

UTILIZATION OF RECONSTRUCTIVE SURGERY, EXTRACELLULAR MATRIX, AND LIGHT EMITTING DIODE TECHNOLOGY TO RETURN FORM AND FUNCTION TO A YOUNG DOLPHIN'S DORSAL FIN.

* **L. Rae Stone DVM, Jay C. Sweeney VMD, Gregg Levine DVM, George Biedenbach**
Dolphin Quest Hawaii 69-425 Waikoloa Beach Dr. Waikoloa, Hawaii 96738

Stephen F. Badylak DVM, PhD, MD
McGowan Institute for Regenerative Medicine, University of Pittsburgh, Pittsburgh, PA 15219

Abby Simmons-Byrd RVT,
ACell, Inc., 2700 Kent Avenue, West Lafayette, IN, 47906

James Carroll FRSM , Melyni Worth PhD PAS
THOR Laser International Ltd, Caer Sidhe, Chiltern Road, Amersham, Bucks, HP6 5PH, UK

Paul Faringer, MD,FACS
Kona Coast Plastic Surgery, 76-6225 Kuakini Hwy Suite A-102 Kailua-Kona, Hawaii 96740

ABSTRACT

Liko, a four-year-old male *Tursiops truncatus* sustained a severe traumatic wound at the cranial junction of the dorsal fin and dorsal body wall. The severity and location of the wound as well as its propensity for reinjury necessitated intervention. As an alternative to partial amputation of the cranial 1/3 of the dorsal fin, a novel surgical reconstruction was performed utilizing ACell extra cellular matrix (ECM) (ACell Inc., Jessup, M.D.) to stimulate tissue regeneration and effectively reconnect the leading edge of the dorsal fin to the body wall. Light Emitting Diode therapy (LED), proved to be a valuable adjunct to the healing process .

ACell ECM is derived from the urinary bladder of pigs. The ECM forms a biological scaffold, promoting tissue restoration and wound healing by supporting angiogenesis, neomatrix deposition and dermal healing. This acellular substance appears to stimulate site-specific accumulation of organized and differentiated cells that perform similar structural and functional purposes as native tissue.^{1,2,4,5}

Light Emitting Diode (LED) therapy is believed to improve tissue viability and repair. LED wavelengths are absorbed at the cellular mitochondrial level, increasing tissue metabolism and aiding tissue survival until vascularity is reestablished. LED or Photobiomodulation (term adopted by NASA) also increases fibroblast production and the growth of capillaries.^{3,6}

Since ACell ECM requires sustained tissue contact and stabilization for 10-14 days, a detailed plan for bandaging, external coaptation, and animal management was developed prior to the surgical procedure. At surgery, a dermal flap was created by incision of the dorsal midline of the fin from the wound margin extending distally. A wedge of epidermal and fibrous connective tissue was excised establishing an improved contour along the cranial dorsal fin margin and the wound was surgically debrided.. ECM in

sheets and lyophilized powder form was placed deep within the wound, along the edges of the incision, and over the sutured incision line. A prefabricated ECM shield was placed over the entire area and was secured with Gore-Tex sutures and pre-cut soft rubber skin bolsters. Finally surgical foam padding, a fiberglass splint and a custom fitted neoprene sling were applied. The animal remained in confined quarters and under 24-hour observation for 12 days postoperatively.

On Day 12 postoperatively, the sutures and ECM molding were removed. Daily treatment with a thin-layer of sterile ACell was then applied to the wound surface. Weekly, the perimeter of the surgical site was injected with a sterile ACell suspension. On Day 26 a loss of collateral circulation in the tissue above the surgical site led to an isolated region of ischemic necrosis. Thermography revealed a significant decrease in temperature along the leading edge of the dorsal fin. Hematology indicated a systemic bacterial infection. The region was carefully debrided and ACell applications were temporarily discontinued. Systemic antibiotic therapy was begun and Light Emitting Diode (LED) treatment was initiated to facilitate tissue healing and neoangiogenesis. By Day 60 there was complete fusion of the apposing edges of the wound. However, an 8 cm by 2cm open wound remained on the leading edge of the dorsal fin. LED and routine wound care was continued daily, and at Day 180 all wounds were healed and only a small scar remained at the leading edge of the dorsal fin.

This case illustrates the feasibility of the ACell ECM biological platform and LED therapy in marine mammals. Application of this technology offers a new alternative to wound management in marine mammals and has the potential to significantly improve the outcome of complex trauma cases.

Literature cited

1. Badylak, S.F., *The extracellular matrix as a scaffold for tissue reconstruction*. Semin Cell Dev Biol, 2002. 13(5): p. 377-83.
2. Badylak, S.F., *Xenogeneic extracellular matrix as a scaffold for tissue reconstruction*. Transpl Immunol, 2004. 12(3-4): p. 367-377.
3. Dyson M. Agaibya, Ghali L, *Lasers*, Med Science 2002:17 (4):A22
4. Hodde, J.P., R.D. Record, H.A. Liang, and S.F. Badylak, *Vascular endothelial growth factor in porcine-derived extracellular matrix*. Endothelium, 2001. 8(1): p. 11-24.
5. Rickey, F.A., D. Elmore, D. Hillemonds, S.F. Badylak, R. Record, and A. Simmons-Byrd, *Re-generation of tissue about an animal-based scaffold: AMS studies of the fate of the scaffold*. Nuclear Instruments and Methods in Physics Research, 2000. 172: p. 1097-1103.
6. Turner J, Hode L., *Medical indications: wound healing in laser therapy* Granesberg Prima Books 2002 P. 189- 96