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Single-pedicle hinge flap performed by shelter medicine team resolves chronic antebrachial wound in a cat

Jodi M Richardson, Jacob M Shivley and Philip A Bushby

Abstract

Case summary An approximately 3-year-old, male domestic longhair cat was presented to a mobile veterinary unit for routine neuter. Preoperative physical examination revealed an approximately 5 cm × 2 cm scab on the craniolateral portion of the left antebrachium. The cat was anesthetized for the neuter using an injectable anesthesia protocol. After castration, the wound area on the antebrachium was clipped, copiously lavaged and the wound edges were surgically debrided. Injectable antibiotics and analgesic management were instituted. The wound was conservatively managed using sugar bandaging and antibiotic dressings until the progression of healing plateaued. Procedures for closing the defect were explored, and it was decided that a single-pedicle hinge flap would be ideal. The procedure was performed on the mobile veterinary unit and managed postoperatively with pain control and biweekly bandage changes. After 3 weeks, the single-pedicle hinge flap was released to create a skin graft, which successfully filled the defect.

Relevance and novel information Single-pedicle hinge flaps performed in feline patients have been minimally reported. This case report serves to provide detailed information on the surgical procedure and aftercare required for a successful outcome. Furthermore, this procedure was performed by a shelter medicine team in a mobile veterinary unit with no specialty equipment or instruments. This report documents an alternative procedure that may be used in a shelter environment for distal forelimb wounds rather than amputation or euthanasia.

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Introduction

Not only are wounds painful for patients, they can also be a source of frustration to the clinician and expensive to treat until resolution. These defects may require reconstructive surgery to avoid prolonged healing times and excessive scarring. Every wound goes through the same healing process; however, differences in wound size and location, species of the patient and the patient's health status will affect wound healing.[1,2] Additionally, the wound classification will guide when and how the wound should be managed – with primary closure techniques or healing by second intention. If a large wound is present, then various portions of the wound may be in different phases of healing. For these reasons it is important to continuously monitor the wound for healing and determine if and when the treatment plan should change.[1] This case report illustrates this principle along with the frustrations of managing chronic wounds. It also offers an inexpensive, effective surgical strategy for closing a chronic antebrachial wound on a cat in the shelter environment.

Case description

A 3-year-old male domestic longhair cat was presented to a mobile veterinary unit for a routine neuter. Preoperative physical examination revealed an

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Figure 1 Medical management of wound prior to surgery. (a) Wound after initial debridement and lavage. (b) Gross appearance of the wound after being managed for eight consecutive days with sugar bandages. (c) Representation of wound appearance during days 12–24 when silver sulfadiazine ointment was being applied every other day. (d) Gross appearance of the wound after two applications of calcium alginate bandages, changed 3 days apart

approximately 5 cm × 2 cm scab on the craniolateral portion of the left antebrachium. The patient was anesthetized using dexmedetomidine 35 µg/kg (Dexdomitor; Zoetis), butorphanol 0.35 mg/kg (Torbugesic; Zoetis) and ketamine 3.5 mg/kg (Ketaset; Zoetis) intramuscularly, and administered carprofen 4.4 mg/kg (Rimadyl; Zoetis) subcutaneously for pain control. Following castration, the scab was manually removed and sterile lubricant was placed in the antebrachial defect, the hair around the wound was clipped and the wound was copiously lavaged with water. The wound edges were debrided with a #15 scalpel blade and the patient was given cefovecin 8 mg/kg (Convenia; Zoetis) subcutaneously. After debridement, the wound measured approximately 6 cm × 3 cm (Figure 1a).

