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Compendium

Case Report

Surgical Reconstruction of Canine Footpads Burned by Sodium Hypochlorite Drain Cleaner

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The canine foot is anatomically well suited to the provision of a durable surface and designed to withstand the rigors of weight bearing.[1–3] Footpads provide cushioning, abrasion resistance, and traction during normal ambulation. As a consequence of this highly specialized anatomy, loss of footpad tissue can have catastrophic implications for maintenance of limb function.[1–6] Numerous surgical options have been described for canine footpad reconstruction;[1–4,6] however, we are not aware of any previous reports describing the management of a dog with severe traumatic injuries to all four feet.

Chemical burns caused by contact with alkaline agents consistently result in extensive necrosis of skin and underlying structures.[7] Alkaline burns due to accidental contact with industrial-grade solvents and household cleaning agents are common in humans and are responsible for more than 15,000 skin burns annually in the United States.[8] In contrast, alkaline burns are listed as an unusual cause of skin injury in companion animals, with only eight cases reported in the veterinary literature.[9] This case report details the clinical management of severe alkaline burns to all four feet in a client-owned dog.

Presentation

An 8-year-old, 42.7-kg (93.9-lb), intact male German shepherd was referred with a 6-hour history of severe weight-bearing lameness affecting all four limbs and full-thickness ulceration of the weight-bearing surfaces of all four feet. The dog had been treated 4 weeks previously for a complete rupture of the left cranial cruciate ligament by tibial plateau leveling osteotomy. During recovery, the dog had been tethered in an area in which some surfaces had been accidentally contaminated with a sodium hypochlorite–based liquid drain cleaner (sodium hypochlorite 47 g/L, sodium hydroxide 30 g/L; Drano Ultra Gel, SC Johnson, Lane Cove, NSW, Australia). The dog had been found standing in a puddle of residual surface liquid and was taken immediately to the referring veterinarian. The feet had been thoroughly irrigated with tap water and bandaged prior to referral. Examination revealed that the dog was depressed but responsive to external stimuli. The heart and respiratory rates were within reference ranges, and rectal temperature was 40.1°C (104.2°F). The dog was ambulatory with a slow, shuffling gait but showed an obvious pain response when attempting to walk.

Examination of the feet revealed circumferential footpad loss and peripheral detachment of the digital and metacarpal–tarsal pads (**FIGURE 1**). The estimated overall mean percentage of pad necrosis compared with normal German shepherd feet (measured using retrospective photographic analysis) was 32.5% (**TABLE 1**). Variable portions of interdigital skin, palmar–plantar skin, and abaxial marginal

Figure 1. Palmar surface of the right forefoot (photographed at initial presentation). Note the peripheral detachment of the digital and metacarpal pads. Most of the interdigital, palmar–plantar, and abaxial marginal skin was affected by black discoloration with a distinct yellow peripheral margin, suggestive of deep tissue necrosis.

Table 1. Estimated Percentage of Footpad Necrosis on Initial Presentation[a]

Pad	% Pad Loss				
	LF	RF	LH	RH	Mean
Metacarpal/tarsal	6	20	25	0	13
DP-2	27	52	0	0	20
DP-3	16	38	71	54	45
DP-4	19	42	83	50	49
DP-5	0	44	58	48	38
Mean	14	39	47	30	
Palmar–plantar skin defect (mm^2)	336	1225	300	960	

[a]Measured using digital photography and a commercial image-analysis software package (Adobe Photoshop 7, Adobe Systems, London, UK).

DP = digital pad, *F* = fore (thoracic) limb, *H* = hind (pelvic) limb, *L* = left, *R* = right.

skin were affected by black discoloration with a distinct yellow peripheral margin, suggestive of deep tissue necrosis.

Serum biochemical analyses revealed no abnormalities. A complete blood count revealed leukocytosis (31.42×10^9/L; reference range: 5.5 to 16.9×10^9/L) due to neutrophilia (3.11×10^9/L; reference range: 0.3 to 2×10^9/L), basophilia (0.19×10^9/L; reference range: 0 to 0.1×10^9/L), and monocytosis (3.11×10^9/L; reference range: 0.3 to 2.0×10^9/L). Shower irrigation of the feet with copious tap water was performed (total time approximately 30 minutes), and soft-padded foot bandages were reapplied, incorporating an unpasteurized honey primary layer (Active+ Manuka Honey, Medihoney Pty, Eight Mile Plains, QLD, Australia).

