

# Cutaneous injuries and envenomations from fish, sharks and rays

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**ABSTRACT:** Although dermatologists may not live or work in a marine environment, they and their patients are likely to be spending some of their leisure time on or near the water. The intent of this article is to give a basic working knowledge of the diagnosis and treatment of the more common as well as the most dangerous injuries that can result from the bites and stings from fish, sharks and rays.

**KEYWORDS:** bite, envenomation, marine, puncture wound, stings.

Cutaneous injuries to humans from fish, sharks and rays range in severity from trivial to life-threatening. Although dermatologists may not live in areas where these animals are endemic, their patients may need treatment upon returning home after suffering painful encounters with these creatures in aquatic habitats throughout the world. Victims may include fishermen, seafood handlers, bathers, waders, swimmers, surfers, sailboarders, boaters, snorkelers, scuba divers, as well as fresh- and saltwater aquarium enthusiasts.

This article will be divided into sections based on the mechanism of injury with a review of the more common and most noteworthy species responsible for that type of injury. Prevention and treatment for each class of wound will be addressed at the end of each section.

## **Irritant contact dermatitis from cutaneous toxins of fish (ichthyocrinotoxism)**

Ichthyocrinotoxins are defined as poisonous glandular secretions from the skin of fish that are not

associated with a venom apparatus such as spines or teeth (1). These secretions serve a defensive purpose and are released directly into the water where they are toxic or lethal to other species of fish.

In the waters of the Caribbean Sea soapfish (*Rypticus saponaceus*), family Grammistidae, are well known by fishermen to cause the death of other fish if they are kept together in a restricted volume of seawater (2). These fish secrete large amounts of a soapy skin mucous when handled or disturbed (2,3). The secretions contain a toxin called grammistin which can cause a mild irritant contact dermatitis when it comes into contact with human skin (2,3).

A number of other species of fish are reported to produce crinotoxins, including hagfish (family: Myxinidae), lampreys (family: Petromyzontidae), moray eels (family: Muraenidae), perchlike fish (family: Serranidae), soles (family: Soleidae), porcupine fish (family: Diodontidae), trunkfish (family: Ostraciontidae), pufferfish (family: Tetraodontidae) and toadfish (family: Batrachoididae) (4).

Very little is known about the mechanism of dermatitis due to ichthyocrinotoxins in man. The slime from many of these species is toxic to ingest and can be irritating to both skin and mucous membranes (4). Although these toxins are very potent for other fish, they produce relatively mild effects when they come in contact with human skin (3).

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The toxins from ichthyocrinotoxic fish are found primarily in the slime, but may also be contained in the flesh and viscera. Ingestion of these toxins by humans can cause a range of symptoms, including nausea, vomiting, diarrhea, abdominal pain and weakness (4). Poisonings due to ingestion of pufferfish, also known as Fugu poisoning, may be lethal. Death results from an ascending paralysis of respiratory muscles caused by tetrodotoxin, an extremely potent neurotoxin. A severe erythrodermic eruption followed by extensive desquamation may be seen in pufferfish poisonings (5).

### Prevention and treatment of ichthyocrinotoxic dermatitis

Prevention and treatment of ichthyocrinotoxic dermatitis is straightforward. Species likely to cause such injuries should be handled carefully with a gloved hand (3). If the mucous secretions do come into contact with bare skin or mucous membranes, they should be washed off as soon as possible. Symptomatic itching and burning may be relieved by cold compresses with Burow's solution or colloidal oatmeal (2,3).

In order to avoid toxic effects from eating fish such as hagfish and lampreys, which are known to be crinotoxic, the slime should be removed by covering the fish with salt and leaving them in a concentrated brine solution for several hours before cooking (4).

In the case of pufferfish, the safest course is to avoid eating this type of fish entirely, because the skin, entrails and even the flesh of these fish may contain lethal amounts of tetrodotoxin. Poisonings and death from eating pufferfish is a public health issue in Japan where the consumption of fugu (pufferfish flesh) is considered a delicacy. If a person desires to eat fugu in Japan, it must be purchased at a first-class restaurant where a licensed puffer cook should carefully remove the skin and visceral organs before preparing the fish to eat (5).

Treatment for pufferfish poisoning is supportive, as there is no antidote for tetrodotoxin. Gastric lavage is recommended in cases where the ingestion has occurred within three hours (6).