The wound was conservatively managed using sugar bandaging for 7 days. Sugar acts to draw in macrophages and enhance debridement of necrotic tissue.[1,3–5] Additionally, sugar aids in expediting the healing process through its antimicrobial properties.[4,5] The bandage was changed daily; sugar was packed into the wound and the wound was covered with a soft padded bandage. Buccal buprenorphine 0.02 mg/kg (Buprenex; Reckitt Benckiser Healthcare) was administered twice daily to provide analgesia. On day 6 the patient became depressed. Complete blood count and chemistry revealed a mild increase in alanine aminotransferase and a mild thrombocytopenia. No other diagnostics were performed owing to financial constraints. On day 8 the buprenorphine was discontinued as the wound was non-painful and was showing clear signs of improvement. There was no evidence of gross necrotic tissue and a healthy granulation bed was beginning to form (Figure 1b). Therefore, sugar bandaging was discontinued and application of silver sulfadiazine (SSD) cream 1% (Thermazene; Alkem Laboratories) was instituted to encourage epithelialization and provide antimicrobial action.[6] The patient was started on pradofloxacin 7.5 mg/kg (Veraflox; Bayer Healthcare) orally for 7 days owing to its broader spectrum of activity and label, which indicates its use for the treatment of skin infections. Antibiotic therapy was continued because even though a granulation bed had started to fill in on the wound edges it was not completely covering the wound. Pradofloxacin was the antibiotic chosen owing to its ease to be given once daily. On day 12, every-other-day bandage changing with fresh applications of SSD cream 1% was instituted because the wound was progressively contracting and the wound exudate was greatly reduced. From days 12–24 healthy granulation tissue continued to fill the defect and the wound edges began to contract. There was no necrotic tissue present around the wound's edges. Each time the bandage was changed the wound looked shiny and moist (Figure 1c).

On day 24, calcium alginate was applied to the wound in place of the SSD cream 1% owing to our concern about the wound's exudative nature.[4] The calcium alginate dressing was left in place for 3 days and then reapplied on day 27. When the bandage was removed again 3 days later (day 31) it appeared that the progression of healing was impeded (Figure 1d), so we chose to return to the application of the SSD cream 1%.

By day 40 it had become apparent that the wound would not close completely with medical management, so surgical options were explored. Owing to the size and location of the defect it was decided that a single-pedicle hinge flap would be the ideal procedure to be performed in the mobile veterinary unit.

The first stage of the hinge flap procedure was performed on day 42. Pradofloxacin (7.5 mg/kg) was started 2 days prior to the surgery and continued until 7 days after the second surgery. The patient was anesthetized using dexmedetomidine (35 µg/kg), butorphanol (0.35 mg/kg) and ketamine (3.5 mg/kg) intramuscularly, intubated and maintained on isoflurane between 1% and 1.5% (Isoflurane USP; Piramal Enterprises). The patient was also given robenacoxib 2 mg/kg (Onsior; Novartis