Treatment

The initial therapeutic plan consisted of surgical debridement and open wound management followed by staged surgical foot reconstruction. Over a period of 46 days, five surgical procedures and 22 bandage changes were performed, with 17 bandage changes requiring deep sedation with medetomidine hydrochloride (Domitor, Pfizer). Surgical debridement (days 3 and 6) involved tangential full-thickness resection of necrotic pad and skin on all four feet. At this stage, establishing viability of the footpads was challenging because of the similar color and consistency of potentially viable digital pad and nonviable digital cushion. Due to the lack of available pad for subsequent reconstruction, conservative surgical debridement was performed and the therapeutic plan was modified to include maggot debridement therapy (MDT) on days 8 through 10.

Maggot Debridement Therapy

With the dog deeply sedated (medetomidine hydrochloride), each foot was shower-irrigated for 1 minute before application of a 5 × 5–cm gauze sponge containing 60 to 80 disinfected *Lucilia sericata* maggots (Department of Medical Entomology, Westmead Hospital, Sydney, NSW, Australia) to each palmar–plantar surface. The feet were covered with needle-perforated, paper theater shoe covers (Livingstone International, Pty, Rosebery, NSW, Australia), which were taped (Askina Plast E, B. Braun, Bella Vista, NSW, Australia) approximately 3 cm above the foot to provide a semiocclusive cover that prevented the maggots from escaping while preserving a source of air. An indwelling silicone Foley urinary catheter (Smiths Medical PM, Inc, Waukesha, WI) with a closed collection system was placed. To prevent iatrogenic trauma to the maggots, the dog was hospitalized on padded bedding in either lateral recumbency (with turning every 4 hours) or ventral recumbency until removal of the MDT dressings. The MDT dressings and urinary catheter were removed with the dog under deep sedation on day 10, approximately 40 hours after placement (**FIGURE 2**).

Figure 2. Photograph of the left forefoot on day 10 of treatment. Healthy-appearing interdigital granulation tissue was present immediately after maggot debridement therapy.

Ozonated Water

After removal of the MDT dressings, the feet were irrigated with ozonated water (4 ppm ozone at 120 L/h) for a contact time of 2 min/foot. Soft-padded bandages incorporating a honey and polyurethane foam diaper (Sorbies Pty, Port Melbourne, VIC, Australia) primary layer were placed. Bandage changes were scheduled every 24 to 48 hours, and ozonated water irrigation was repeated at each bandage change.

Surgical Reconstruction

Healthy granulation tissue was present on all four feet by day 14 after presentation, and a 3- to 4-mm rim of white dermal footpad tissue had formed around the circumference of each digital pad (**FIGURE 3**). The surgical techniques employed for foot reconstruction are summarized in **TABLE 2.** Three surgical interventions were performed, with approximately 2-week intervals between procedures: day 15, right forefoot (RF); day 29, left forefoot (LF) and right hindfoot (RH); and day 44, LF revision and left hindfoot (LH). The surgical technique employed for each foot depended on the extent of pad and skin loss. Techniques included combinations of digital amputation with phalangeal filleting, partial or complete fusion podoplasty, interdigital skin fold transposition, free meshed skin grafting, multiple punch skin grafting, and free pad grafting.