### Abrasions due to elasmobranch fish skin

The skins of sharks, skates and rays are covered by plate-like scales known as dermal denticles. These

scales impart a sandpaper-like quality to the skin of these fish. When the skin of a shark or ray comes in contact with unprotected human skin, the resulting trauma may range from a mild abrasion to a severe tearing injury, depending on the size of the fish and the force of the impact (3). Occasionally these injuries are not accidental, as Mandojana has described linear abrasions on the fingertips, elbows and knees of divers who had been "riding" on the backs of manta rays (3).

Another unusual abrasive injury has been reported in divers feeding stingrays. When the diver presents a small piece of fish or squid for the rays to eat, the rays occasionally miss the food and press their mouths against the barehanded skin of the diver. The sucking action of the mouth, which is lined with rasp-like teeth, causes a superficial abrasion known as a two-fathom hickey (7, Fig. 1)



**Fig. 1.** This diver received an abrasive injury from the mouth of a stingray known as a "two fathom hickey" while attempting to feed stingrays off the coast of Cancun, Mexico.

Wearing protective clothing such as gloves and a wetsuit can prevent these injuries. Treatment involves cleansing and disinfecting the wound to remove foreign bodies and the application of a nonadherent sterile dressing as needed for deeper wounds (3).

## Nonvenomous traumatic wounds due to fish

Nonvenomous injuries due to fish, eels and sharks can be divided into several categories based on the type of trauma. These include puncture wounds, spearing wounds, lacerations and bites.

### Puncture wounds

Puncture wounds from fish spines are nonvenomous in most cases (8). Spines may be located on the body of the fish, as is the case with porcupine fish, or they may be located in close proximity to or form part of the fish's fins (Fig. 2). Both salt- and freshwater species may cause puncture wounds. These injuries usually occur when an unwary fisherman is handling a fish in the process of removing a hook, or when the fish is being cleaned or processed. Although these wounds are usually not severe they can be painful, and significant secondary infections or foreign body reactions may result if they are not treated properly.

Garfish, also known as needlefish, houndfish, long tom, alligator gar and aiguille, are found in temperate and tropical ocean waters throughout the world (9,10). Garfish are members of the order



**Fig. 2.** If not carefully handled this squirrelfish can cause a nonvenomous puncture wound with the sharp spines of its dorsal fin.

Beloniformes, which is composed of two families, the Belonidae, and the Hemiramphidae (11). The Belonidae are carnivorous surface feeders. They are well equipped for this purpose with a long spear-like beak formed by a pair of elongated narrow upper and lower jaws lined by sharp teeth (9). Members of this family range in size from 0.5 to 1.5 meters (10). The Hemiramphids are smaller, have only an elongated lower bill, and feed on plankton (12).

Garfish have been reported to cause serious and occasionally fatal penetrating puncture wounds. Most of these injuries occur among fishermen in the Indo-Pacific, especially those fishing at night from flat canoes using artificial light to attract fish (9). Waders, divers and wind-surfers have also been injured by these fish (9,10).

Garfish swim along the surface of the water in search of smaller prey. They are capable of swimming at high rates of speed and may leap several feet out of the water when frightened. The speed of the impact can drive the sharp beak deep into soft tissues, muscles and joint spaces of the extremities (10,11). Life-threatening and fatal injuries result from penetrating wounds of the chest, abdomen, orbit, spinal canal and skull (8–10).

The severity of the trauma caused by these fish may not be readily apparent on casual inspection. The puncture wound at the entry site may appear innocuous, belying the depth of penetration and extent of injuries to underlying vital structures (9). Additional and delayed complications may arise from the tendency for the bill to break off and fragment at distance far from the entry wound (8,10,11). As with other penetrating injuries of marine origin, there is a high risk of secondary bacterial infection as well as foreign body reactions with needlefish wounds (10).

### Spearing wounds

The Billfish (family Istiophoridae) includes a number of species, which are highly prized for their commercial or recreational value (8). Members of this family include Swordfish (*Xiphiidae*), spearfish (*Tetrapturus*), sailfish (*Istiophorus*), and marlins (*Makaira*) (3). All of these fish have an elongated upper jaw with a pointed tip known as the bill or spear, which is capable of causing deep penetrating wounds or lacerations (3,8).

Spearing wounds from billfish are rare but potentially lethal accidents that are most likely to occur when fishermen land these fish onto boats before the fish has been completely subdued.