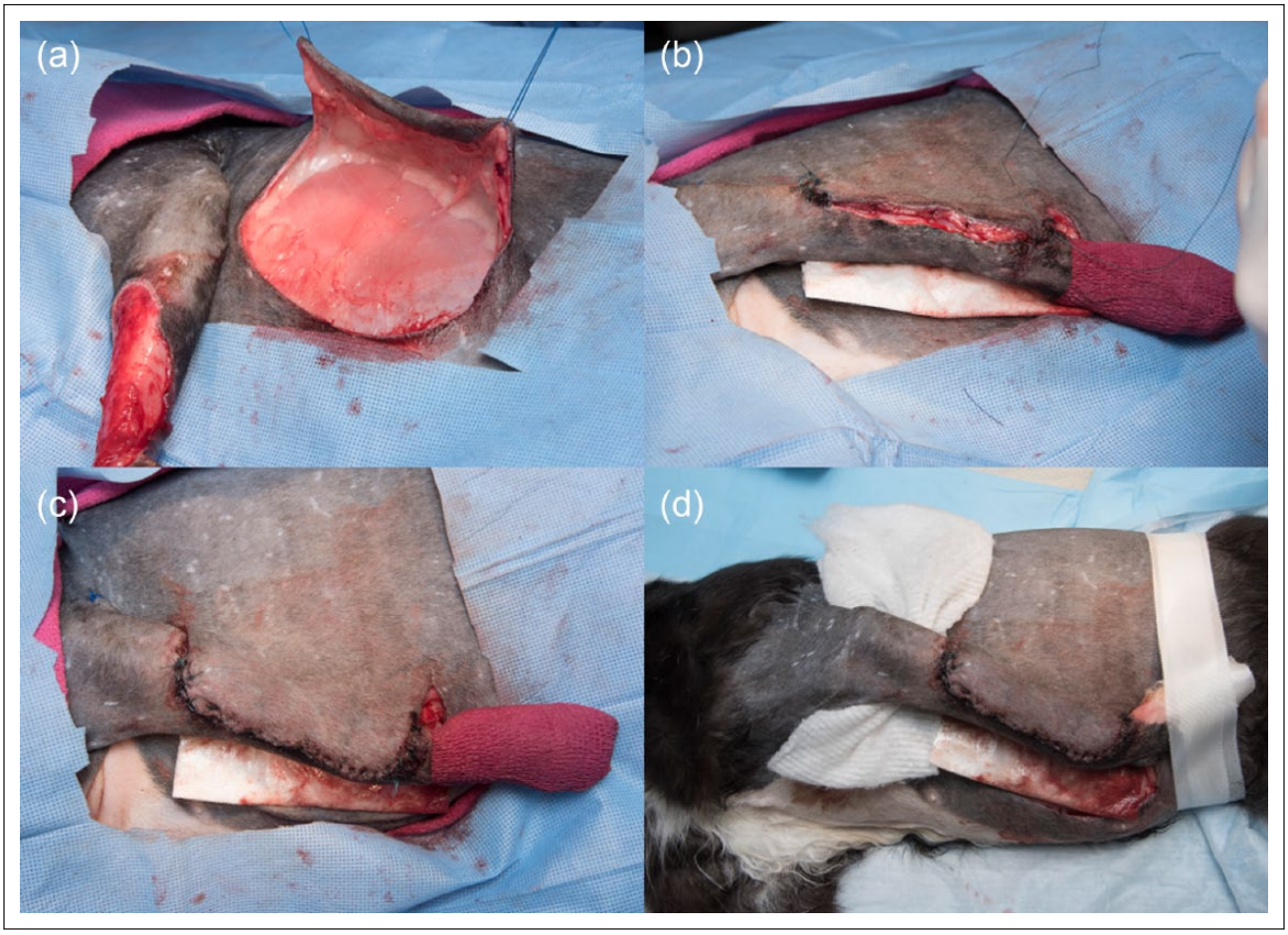

Figure 2 First stage of the single-pedicle hinge flap procedure. (a) The wound was debrided and a skin incision the same length of the antebrachial wound borders plus an additional 2 cm was made in a craniocaudal direction over the patient's left thoracic wall. (b) Buried simple interrupted sutures were placed in the subcutaneous layer with 4-0 Monocryl to help relieve tension and accurately appose skin edges. (c) Cruciate and simple continuous suture patterns using 3-0 Maxon were placed to appose the skin edges. (d) A non-adherent dressing was placed between the patient's forelimb and exposed muscle and cast padding was also placed between the patient's elbow and thorax to absorb wound exudate. Additionally, 1 inch white tape was wrapped around the patient's paw and then body to help minimize leg movement

Animal Health US) subcutaneously before being clipped and aseptically prepared for surgery using 4% chlorhexidine and alcohol.

The patient was placed in right lateral recumbency and draped aseptically using a hanging leg technique. The edges of the wound were resected using a #15 scalpel blade and curved Metzenbaum scissors until all skin edges were bleeding, which determined their viability. After debridement, the wound measured 10 cm × 2 cm.

The left forelimb was reflected to the left side of the thorax to determine the location and size of the flap development. Using a #15 scalpel blade, a skin incision the same length of the antebrachial wound borders plus an additional 2 cm was made in a craniocaudal direction over the patient's left thoracic wall. Skin incisions 3 cm in length and extending in a dorsal direction were made at each end of the original thorax skin incision. Undermining the skin and cutaneous trunci muscle created a flap in the thoracic skin of the left thoracic wall. Stay sutures were placed in each corner of the flap to elevate the skin (Figure 2a).

The left forelimb was reflected into the thoracic defect and the skin flap was elevated enough to allow the free edges of the flap to match the cranial, proximal and distal borders of the antebrachial defect. The flap was sutured to the wound borders. Buried simple interrupted sutures were placed in the subcutaneous layer with 4-0 Monocryl (Ethicon, Johnson & Johnson) to help relieve tension and to accurately appose the skin edges (Figure 2b). Additionally, one simple interrupted suture was placed in the skin of the elbow and thoracic wall to help minimize movement of the limb. The skin edges of the hinge flap and the wound were apposed using 3-0 Maxon (Covidien, Medtronic) in cruciate and simple continuous patterns (Figure 2c).