After surgical debridement and MDT, only one foot (LF) had any ventral interdigital skin. Conventional fusion podoplasty

Figure 3. A through D: Presurgical images of each foot, photographed immediately before reconstructive surgery on days 15, 29, 29, and 44, respectively. **E through H:** Postsurgical images, taken on days 15, 29, 29, and 54 (immediately after WB-CESF removal), respectively. **I through L:** Palmar–plantar weight-bearing surfaces, photographed at the 6-month reassessment. Note that in 3L, the free footpad grafts in image 3H have coalesced with the adjacent digital pads, resulting in nearly normal-appearing digital pads. Small areas of darker footpad represent particularly hard tissue. This may be an adaptive response to the absence of underlying digital cushion, which cannot be transferred with free pad grafts. These areas were nonpainful on deep palpation.

was precluded by the degree of pad loss in all but one foot (RH). Modified podoplasty was performed by primary closure of adjacent pads where tension-free appositional suture closure was possible. A subdermal plexus flap, utilizing the dorsal interdigital skin folds (interdigital skin fold transposition flap [IDTF]), was created on all four feet by elevating the entire dorsal skin surface of each foot using a combination of sharp and blunt dissection from the level of the nail bed to the level of the metacarpo(tarso)-phalangeal joints (**FIGURE 4**). Digits 2 (LH), 2 and 5 (RF, RH), and 4 and 5 (LF) were amputated at the distal one-third of P2 via a dorsal approach after elevation of the IDTF. The associated pad was rotated axially (centralized) to facilitate tension-free closure of the podoplasty. This technique also allowed tension-free suture apposition of the abaxial pad margins to the abaxial margins of the IDTF, thus providing skin cover for the significant abaxial skin defects. The palmar–plantar skin defects on the RF and RH were covered with full-thickness meshed skin grafts harvested from sites over the right lateral flank. Any remaining interdigital skin and footpad defects were managed using multiple full-thickness free punch and free pad grafts, respectively (**TABLE 2, FIGURE 3**), harvested from the right lateral flank and both carpal pads. All free grafts were harvested, prepared, and transposed as described elsewhere.[1,6,10] Grafts were secured using paired simple interrupted 4/0 polypropylene sutures (Prolene, B. Braun) and were protected with a nonadherent paraffin gauze dressing (Jelonet, Smith and Nephew, Mount Waverley, VIC, Australia), with a thin coating of framycetin (5 mg/g), polymyxin B sulfate (5000 IU/g), and bacitracin zinc (500 IU/g) ointment (Framixin, Apex Laboratories, Somersby, NSW, Australia). Skin and pad apposition (including podoplasty) was achieved using 4/0 polypropylene in either a simple continuous or cruciate pattern.

When free skin grafts or pad grafts were used (RF, LH, RH), the skin/pad reconstruction was protected via suspension of the foot within a weight-bearing circular external skeletal fixator (WB-CESF; IMEX Veterinary Inc, Longview, TX; **FIGURES 3** and **5**) for 12 to 14 days postoperatively. The WB-CESF configuration varied between the thoracic and pelvic limbs (**TABLE 3**). Features common to the thoracic and pelvic limb WB-CESFs were the use of (1) 66-mm internal diameter rings and threaded rods; (2) 1.6 × 210–mm smooth fixation wires (tensioned to the first indicator line on a semicalibrated tensioner [Dyna wire tensioner, IMEX Veterinary Inc]) positioned through the proximal and distal metaphyses of the metacarpal–tarsal bones; (3) suspension of the palmar–plantar surfaces approximately 1 to 2 cm above the distal (weight-bearing) ring; (4) use of multiple angular hinge assemblies to position the

Table 2. Surgical Techniques Employed for Foot Reconstruction

Foot	Day	Digit Amputation	Reconstruction: *Podoplasty*	Reconstruction: *Palmar–Plantar*	Reconstruction: *Interdigital*	External Fixation
RF	15	2, 5	Digits 2–5	Meshed free skin graft	Free punch grafts	4-ring CESF
LF	29, 44	4, 5	Digits 2–4; 2, 5-MC pad	Primary closure	Partial podoplasty	None
RH	29	2, 5	Complete	Meshed free skin graft	Podoplasty	Stretch ring CESF
LH	44	2	None	Primary closure	Free pad grafts	Stretch ring CESF

CESF = circular external skeletal fixator, *F* = fore (thoracic) limb, *H* = hind (pelvic) limb, *L* = left, *MC* = metacarpal, *R* = right.

