum* in the *stratum germinativum* is absent (Stettenheim, 1972);
- tendons are present in the dermis and these can contract to alter the shape of the wound (Stettenheim, 1972);
- bird stratum corneal cells contain intracellular lipid droplets which assist in reducing skin water loss, albeit not as efficiently as mammals (Elias *et al.*, 2005) and probably act as a barrier for microbial invasion;
- bird skin lacks collagen;
- feathers are present and emerge from follicles in the skin; and
- despite these differences, avian skin heals similarly in rate as mammalian skin.

Stages of skin healing

Avian skin healing appears to follow the same stages as mammalian skin healing. The assumption is that avian cells react similarly in their function as their mammalian counterparts. We can describe healing as occurring over several stages (Swaim and Henderson, 1990):

- **Inflammatory stage**
  This occurs immediately after the injury. Initially blood vessels constrict to allow clotting of blood. Blood vessels dilate a few minutes later to allow leucocytes to enter the wound. Fibrinogen is converted to fibrin in the wound cavity as is haemostatic.

- **Debridement stage**
  This stage begins 6 – 8 hours after injury and can last about 5 days. Heterophils phagocytize micro-organisms and release hydrolytic enzymes.

Thrombocytes produce various growth factors that recruit heterophils and assist in repair. The macrophages phagocytise necrotic tissue and also release factors involved in repair for example, interleukin 1.

- **Repair stage**
  Repair happens as quickly once necrotic tissue, blood clots and debris are removed from the wound. Macrophages are essential for deposition of collagen.

  The stage begins 2 – 3 days later and lasts up to 3 weeks. Three processes occur: fibroblast proliferation, capillary infiltration and epithelial proliferation and migration.

  Undifferentiated mesenchymal cells from around small vessels become fibroblasts which migrate along the fibrin strands in the blood clot.
  Capillaries follow the fibroblasts, sprouting from existing vessels. The fibroblasts and capillaries form the bright red granulation tissue. It forms a surface for epithelium to migrate, resists microbial penetration and holds the fibroblasts that produce collagen for wound healing.

- **Fibroblastic (scar) phase**
  Fibroblasts are responsible for centripetal contraction of the wound. Contraction stops when the tension of the normal skin equals the tension from the fibroblasts. The stage lasts 2 – 4 weeks and possibly longer.

- **Epithelization phase (skin regrowth)**
  Skin cells on edge of wound begin to migrate in response to chemicals released and this process is independent of the wound contraction. It is thought that the cells slide or leapfrog onto the granulation tissue. In larger wounds, migration slows at the centre of the wound as the epithelial layer thins.

Impediments to skin healing
Often the focus is only on the wound. However, there are several factors that can slow down healing and these can be divided into patient and management factors.

Patient factors include:
- Dehydration,
- Shock,
- Cortisone,
- Infection,
- Low protein states: healing requires twice maintenance requirements
- Anaemia
- Necrotic tissue that remains in the wound.
- Behavioural issues – such as wound mutilation

It is important to address other issues that impact on morbidity of the avian patient by providing treatment with warmth, fluids, and sufficient nutrition. Without attention to these issues, the ability of the skin to heal is slowed.

Management factors include:

- Application of alcohol or other unsuitable agents to the wound
- Wiping away granulation tissue,
- Use of powders,
- Not covering the wound.

These are education issues. Unfortunately, in veterinary practice, we may not always be taught how to apply wound bed preparation skills as undergraduates. We may pick up bad habits along the way! However, we must remain vigilant that our management of the wound is not contributing to its ability to heal.

The TIME principle

The goal of the TIME principle is to have a well-granulated wound bed that permits a maximal rate of healing. The TIME principle is used in human wound management. It provides a mnemonic to assist in the evaluation of wounds with the goal of identifying when the wound is having an impediment to healing. It allows evaluation of a wound and identification of appropriate treatment for the wound at that time.

T – tissue is dead or absent

Does the wound contain non viable or dead tissue?