Injuries may also occur when fish that were believed to be subdued suddenly spring to life while being held for “trophy pictures” (8).

Sawfish (*Pristis perotteti*) have a long saw-like beak, which the fish uses for digging in the sand or flailing from side to side to injure or impale smaller fish (13). These fish can grow to a length of six meters (13). Fishermen may be injured while attempting to land a live hooked fish before it has been subdued, or while trying to remove a fish from a net (8).

### Lacerations

Surgeonfish (*Acanthurus* spp.), also known as doctorfish and blue tang, are equipped with a sharp, scalpel-like spine at the base of the tail on both sides (14,15 Fig. 3). In some species the spine is mobile. When the fish is not excited the spine remains tucked into a recessed groove partially surrounded by an integumentary sheath (14,15). When threatened, the fish can raise the spine at right angles from the body like a jackknife. In other species, the spines are fixed and erect (15). Divers and snorkelers may be slashed by surgeonfish during feeding sessions, or when a fish is cornered and approached too closely (15). Spear fishermen and anglers are at risk for lacerations when attempting to remove these fish from a spear, fishhook, or net (15,16). The pain from surgeonfish lacerations may be more severe than would normally be expected from the appearance of the wound. This suggests that in some species the spines may be venomous, although this has not been fully determined (14–16).



**Fig. 3.** The blue tang or surgeonfish is armed with a knifelike spine on either side of the base of its tail. The spine on the fish in this photo is yellow.

### Fish bites

Fish bites can range from relatively mild to severe life-threatening injuries. The degree of trauma depends on several variables, including the size and species of the fish involved, and the location of the wound.

Smaller gamefish such as bluefish (*Pomatomus saltatrix*), mackerel (*Scomberomorus* spp.), and flounder (*Paralichthys albigutta*) have jaws lined by small sharp pointed teeth (Fig. 4). Bites may occur if these fish are not carefully handled when removing them from a net or fishhook. Larger “chopper” sized bluefish can cause a serious bite, similar to those seen with a piranha (8,17,18). Bluefish travel and feed in large schools. Their voracious feeding habits are well known to fishermen. In order to avoid a painful piranha-like bite, swimmers should leave the water or be very cautious when bluefish are present in large numbers (1).

Serious crush injuries and occasionally amputation of digits may be caused by the bites of several species of fish, including the toadfish (family Batrachoididae), ratfish (family Chimaeridae) and parrot fish (family Scaridae) if they are carelessly handled (8).

Unwary fishermen and divers have also suffered serious bites from giant sea bass and large grouper (family Serranidae), snapper (family Lutjanidae) and wahoo (*Acanthocybium solanderi*) (8,18,19). In one rare chance event, a fisherman was bitten on the arm by a large wahoo that jumped from the water off the Mexican coast of Baja California (19). He suffered a long deep laceration with injury to the extensor tendons of the forearm from the razor-sharp teeth (19).

Among the barracuda family, only the great barracuda (*Sphyræna barracuda*) has a history of documented attacks on humans (20,21). Great barracuda may reach a length of six feet and weigh over 100 pounds (21). Armed with extremely sharp canine-like teeth and powerful jaws, their bite produces straight or V-shaped lacerations (20). They are frequently seen hanging nearly motionless over a coral formation in tropical or semitropical waters (Fig. 5), but are capable of swimming at speeds of up to 27 mph in pursuit of prey (21). The incidence of bites from these fish is quite rare, especially when compared with shark attacks (which, as will be seen later in this section, are relatively uncommon). Most barracuda attacks on bathers have occurred in murky, shallow, turbid waters (20,21).



**Fig. 4.** Many game fish including bluefish, snapper and the mackerel in this picture can cause painful bites if fishermen fail to take proper care in handling them.

While nothing strikes fear into the hearts of the bathing public like a well-publicized shark attack, the incidence of human confrontations with man-eating sharks is actually quite low. The odds of being attacked by a shark along the coastline of the United States have been estimated at one in five million, while worldwide the average number of shark attacks ranges from 30 to 100 per year (20).