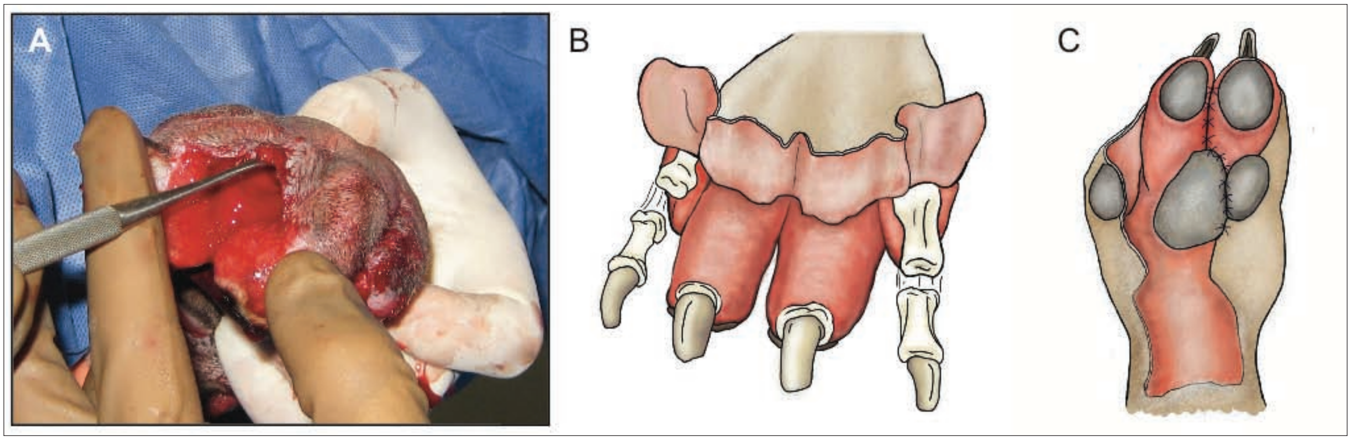

Figure 4. Operative images demonstrating the footpad reconstructive techniques employed. (**A**) Intraoperative image showing elevation of the interdigital transposition flap (IDTF). (**B** and **C**) Schematic images of the combined reconstructions showing digital amputation, phalangeal filleting, and interdigital skin flap transposition. *Courtesy of Medipicsandprose.com.au.*

weight-bearing ring approximately parallel to the ground during midstance; and (5) protection of the weight-bearing ring with heavy-duty electrical tape (Gaffa tape, Saint Gobain Abrasives, Pty, NSW, Australia). The pelvic limb WB-CESF used a combination of tensioned transfixation wires directed from medial to lateral and 2-mm Ellis pins directed from dorsal to plantar via a single 3.2-mm connecting bar and paired mini clamps (mini SK, IMEX Veterinary Inc) spanning the stretch ring dorsally (**FIGURE 5**). Dressings were changed 3 days after each surgery and every 2 to 3 days thereafter until WB-CESF removal after 12 to 14 days. Each WB-CESF was replaced with soft-padded bandages incorporating a polyurethane foam diaper, with changes scheduled twice weekly until bandage removal. After the second surgical procedure, during which two feet were reconstructed simultaneously (LF and RH), the grafted right pelvic limb was protected with a WB-CESF and the left thoracic limb was coapted using a modified "clamshell" splint, as described elsewhere.[11]

The total surgical time (over five procedures) was 13.25 hours, with a total general anesthesia time of 26.75 hours. The total time spent in hospital was 44 days. During this time, appropriate local, regional, parenteral, and oral analgesic protocols were employed (**BOX 1**). Antimicrobial therapy comprised topical unpasteurized honey (days 0 to 14), ozonated water irrigation (during dressing changes between days 10 to 60), perioperative cefazolin (20 mg/kg IV q2h, from induction of general anesthesia), cephalexin (21 mg/kg PO q12h, days 1 to 14) and clindamycin hydrochloride (10.5 mg/kg PO q24h, days 1 to 30).

