NOVEL SHELL WOUND CARE IN THE AQUATIC TURTLE

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Abstract

When shell damage occurs in chelonians, fractures and/or areas of barrier disruption often lead to secondary infections and loss of shell integrity. Timely healing depends on fragment stabilization and proper wound care. Wound management is problematic in aquatic and semiaquatic chelonians, as they must remain in water for natural physiologic functions. The purpose of this investigation was to develop a waterproof wound shield allowing routine husbandry and encourage natural behaviors during healing of shell and skin wounds. A nontoxic, underwater epoxy (Aqua-Stix, Two Little Fishies, Inc., Miami Gardens, FL USA) was applied to shells of 14 red-eared sliders (*Trachemys scripta elegans*) around an approximately 1 cm, surgically created, full-thickness shell wound. A urine specimen cup was cut in half, and the uppercut edge was seated into the center of the epoxy, leaving the cup lumen exposed over the wound. Special attention was paid to applying the ring of epoxy congruent with the shell scutal plates and embedding the epoxy tightly to the cup. The specimen lid was then threaded into place before the subjects were exposed to water. Infrared thermography determined thermal effects of epoxy application by using an ETIP 7320 P-Series infrared camera (Infrared Cameras Inc., Beaumont, TX USA). The average baseline shell temperature was 24°C. During epoxy application, local temperature increased from 28°C to 32°C, followed by rapid (<5 minutes) temperature reduction. Turtles showed no noticeable discomfort during application, and the wound shield remained water tight for 6 months allowing study subjects to recover under more physiologic conditions (aquatic environment).

Key words: chelonian; shell injury; shell fracture; shell wound

Chelonian shells provide a protective armor for the species and play an integral role in animal survival; the shell not only shields the internal organs from injury and infection but also provides an anchor for muscles, serves as an essential mineral reserve, and prevents the loss of body heat and fluids.[1,2] A fracture of this protective armor can take from 6 to 30 months to heal, and full ossification may take years to complete.[3-5]

In aquatic and semiaquatic chelonians, physiologic functions, such as eating and voiding, occur almost exclusively in the water.[6,7] Shell fractures offer problematic wound care as exposure to water increases the likelihood for contamination, hindering wound healing, and increasing the opportunity for osteomyelitis and systemic infection.[7,8] Although epoxy and fiberglass repair of shell wounds is often used, their use in traumatic or contaminated wounds is often contraindicated because of the increased likelihood of infection and septicemia.[8] Therefore, "at-risk" chelonian shell fractures should be managed with an open fixation system that allows

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for appropriate wound management.[8] As such, affected chelonians must be maintained out of a natural water habitat (dry docked) for a prolonged period or the wound must be covered with an occlusive dressing during water exposure.[6-8] Dry docked chelonians experience many stresses, including the loss of normal physiologic functions, the stress of assisted feedings, and the assumed mental stress secondary to the absence of normal behaviors.[5] If occlusive bandages are used, frequent changes are required, increasing handling stress and hospitalization expense.[4,5]

Many different techniques have been used to stabilize shell fractures, and numerous products are employed to treat open shell wounds. Unfortunately, few options are available to provide water-tight protection of the affected area to allow for water immersion, encouraging normal behaviors and physiologic functions. The objective of this study was to develop a novel wound shield that would allow for the maintenance of open shell wounds, thereby reducing dry docking times and allowing injured chelonians to preserve natural behaviors. Because of encouraging environmental normalcy during the rehabilitation period, hospitalization stress is reduced and patient quality of life is improved. In addition, as an epoxy was used to create the shield, the investigators wanted to provide objective data regarding the temperature change that results from the exothermic reaction that occurs when this type of glue cures to determine if its use would be detrimental to the animals on which it was applied.

MATERIALS AND METHODS

This investigation was approved by the Institutational Animal Care and Use Committee at Oklahoma State University and was performed in accordance with the EU directive 2010 for animal experiments.

FIGURE 1. Surgically created full-thickness shell wound in a study subject.

In total, 14 red-eared slider turtles (*Trachemys scripta elegans*) were used to develop a shell wound healing model at the Boren Veterinary Teaching Hospital of Oklahoma State University from August 2013 to January 2014. After each turtle was premedicated with tramadol (Roadrunner Pharmacy, Phoenix, AZ USA) 10 mg/kg subcutaneous, the turtles were heavily sedated with injections of midazolam (West-Ward, Eatontown, NJ USA) 1.0 mg/kg subcutaneously, and dexmedetomidine (Dexdormitor; Pfizer Animal Health, New York, NY USA) 0.1 mg/kg subcutaneously. This level of sedation and pain control allowed investigators to surgically create a full-thickness shell lesion using a high-speed dental burr (iM3 Elite iM3 Inc., Vancouver, WA USA). The lesion was 1 × 1 cm^2 and located on the caudolateral aspect of the carapace (pleural scute), exposing underlying musculature (Fig. 1). Following the procedure, a 2% lidocaine (Hospira Inc., Lake Forest, IL USA) splash block (0.1 mL, topically) was performed, and the sedation was reversed with atipamezole (Antisedan; Pfizer Animal Health, New York, NY USA) 0.1 mg/kg intramuscularly; tramadol 10 mg/kg subcutaneously every 12 hours for 36 hours was also administered. Subjects were given ceftazidime (Sagent, Schaumburg, IL USA) 20 mg/kg subcutanteously every 3 days for 4 total treatments. A light, nonocclusive bandage was placed postprocedure, and the resultant open shell wound was allowed to heal via second intention.

For 7 days, subjects were dry docked and the open shell wound was managed with light daily sterile saline flushes followed by the application of a nonadherant bandage. The subjects were nutritionally managed by oral gavaging a commercial critical care diet at a dose of 1% to 2% of body weight every other day (Emeraid Omnivore; Lafeber Company, Cornell, IL USA). In addition, the subjects were closely monitored and allowed daily access to very shallow water baths to encourage drinking and ingestion of a normal diet, as well as to provide the opportunity for urination and defecation. On the seventh day following the surgical procedure, the developed wound shield was applied. The bottom half of a plastic urine specimen cup was removed with a band saw and the cutting edge deblurred. A high-speed rotory hand tool (Dremel; Robert Bosch Tool Corporation, Mt. Prospect, IL USA) was used