There are 350 known species of sharks, but only 32 species have been reported to attack humans (20). The top 15 species (in order of decreasing numbers of unprovoked attacks according to the International Shark Attack file) include the great white (*Carcharodon carcharias*), tiger (*Galeocerdo cuvier*), bull (*Carcharhinus leucas*), sand tiger (*Carcharias taurus*), blacktip or spotted (*Carcharhinus limbatus*), hammerhead (*Sphyrna* spp.), blue (*Prionace glauca*), blacktip reef (*Carcharhi-*



**Fig. 5.** This barracuda was seen floating motionless over a coral head in the Florida Keys.

*nus melanopterus*), shortfin mako (*Isurus oxyrinchus*), spinner (*Carcharhinus brevipinna*), lemon (*Negaprion brevirostris*), Caribbean reef (*Carcharhinus perezii*), bronze whaler (*Carcharhinus brachyurus*), nurse (*Ginglymostoma cirratum*) and gray reef (*Carcharhinus amblyrhynchos*) (22). Other species of sharks frequently cited as dangerous to man include the silky (*Carcharhinus falciformis*), oceanic whitetip (*Carcharhinus longimanus*), and reef whitetip (*Triaenodon obesus*) (8,20,21).

Recreational water activities most frequently associated with unprovoked shark attacks include surfing, snorkeling, scuba diving, swimming and wading (22). Shark bites may be single or multiple, with either concentric linear cuts or jagged edges (18).

Although the majority of shark bites result in relatively minor injuries, more severe attacks may cause deep lacerations with extensive soft tissue loss and massive hemorrhage (23). The most severe cases may result in limb loss and death, which is usually due to exsanguination (24).

Moray eels (family Muraenidae) are snake-like bottom dwellers that live in holes and crevices of rock and coral formations (Fig. 6). They are found in tropical, semitropical and some temperate waters, and may grow to a length of 15 feet (20). Moray eels have sharp teeth and muscular jaws, and a well-deserved reputation for biting viciously when provoked. Their bites can produce deep puncture wounds, lacerations or crush injuries (25). Because various pathogenic bacteria including *Vibrio* and *Pseudomonas* species colonize their teeth, puncture wounds due to moray eel bites are especially prone to closed space infections (8,25). Morays often hang on to their victims



**Fig. 6.** Moray eels like to conceal themselves among the crevices and holes of rock and coral formations. (photograph courtesy of Marty Gilman, Worcester, MA.)

with bulldog-like tenacity, so that it may be necessary to disarticulate the jaw or decapitate the animal in order to cause it to release its grip (18,20,25). Most traumatic encounters with moray eels occur when they are cornered or provoked by divers. Fish fanciers who keep moray eels as pets may suffer bites when feeding their eels or cleaning their tanks (25).

## Prevention of nonvenomous fish injuries

Prevention of nonvenomous fish injuries requires common sense, a few precautionary measures and a small degree of luck. Fishermen can avoid most spinous injuries and fish bites by carefully handling the fish they catch. A heavy leather glove or fish mit and a pair of pliers are preferable to bare hands in most cases. Larger fish, especially wahoo, barracuda and billfish, should be completely subdued before any attempt is made at removing a fishhook or displaying the fish for picture taking.

Not much is known about the prevention of garfish or needlefish injuries. It would seem prudent to avoid fishing at night with artificial lights in areas where these fish are common. It is unlikely however, that this advice can be followed by those fishermen who are dependent on this mode of fishing for their livelihood. Since these fish do not leap more than several feet out of the water, fishing from larger boats may offer some protection (26). Those who face this occupational hazard might consider wearing a life jacket, vest or jacket made of penetration-resistant materials as well as shatter resistant eye protection (26).

In order to reduce the risk of barracuda attack, swimmers and divers should avoid wearing jewelry or brightly colored objects that may attract these predators (21). Barracuda have also been known to strike at a hooked or speared fish, so fishermen and divers should handle their catches with care, especially when barracuda are around (18).

Although there is no completely effective method for preventing a shark attack, there are a number of rules, which if followed, may reduce the chances of being bitten by a shark (18). Swimmers, surfers and divers should avoid waters where sharks are known to be dangerous, and should never swim alone (21). They should also not swim in murky waters, at dusk or at night (18,21). They should stay out of waters contaminated with sewage or garbage as well as areas

where sport or commercial fishermen are operating, especially if there are signs of bait fish or feeding activity (22). Blood in the water is known to attract sharks, so never enter the water with a bleeding wound or while menstruating.