Lameness varied markedly throughout the course of treatment. However, there were only 5 days (days 2, 3, 8, 9, and 10) in which the dog was nonambulatory, with 3 of these days being imposed by staff due to the MDT therapy. Tolerance of bandages and WB-CESF was excellent, and the dog consistently and reliably used all

Table 3. Weight-bearing Circular External Skeletal Fixator Configurations Employed for Protection of Skin/Footpad Reconstructions

Foot	Hinge Angle	Ring	Type	Ring Function	Wire
RF	140°	1	Full	Transfixation	1 mediolateral
		2	Full	Transfixation	4 craniocaudal
		3	Full	Bridging	None
		4	Full	Weight bearing	None
LH/RH	125°	1	Stretch	Transfixation	1 mediolateral (dorsal angled 2-mm Ellis pins)
		2	Stretch	Transfixation	2 mediolateral
		3	Full	Weight bearing	None

F = fore (thoracic) limb, *H* = hind (pelvic) limb, *L* = left, *MC* = metacarpal, *MT* = metatarsal, *R* = right.

Box 1. Analgesic Protocols

- Morphine sulfate (0.3–0.5 mg/kg IM q4h, days 0–14)
- Morphine sulfate (0.1 mg/kg/h constant-rate infusion, days 3–5)
- Transdermal fentanyl (Durogesic 100-µg/h and 50-µg/h transdermal patches, Janssen-Cilag, Macquarie Park, NSW, Australia; 150 µg/h, days 3–12, patches changed every 3 days)
- Perioperative regional anesthesia:
  —Perineural bupivacaine (radial, ulnar, median, musculocutaneous nerves; 1 mg/kg, day 15)
  —Epidural morphine sulfate (0.2 mg/kg) and bupivacaine (1 mg/kg) (days 29 and 44)
- Meloxicam (Metacam, Boehringer-Ingelheim, Chatswood, NSW, Australia; 0.1 mg/kg PO q24h, days 1–65)

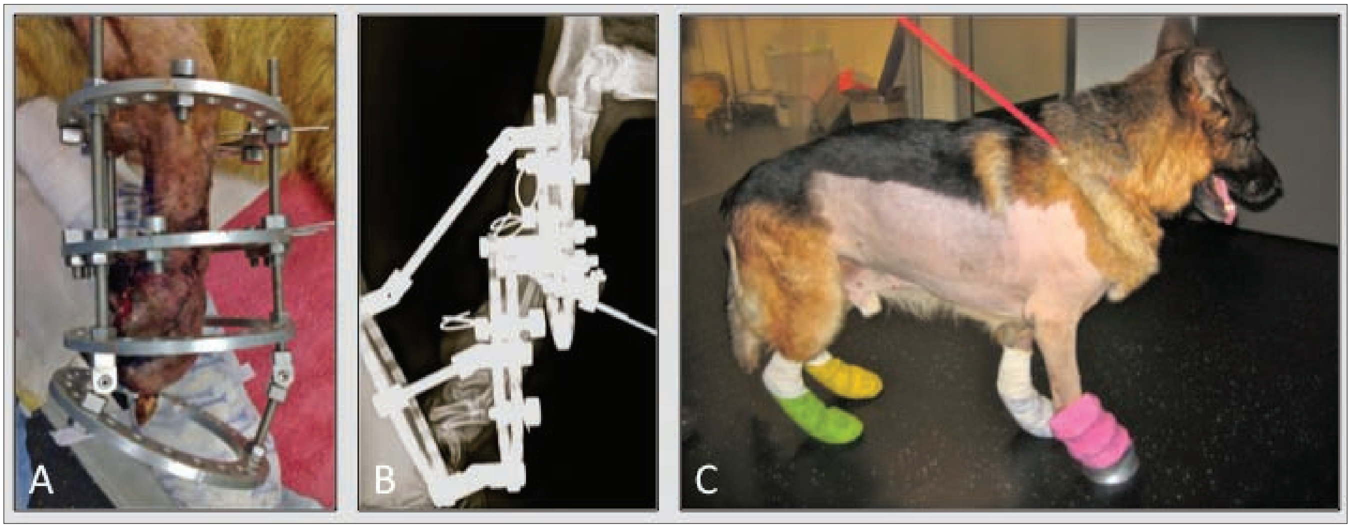

Figure 5. Weight-bearing circular external skeletal fixator (WB-CESF) employed for protection of the skin/footpad reconstructions. (**A**) Photograph of the RF construct, taken immediately postoperatively (day 15). (**B**) Mediolateral radiographic image of the LH construct. (**C**) Tolerance of bandages and WB-CESFs was excellent, and the dog consistently and reliably used all operated limbs from the day after surgery until WB-CESF removal.