The first step in local wound assessment is to evaluate the level of tissue viability present in the wound.

- Viable tissue is either red granulation tissue or pink new skin and represents an environment conducive to normal wound healing.
- Non-viable tissue may be black, necrotic or yellow and if left in the wound, creates the ideal conditions for bacterial growth and infection.

Treatment is aimed at effective debriding of non-viable tissue, and protecting viable tissue from desiccation or damage.

I - Infection or Inflammation

Does the wound indicate signs of increasing bacterial contamination or inflammation?

Infected wounds display particular characteristics, such as increased exudate, redness, smell, inflammation, increased tenderness and fragile, tissue that bleeds easily.

Treatment is aimed at debriding necrotic tissue, flushing the wound to reduce microbial contamination and administration of antibiotics.

M – Moisture Imbalance

Is the wound too wet or too dry?

Wounds heal better in a moist environment. Nerve endings are protected - reducing pain - and skin layers repair at a faster rate producing less scarring than in dry wounds. As part of the normal healing process wounds release exudate. Too much exudate (maceration) or too little exudate (desiccation) can interfere with wound healing. Therefore it is important to manage moisture levels, particularly in chronic wounds.

Products are available to manage wounds with different exudate levels.

- Dry wounds – use hydrogels: Intrasite, Solosite, honey, Duoderm gel
- Large amounts of exudates – use absorptive dressings: eg: Algisite M, or Allveyn.

E - Edge of wound not advancing or undermined

Are the edges of the wound undermined and is the epidermis failing to migrate across the granulation tissue?

Wounds need to fill in the defect before the skin cells can migrate across the wound – in other words, they heal from the inside out. Dead spaces must be addressed before the skin can migrate over the wound.

Treatment of Wounds in Birds

The treatment of wounds is multi-faceted. A variety of modalities are used during the healing process.

Antibiotics

These are required in the inflammation and debridement phase.

Other indications for antibiotics include muscle damage, if all necrotic tissue is unable to be debrided, of systemic evidence of infection is present. They are not required once the wound has granulated. Antibiotics suitable against the likely pathogen are selected. Bacteria from the skin, such as Staphylococcus may invade the wound. Cat bite wounds bring *Pasturella*, anerobes and *Streptococci* bacteria into the wound (Degernes). Some wounds may be contaminated by *Pseudomonas aeroginosa* or faecal coliforms if the site is not protected from faecal or environmental contamination.

Broad spectrum penicillins remain the antibiotic of choice for the majority of skin wounds. However, a Gram stain of the wound, and possible culture at initial debridement and a week later may assist in an informed choice of antimicrobials.

Pain relief

Damage to the skin is painful due to the presence of nociceptors in the skin. Exposure of nerve endings in the dermis is also painful. Hydroactive gels cover the nerve endings and assist in pain relief.

Systemic non-steroidal anti-inflammatories may be administered. They have a role after debridement has been performed or if concurrent muscle or skeletal damage has been sustained.

Collars

Elizabethan collars, ball collars, etc may all be used to prevent the bird from causing further damage to itself or removing the dressings during the healing period. Any bird with a history of feather picking may need collaring on a preventative basis to avoid further self-trauma to the wound.

Debridement

Initial treatment of open wounds involves anaesthesia for assessment and debridement. The more aggressive the debridement, the more quickly the wound can progress into healthy granulation.

Debridement of the wound has several goals (Swain and Henderson, 1990):

- Remove of necrotic or dying tissues – until some capillary oozing results. It may not be possible to remove all questionable material, and debridement at a later stage may be more prudent.
- Removal of debris – such as feathers, dirt, and grass.

- Flush the wound with lavage solution - warm saline. Saline is recommended until the extent of the wound is determined. A syringe with a needle attached is used at this point. Chlorhexidine or Betadine are also effective agents to flush the wound. Samples for culture and sensitivity should be taken prior to their application

Pack the wound with KY jelly during surgical preparation to prevent contamination with feathers.
Pluck feathers away to permit more effective assessment of the extent of the wound.
Some wounds may be able to be partly closed if the wound is clean. Skin sutures may be placed if they are not under tension. However, it is more likely that the wound will require dressings under bandages to permit second intention healing.