Spearfishing is an activity that in addition to leaving a blood trail in the water may also attract sharks because of the vibrations produced by fish struggling on the end of the spear. Spearfishermen should boat their fish immediately and never tie dead fish to themselves (18,21). Avoid splashing in the water or swimming with pets whose erratic movements in the water may also attract sharks (22). Remember that sharks, like barracudas, are attracted to bright shiny objects and contrasting colors; so avoid wearing or carrying these items (18,21).

## Treatment of nonvenomous fish injuries

Treatment of nonvenomous fish injuries depends on the type and size of the wound and the risk or presence of secondary complications such as infection or foreign body reaction. Very superficial puncture wounds and lacerations should be thoroughly cleansed and dressed, and carefully watched for signs of infection. Prophylactic antibiotics are not usually required for superficial wounds in a normal host (25).

Victims of more severe injuries should be stabilized with first aid measures designed to prevent shock. Direct pressure should be used to control bleeding. Deeper puncture wounds and penetrating wounds should be cleansed, irrigated and surgically explored to determine the depth and extent of damage to underlying structures. Imaging studies should be done prior to exploratory surgery to determine the presence of foreign bodies such as needlefish bills (10). Arteriography may be necessary to determine the extent of vascular injuries, while arthroscopy has proved useful with wounds involving articular spaces (10,11). Once injury to deeper structures has been ruled out or repaired and devitalized tissues debrided from the wound edge, lacerations may be approximated by sutures and or steri strips as long as there is room left for drainage.

Prophylactic antibiotics should be considered in the case of deep puncture wounds or large lacerations, and in cases where there has been a retained foreign body (25,27).

Antibiotic therapy for infections arising in saltwater wounds should include coverage against *Vibrio* species (10). Prior to the results of definitive wound cultures, choices of recommended initial parenteral antibiotics include IV ciprofloxacin, imipenem-cilastatin, cefoperazone, cefotaxime, ceftazidime, gentamicin, tobramycin, chloramphenicol or trimethoprim-sulfamethoxazole (10,27). Outpatient oral antibiotic choices include ciprofloxacin, trimethoprim-sulfamethoxazole and doxycycline (10,27). In the case of wounds acquired in freshwater, antibiotic therapy should include coverage of *Aeromonas* species (10). Tetanus prophylaxis should be administered.

In cases of severe shark or barracuda attacks, the victim must first be rescued from the water, since fatalities may result from panic and drowning in addition to hemorrhage (18). If bleeding from a massive extremity wound or traumatic amputation cannot be stopped by direct pressure and there is a risk of exsanguination, it may be necessary to apply a tourniquet or attempt to ligate or clamp the bleeding vessel. In making this decision the first aid responder should realize that these procedures may save a life but may sacrifice a limb (18). As soon as the victim is stabilized he or she should be transported immediately for advanced medical services.

## Injuries due to venomous fish spines (ichthyocanthotoxicoses)

The severity of the injury from a venomous fish spine depends primarily on the species of fish involved. Stingrays, catfish, scorpionfish, and weeverfish are some of the most noteworthy species. Typically the spines from these fish produce puncture wounds or lacerations that are characterized by immediate pain that is often out of proportion to the apparent severity of the wound. They also produce varying degrees of soft tissue reaction that may begin with erythema and edema and progress to frank necrosis in more severe envenomations. Finally there may be associated systemic reactions, which in the worst cases can be fatal.

### Stingrays

Stingrays are one of the most widespread causes of fish spine envenomation with between 1500 and 2000 stings reported annually in the United

States (14,28). Stingrays are found throughout the world in both salt- and freshwater habitats in temperatures ranging from tropical to temperate. They are often seen on the bottom of shallow waters and may be partially buried under sand or mud. Their bodies are shaped like flexible flying wings with a long tail protruding from the back. Stingrays propel themselves through the water by making undulating movements with their wing-tips. Stingrays are divided into four groups (Gymnurid, Myliobatid, Dasyatid, and Urolophid) based on the size and location of their stinging appendage (14).