operated limbs from the day after surgery until WB-CESF removal 10 to 13 days later (**FIGURE 5** and **VIDEO**). The duration of bandage maintenance varied between feet (**TABLE 4**), with a mean time between surgery and bandage removal of 32 days.

Complications

Although complications were generally considered mild (**TABLE 4**), two required surgical management. Gapping of skin-to-pad suture lines on the LF was attributed to a combination of excessive tension and inadequate coaptation (this being the only foot not protected postoperatively using a WB-CESF). Revision surgery was performed at the time of reconstruction of the last foot (LH). This consisted of tension relief via phalangeal filleting of digit 4 and undermining of the palmar aspect of the metacarpal pad and palmar skin, with appositional closure as described above. The second complication requiring surgical management was persistent trauma to the lateral aspect of digit 4 due to ingrowth of the nail plate of digit 5 (LH). This complication was treated by total nail avulsion of digit 5, with phenolization of the germinal matrix to prevent nail regrowth (**BOX 2**).[12]

Table 4. Postoperative Outcome

Foot	Time to Removal (days postsurgery)		Approximate Graft Viability (%)	Complications
	WB-CESF	*Bandage*		
LF	N/A	25	N/A	Partial (70%) dehiscence of palmar skin to metacarpal pad and IDTF to digital pad 4 wounds
RF	10	22	100	None
LH	13	42	100	Multiple transfixation pins loose at the time of WB-CESF removal; digit 5 nail growing into digit 4 pad
RH	12	39	90	Multiple transfixation wires fractured or loose at the time of WB-CESF removal
Mean	11.7	32	96.7	

F = fore (thoracic) limb, *H* = hind (pelvic) limb, *IDTF* = interdigital skin fold transposition flap, *L* = left, *R* = right, *WB-CESF* = weight-bearing circular external skeletal fixator.

Outcome

The dog's exercise tolerance and lameness gradually improved over the following 2 months. At 6-month reassessment, the owners described the dog's exercise tolerance as normal. The dog was able to walk on hard and soft surfaces without any visible limp, and duration of exercise had returned to preinjury levels. Walking, trotting, and running were all possible without restriction or analgesic medications. Orthopedic examination revealed no lameness, and examination of the feet revealed robust, keratinized weight-bearing surfaces without any ulceration or pain on deep palpation (**FIGURE 3**).

Discussion

Chemical burns affecting client-owned dogs are considered very rare, with the case described representing the only report to date describing alkaline burns affecting a dog's feet. It has been well established from studies using experimental animals that skin handles alkali burns poorly.[7] After penetrating the skin, alkaline substances cause saponification of fat, which allows deeper penetration and increased tissue damage.[8] The pH aberration lasts

Box 2. Total Nail Avulsion and Phenolization

Under general anesthesia, a Penrose tourniquet was applied approximately 5 cm proximal to the foot. Digits 4 and 5 were clipped and aseptically prepared. Bone cutters were used to clip the fifth nail plate short enough to include amputation of the terminal 2 mm of the nail bed. A Freer periosteal elevator was used to separate the nail plate from the proximal nail fold and underlying nail bed. The nail plate was divided sagittally into four segments. This was accomplished from the free margin to the proximal nail fold using pointed bone cutters and from the proximal nail fold through the nail base using a push-cutting action with a beaver blade. Each nail plate segment was grasped with straight Kelly hemostats and rolled toward digital midline to complete nail plate avulsion. An insulin syringe was used to deliver 0.3 mL of 80% phenol to the nail sinus, with care taken to prevent spillage of phenol onto the adjacent skin. After a 3-min application time, residual phenol was removed from the operative site using 500 mL of sterile saline delivered via a 60-mL syringe. A soft-padded bandage was reapplied to this foot for the following 3 days.