Hydroactive gels
Hydroactive gels are gaining in popularity. These gels are placed onto the wound to keep it moist. They are applied evenly over the wound to ensure delivery of the agent to the entire surface of the wound. There are different types of gels:

- Gels without antimicrobial activity: these gels assist in keeping the wound moist. They are ideal for wounds without significant bacterial contamination, such as surgical wounds and minor abrasions.
  Examples include: Solugel, Solusite, Intrasite, duoderm gel, duoderm paste
- Gels with antimicrobial activity: these gels may contain antibacterial or antifungal activity. Ideally, the antimicrobial activity is sustained over a period of time.
  Examples include: Silvazene, Iodosorb, Metronidazole gel, triple antibiotic ointments.

Bandages
There are several reasons that bandages may be used on wounds.

- In the first aid setting, a bandage may assist in the control of bleeding.
- Bandages can protect the area from further damage – from beaks or from movement
- They may also be used to hold the wound dressing in place.

Bandages are required to be lightweight and comfortable. Particularly in wild birds, it is important not to cause further damage to feathers as this affects the time spent in rehabilitation. The bandage needs to be suited for its intended purpose – a bandage over open fracture must be thick enough to provide support for the fracture as well as permitting the wound to heal.

The bandage or dressing can be divided into 3 layers (Degernes).

- Primary layer is the dressing in contact with the wound
- Secondary layer is an absorptive layer
- Tertiary layer is the layer used to hold the other layers in place on the bird

Primary layer

- This layer may have several functions.
- It should provide a moist wound environment
- It may assist with further debridement

It may absorb some exudates.

Several types of dressings can be used as the primary layer

1. **Adherent dressings**. The best example is the wet-to-dry dressing. Moistened cotton gauze squares are placed on the wound. Dry cotton gauze squares are placed over them. This dressing is changed daily. This dressing may need soaking to assist in its removal from the wound as the exudate becomes stuck to the wound and the dressing. The wet-to-dry dressing is used to mechanically debride the wound.
   Examples of dressings for highly exudative wounds include: cotton gauze squares, Algisite, Allevyn, Aquacel.

2. **Non-adherent dressings** do not adhere to the wound. They often have a barrier layer that permits exudates through, but does not stick to the exudate. There are several types. Some may be used with various hydroactive gels or by themselves.
   Examples include: Melolin, Telfa,
   Other non-adherent dressings are impregnated with silver to give a combined antimicrobial action in the primary dressing.
   Examples include Acticoat, Acticoat 7, Aquacel Ag.
   Some dressings will promote haemostasis and absorb many times their weight in exudates.
   Examples include the alginate fibre dressings: Algisite, Kaltostat.

3. **Petroleum-gauze mesh dressings**. These have been popular in the past. However, their main disadvantage is the contamination of adjacent feathers from the oily dressings and damage to the granulation bed at removal. However, they do remain suited to the unfeathered portion of the leg on birds.
   Examples include: Bactigras, Jenolet

4. **Hydrocolloid dressings** are also known as hydroactive dressings. They are semi-flexible membranes. They are impermeable to moisture vapour and oxygen. They absorb exudates to create a moist cover over the wound. They are suitable for large wounds, wounds that require some debridement. They have been used as the sole dressing for wing membrane wounds in raptors (Aguilar). These dressings are adhesive to normal skin and are reasonably conformable to the shapes of our avian patitents. However, sutures or tissue glue may be used to keep them in place on such locations as the head or the patagial membrane.
   Examples include: Duoderm and Duoderm ExtraThin.

Duoderm gel under Duoderm Extrathin as this dressing is suitable for wounds at all stages when the exudates level is low. The paste is suitable for necrotic and sloughy wounds.