Telfa pads (Covidien, Medtronic) were placed between the skin of the medial surface of the antebrachium and the exposed muscle layer of the thoracic wall,

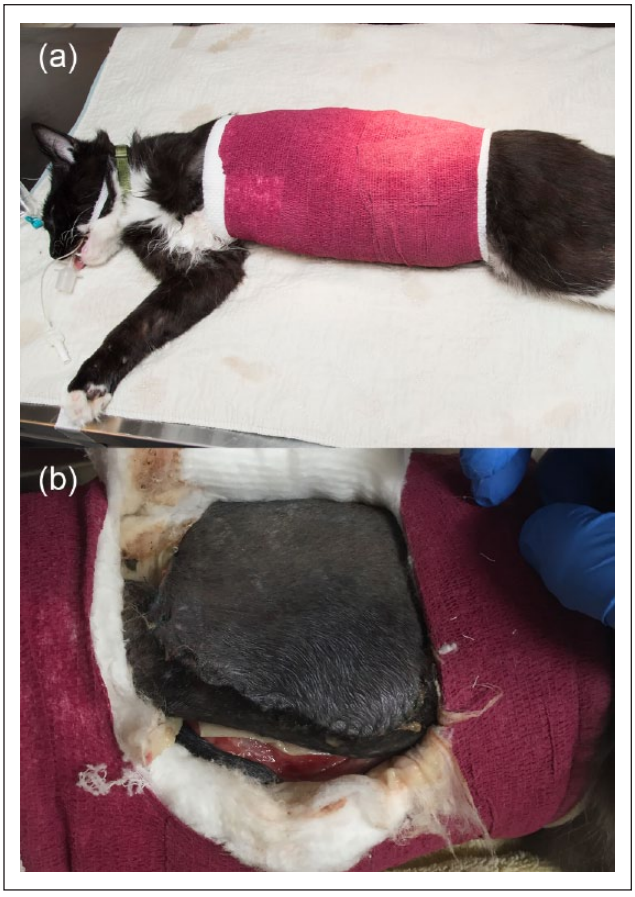

Figure 3 Postoperative bandaging. (a) A soft padded bandage was placed around the patient's thorax to immobilize the forelimb, absorb wound exudate and protect the graft site during healing. (b) A #15 scalpel blade was used to create a three-sided window directly over the graft site so it could be monitored without entirely removing the bandage. In the image the patient is in right lateral recumbency with its head to the left. The window is open to expose the healing wound

and cast padding was placed between the elbow and body to absorb exudate from the wound. One-inch white tape was wrapped around the patient's paw and then around the patient's body to help prevent further leg movement (Figure 2d). A soft padded bandage was placed around the patient's thorax to cover the surgical site and immobilize the forelimb (Figure 3a). A hinged window was created in the bandage by cutting the full thickness of the bandage with a #15 scalpel blade (Figure 3b). A self-adhering bandage was wrapped around the patient's body to keep this window closed. The hinged window allowed observation and management of the surgical site without removing the entire bandage. Additionally, if strikethrough occurred over the surgical site, additional bandage material could be placed just in the window rather than removing the entire bandage.

Postoperative pain management consisted of buprenorphine (0.02 mg/kg) orally q6h to q8h as needed for the next 2 days, and two additional doses of robenacoxib (2 mg/kg q24h).

On days 45, 48, 55 and 60, the patient was sedated, the entire bandage was removed and a new bandage was applied as previously described. The bandage changes were necessitated owing to exudate from the thoracic wound. On days 51 and 58, a window bandage change was performed owing to strikethrough and self-adhering bandage was placed over the whole bandage again to secure it. No sedation was necessary for these bandaging procedures.