about 12 hours and can produce a tissue pH elevation of 9.5 units above normal.[13] The first few minutes after contact are the most important with respect to management because tissue damage is progressive once penetration is achieved.[7,8] After exposure has been recognized, immediate termination of activity by dilution or neutralization is crucial.[7,8,13,14] Continuous water irrigation can reliably reduce the pH of tissue and thus halt injury when initiated within 1 minute of exposure but is ineffective if started more than 1 hour post-burn.[14] Late recognition of exposure in veterinary patients may require treatment on suspicion using a neutralizing agent. Due to its availability, irrigation with 5% acetic acid (i.e., household vinegar) has been recommended as an effective alternative to tap water dilution hydrotherapy.[8] We chose manuka honey, which is readily available, has a pH of 3.5 to 4.0, and has beneficial properties for open wound management, including reduction of inflammatory edema, acceleration in necrotic tissue sloughing, provision of a local cellular energy source, and potent polyantimicrobial effects.[15,16] In previous studies, failure of acute and chronic wounds to heal was correlated with alkaline tissue pH, and use of topical manuka honey was associated with statistically significant decreases in wound pH and wound size.[15,17]

We used MDT early in the course of open wound management. Although there is growing literature reporting the successful use of MDT in human medicine,[18] examples in veterinary medicine remain sparse, probably due to unfounded concerns regarding the potential for tissue invasion common to agents of obligate myiasis, including the flesh fly and screwworm species.[19,20] The larvae of agents of facultative myiasis (particularly *L. sericata*) feed superficially, allowing selective debridement of necrotic tissue that is visually difficult to distinguish from viable tissue.[20] In humans, MDT has saved from amputation about 50% of limbs in which it has been tried.[21] Similarly, in the only small animal case series,[19] MDT was associated with limb salvage in three of five dogs and cats that were expected to require amputation or euthanasia. Importantly, no adverse events were attributed to MDT in any of the reported cases.[19] Previous use of MDT for treatment of recalcitrant footrot in sheep illustrated that treatment is possible even in the relatively anaerobic and inaccessible area of the foot.[22] Our experience with MDT was similar to that reported in sheep in that MDT was well tolerated and facilitated formation of healthy granulation tissue after a short (2-day) application time.

To our knowledge, this is the first clinical veterinary report of wound management using ozone (O_3) therapy. The beneficial effects of ozone on wound healing are a consequence of its potent bactericidal and antifungal effects and increased wound oxygen tension via O_2 donation.[23] In experimental animals, ozone application has been associated with enhanced cutaneous wound repair and increased expression of platelet-derived growth factor, transforming growth factor β, and vascular endothelial growth factor.[24] It has been used in humans to treat chronic wounds, such as trophic and ischemic ulcers, furunculosis, gingivitis, and diabetic wounds.[25] We had access to a commercially available point-of-use electrolytic ozone generator (C-7100M electrolytic ozone disinfection system, Biotek Ozone, St Leonards, NSW, Australia), which produces soluble ozone by splitting purified tap water into oxygen and hydrogen.[26] The most practical benefit for our patient was a considerably shorter application time (20 seconds to 2 minutes) compared with the time required for the high-pressure saline irrigation systems most commonly employed for open wound management in small animals. We noted a remarkable cleansing and deodorizing effect, coupled with a consistent change in granulation tissue color from pale pink to deep pink. This color change was sustained until bandage reapplication and was consistent with previous reports of increased capillary oxygen tension after ozone treatment of open wounds.[22] Currently, ozonated water generators are marketed primarily for use in food processing and surface disinfection. However, promising data from experimental and clinical trials using ozonated olive oil suggest that ozonated water may become a useful clinical tool in both human and veterinary medicine.[23–25] Toxicologic studies report no adverse effects of ozone therapy in humans.