5. **Moisture-permeable dressings** are thin, flexible, transparent polyurethane membranes. They are permeable to oxygen, but not to water and bacteria. They result in rapid epithelialisation. These dressings are usually changed every 2 days initially in response to increased exudates, but can be extended out to 5 days when granulation tissue is present. They permit the wound to be monitored without the dressing being removed.
   Examples include: Opsite Flexigrid, Tegaderm

Secondary layer

This layer may have two functions

1. It acts as an absorptive layer. It is required in the debridement stage when exudate is still present. It may not be present at the granulation layer, once exudate is reduced.
   Examples include: cotton gauze squares, Duoderm Extrathin
2. It may also be used to immobilize the wound and fracture below it. *Examples include: gauze, softban*

Tertiary layer

This layer is designed to hold the other layers. It also prevents the bird from gaining access to the wound and causing self-induced trauma.
There are two types of tertiary layer bandages

1. **Sticky, adherent bandages** that adhere to themselves and the animal. One side has a cloth or paper appearance while the other contains an adhesive. This type of bandage may be used to form the tertiary layer, or to adhere the bandage at the top or bottom of the bandage to skin or feathers underneath it. Micropore has the advantage that it does not damage feathers as much as Elastoplast.
   Examples: micropore, elastoplast, leucoplast.

2. **Non-sticky, self-adherent bandages** that adhere to themselves, and not to the animal. They are ideal for birds in that these bandages are light-weight, comfortable and do not damage feathers.
   Examples include: Coplus, Vetrap, Rip-rap.

Bandage changes
In the initial stage of debridement, bandage changes are required daily. In situations of copious exudates, it can assist to soak the dressing off the wound, rather than tearing it off the wound bed.
By day 3 – 5, the wound should have begun to granulate, with all factors addressed, and the

frequency of dressing changes can be reduced. While bandages on wings should continue to be changed every 3 days and physiotherapy performed to prevent arthritis, other sites may be able to be extended out to 5 and 7 day changes. It is important to recognise the duration of time that the hydroactive gel are active. The action of Silvazene is only sustained for 24 hours. Duoderm paste under Duoderm Extra Thin continues its action for 5 days.
Bandage removal can be painful and thus consideration should be made as to whether anaesthesia or sedation is required.

Conclusion

By addressing patient factors and performing critical evaluation of the wound, the treatment of avian wounds can be enhanced. Modern hydroactive gels and dressings are useful in promoting healing of avian wounds.

References

Aguilar R (2004). The use of occlusive hydrocolloid wound bandages in raptor wound management. *Conference Proceedings Assoc Avian Vets, Australian Committee*. pp. 135-137.

Cousquer G (2007). Wound assessment in the avian wildlife casualty. Part 1: http://www.worldwidewounds.com/2003/august/Cousquer/Avian-Wound-Assessment.html Part 2: http://www.worldwidewounds.com/2003/november/Cousquer/Avian-Wound-Management-Part-2.html

Degernes LA (1994). Trauma Medicine, in: *Avian Medicine: Principles and Application*. Eds: Rithie BW, Harrison GJ and Harrison LR. Wingers Publishing, Florida. 417-433.

Elias PM, Menon GK, Grayson S, Brown BE and Rehfeld SJ (2005). Avian sebokeratoyctes and marine mammal lipokeratinocytes: Structural, lipid biochemical, and functional considerations. *Am J Anatomy* **180**: 161-177.

Stettenheim P (1972). The Integument of Birds, in *Avian Biology* Vol II, eds Farner DS and King JR, Academic Press, pp 2-9

Swaim SF and Henderson RA (1990). Wound Healing, in *Small Animal Wound Management.* The Williams & Wilkins Co. pp 1-13.

Useful websites

Some interesting papers on wound management: http://www.worldwidewounds.com:
Smith and Nephew site on TIME : http://www.woundbedpreparation.com
information on smith & nephew products: http://wound.smith-nephew.com/au/Home.asp
ConvaTec produce the Duoderm range: http://www.convatec.com.au/index.html