A second surgery was performed on day 63 to release the dorsal border of the single-pedicle hinge flap from the patient's side, thereby creating a free, full-thickness skin graft to completely cover the antebrachial defect (Figure 4a). The patient was again anesthetized using dexmedetomidine (35 µg/kg), butorphanol (0.35 mg/kg) and ketamine (3.5 mg/kg) intramuscularly, intubated and maintained on isoflurane at 1%. The patient was also given robenacoxib (2 mg/kg) subcutaneously. Hair was clipped and the surgical site was aseptically prepared using 4% chlorhexidine and alcohol. The stay suture placed in the patient's elbow was removed. The dorsal border of the skin flap was incised using a #15 scalpel blade. The edge of the flap was trimmed using Metzenbaum scissors so the flap edge would precisely align with the antebrachial wound edge. The edges were apposed using cruciate sutures of 3-0 Maxon. The defect created on the patient's thorax was then sutured using a three-layer closure. The deep subcutaneous layer and superficial subcutaneous layers were closed using 3-0 Maxon in simple continuous suture patterns (Figure 4b). The skin edges were apposed using a simple continuous intradermal suture pattern of 4-0 Monocryl (Figure 4c). The patient then recovered with no postoperative complications. No bandages were placed after the second surgery; however, the patient was fitted with an e-collar. No additional postoperative pain management was required beyond the additional 2 days of robenacoxib (2 mg/kg). The cruciate sutures on the patient's leg were removed 14 days postoperatively on day 77 (Figure 4d).

Discussion

While, over time, the antebrachial wound may have healed with granulation tissue covered by a thin layer of epithelium, this would have resulted in an area prone to repeated injury. Additionally, this course of therapy would involve months of bandage changes and wound care, and carry the potential to compromise the patient's general demeanor and health.

An advancement graft was considered, using skin from the upper portion of the forelimb, but owing to the length of the wound there would have been an open wound at the distal portion of the original defect that

Figure 4 Second stage of the single-pedicle hinge flap procedure and postoperative healing. (a) An incision was made using a #15 scalpel blade to release the dorsal border of the single-pedicle hinge flap from the patient's left thorax to create a free, full-thickness skin graft. In (a) and (b) the patient is in right lateral recumbency with its head to the right. (b) The wound edges on the antebrachium were apposed using 3-0 Maxon and a cruciate pattern. The defect created in the patient's thorax was sutured using a three-layer closure. Pictured is the deep subcutaneous layer sutured in a simple continuous pattern using 3-0 Maxon. (c) This is the patient postoperatively in recovery. The skin edges of the defect in the thorax were apposed using a continuous intradermal suture pattern and 4-0 Monocryl. In this image the patient is in right lateral recumbency with its head to the left. (d) Fourteen days postoperatively the cruciate sutures in the patient's antebrachium were removed

would require continued wound care and bandaging. A pouch graft was also considered; however, in our opinion, it would have been a more complex procedure with the same result. A free graft could have been harvested, but the hinge flap was appealing as it had a blood source present from the original graft site. A tube axial pattern flap or tissue expansion could also have been used. Both of these techniques were considered more difficult to perform than the hinge flap technique with no greater chance of success. Furthermore, cost and resources had to be taken into consideration. Beyond a standard surgical pack of instruments (a spay pack was used in this case), surgical blade, suture and a sterile ruler, no specialty equipment was required. The drug protocol was limited to what was available on the mobile veterinary unit used for spay/neuter.

Single-pedicle hinge flaps have been described minimally in the literature.[7] It is important to note that the patient was a good candidate for this procedure owing to its reserved attitude and excellent disposition. Minimal restraint could be used for bandage changes and after fully recovering from anesthesia following the first stage of the hinge flap procedure, the patient was able to ambulate normally using three legs, and had no problems using a litterbox. Lastly, although the elbow was tacked, held in place with tape and fully covered by a bandage, movement of the left forelimb still occurred. This caused minor tension on the wound edges, which lead to very small holes around the dermal cruciate sutures. These quickly healed by second intention once the flap was fully released from the lateral thorax.

Conclusions

While a single-pedicle hinge flap may seem like an advanced surgical procedure, with basic gentle tissue handling and suturing skills, it is a procedure that can be performed successfully by most veterinary practitioners. Amputation would be a viable option in a shelter setting owing to the low cost and ease of the procedure; however, it is our recommendation to consider limb-sparing techniques first and use amputation only as a salvage procedure. Additionally, patient selection is important for a successful outcome of a single-pedicle hinge flap as fractious animals or concurrent disease processes could compromise flap viability and healing.

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