Successful salvage of all four feet was the only acceptable outcome in the case described. With amputation being unavailable, the only other alternative was euthanasia. Simultaneous reconstructions were considered but were not performed due to concerns regarding our ability to effectively neutralize environmental stresses on more than one foot at a time. Considering each foot in isolation, the primary surgical challenge was related to extensive loss of multiple skin surfaces; namely, interdigital, palmar–plantar, and abaxial skin and footpad tissue. As with any skin defect, the reconstructive plan was designed to follow a cascade from the simplest to the most complex surgical options.[6] The available options included fusion podoplasty, digit amputation, local footpad transposition, free grafting, and microvascular transfer of footpad material.[1–3,6] We used recognized procedures in treating this dog, although the unique circumstances required technical modifications to existing techniques (including fusion podoplasty and phalangeal filleting) and use of a new subdermal plexus flap (IDTF). Previous descriptions of fusion podoplasty assumed an absence of footpad deficits and involved removal of all interdigital and interpad skin on both the palmar–plantar and dorsal surfaces.[26] In the case described, preservation and transposition of the dorsal interdigital skin facilitated tension-free podoplasty and reconstruction of abaxial skin deficits. These surgical innovations proved essential in allowing us to fulfill our primary surgical goal, which was the reconstruction of a durable weight-bearing surface on all four feet.

Foot reconstruction resulted in marked alteration in the distribution of weight-bearing forces in this dog. Historically, it has been documented that load distribution from the canine footpads is principally transferred through the third and fourth digits[27]; however, a recent study showed that loads are more evenly distributed, and digital pad 5 and the metacarpal–tarsal pads bear a substantial amount of load.[28] The concept that the canine foot may be well equipped to adapt to altered load distribution was supported by a recent case report that documented an excellent outcome after conservative management of a Siberian husky with complete loss of a metatarsal pad.[5] Nonetheless, we were careful to conserve any viable pad tissue, and we noted circumferential growth of new digital footpad tissue during the initial period of open wound management. This previously unreported phenomenon produced a dramatic increase in footpad surface area, which was especially important in the worst-affected foot (LH; **FIGURE 3**). Although prolonged open wound management should be avoided on the grounds of increased expense and the potential for suboptimal functional results,[6] a patient approach may be warranted, particularly when the severity of the initial deficits prompts consideration of radical salvage procedures, including pandigital or full-limb amputation. This case illustrates that reepithelialization and keratinization of new footpad can occur remarkably quickly, and the potential reward for any reduction in deficit surface area may be the option for more conservative salvage surgery.

Footpad and skin grafting brings problems of fixation and shear.[11] In the presence of weight-bearing surface injuries, spreading of pad tissue during ambulation counteracts the normal contraction process of the fibroblasts and myofibroblasts involved in wound healing.[29] Complete prevention of weight bearing on wounded pad tissue is the ideal for assurance of uncomplicated healing.[11] For the feet requiring free pad or skin grafting, we used WB-CESFs to effectively neutralize these shear forces. Based on personal experience and data from dogs treated similarly,[30–32] we were confident that the WB-CESF would allow early reliable weight bearing on the operated limb, which was especially critical because of the status of the other three feet. In retrospect, we believe that the WB-CESFs were pivotal in ensuring a successful outcome in this dog. The clamshell splint used after LF reconstruction has been shown to provide better pressure relief to the metacarpal pad compared with other bandage configurations,[11] and this bandage represents the most suitable alternative for dogs in which injuries affect only one foot.[33]

Taking into account the severity of injury and complexity of intervention, the surgical complications were considered mild. Ingrowth of a nail plate into an adjacent digit should be recognized as a potential complication after fusion podoplasty. Although surgical nail plate avulsion had not been described in dogs, this conservative option provided an excellent outcome in this case. The more radical procedure of amputation of the terminal part of the distal phalanx can be considered as a surgical alternative but may be unnecessarily aggressive.

The primary objective of this report is to make practitioners aware that management of simultaneous severe foot injuries is possible even if the initial prognosis appears hopeless. It is important to recognize that success in this case was only possible because of an exceptional emotional and financial commitment from the dog's owners, as well as remarkable patient compliance. Fortunately, injuries of this pattern and severity are rare, and management of similarly affected cases should focus on early recognition of chemical exposure and prompt termination of caustic injury as described in this report.

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