The venom apparatus of stingrays is composed of a retroserrated spine located on the tail of the animal. The spine is covered with venom glands that are enclosed in an integumentary sheath. When threatened or stepped on, stingrays reflexively whip their tails up, usually causing a puncture wound or laceration to the dorsum of the foot, ankle or lower leg. As the spine enters the victim, the integumentary sheath is torn allowing the venom to enter the wound. The pain from stingray wounds is sharp, immediate and intense. Within several hours to days, the wound may appear cellulitic. This may be due either to direct tissue necrotic effects of the toxin or secondary infection. Because the teeth are retroserrated, there can be considerable tissue trauma as it is pulled back out of the victim by the ray. In many cases a portion of the spine may break off and remain in the wound. Even if there is no retained spine, portions of the integumentary sheath may be left in the wound that can cause foreign body reactions and secondary infections. Generalized symptoms from stingray envenomations may develop including hypotension, diaphoresis, vomiting, diarrhea, generalized edema (with truncal wounds), tachycardia, bradycardia, muscular paralysis, and seizures (14,27,28).

The severity of a stingray wound depends on the size and species of ray involved. The most dangerous rays are members of the dasyatid group, also known as the true stingrays, which have the largest spines located further out on their tails (29). The majority of stingray injuries occur when waders or bathers step on these creatures in shallow water. Scuba divers and snorkelers may be at risk during stingray feeding sessions at popular dive sites (Fig. 7). There have also been cases where fishermen are stung trying to remove a ray from a fishing line. Long-line tuna fishermen may be injured when large stingrays are accidentally hooked and brought aboard their boats (30).



**Fig. 7. The author of this section is seen enjoying a dive at Stingray City off the coast of Cancun, Mexico.**

In rare cases deaths have occurred when stingray spines have penetrated the thoracic or abdominal cavity of the victim (31).

### Catfish

Catfish are a common cause of toxic fish spine injuries. Both fresh- and saltwater species may cause these wounds. Catfish are armed with a total of three sharp venomous spines located just in front of their dorsal and pectoral fins. The majority of these injuries occur when careless fishermen handle these fish, but they also pose a risk to seafood processors and occasionally to waders and bathers (32,33). Although most catfish envenomations resolve without complications, they do produce extremely painful wounds that can become secondarily infected. In rare cases severe tissue necrosis may occur, which in one report required amputation of the affected digit (32). One species of catfish, *Plotosus lineatus* is one of the world's most dangerous fish, whose sting may be fatal (34). It is found throughout the waters of Japan, the Philippines, Southeast Asia, eastern Africa, and Australia (35).

### Scorpionfish

Scorpionfish (family Scorpaenidae) are comprised of three main groups: the lionfish (genus *Pterois*), scorpionfish (genus *Scorpaena*) and stonefish (genus *Synanceja*). The divisions are based primarily on the basis of location of their stinging structures.

*Lionfish.* Lionfish are found in tropical waters and are highly sought by fish fanciers because of

their beautiful ornate spines. Their stings are the mildest of the group and are rarely life-threatening (36). Many of the stings reported due to lionfish occur when amateur fish collectors clean their tanks or attempt to feed their fish (36).

*Scorpionfish.* Scorpionfish are bottom-dwellers that are well-camouflaged and able to blend in with surroundings (Fig. 8). They are found in waters ranging from the intertidal zone to depths of up to 50 fathoms or more (14). Their stings are more severe than lionfish, but less severe than stonefish.

*Stonefish.* Stonefish are the most venomous and dangerous fish in the scorpionfish family. They present the greatest risk to swimmers and bathers who may accidentally step on these fish, which often are found half-buried in the mud on the seafloor in shallow coastal waters. Stonefish have highly developed venom glands, which line the distal portion of their 13 dorsal spines (37). In addition to causing severe pain and tissue necrosis, stonefish envenomations are associated with significant systemic reactions. These may include nausea, vomiting, local lymphangitis and lymphadenitis, joint aches, fever, hypotension, myocardial ischemia, cardiac failure, delirium, convulsions, respiratory distress and death (38).

### Weeverfish

In European coastal waters the weeverfish (*Trachinus* spp.) is greatly feared. Weeverfish



**Fig. 8. A scorpionfish (*Scorpaena plumieri*) resting on the sandy bottom off the coast of Bonaire. (photograph courtesy of Marty Gilman, Worcester, MA.)**



are found in shallow temperate waters with sandy or muddy bottoms. They frequently lie buried with only a portion of their heads exposed. They are armed with 5–8 dorsal and two opercular spines (one on each side of their head) (39). Weeverfish have well-developed venom glands and can produce excruciatingly painful stings (40). As with scorpionfish, the majority of weeverfish stings are inflicted on the lower extremities of bathers who are unfortunate enough to step on these fish. Fishermen may be stung while removing these fish from nets (41). In some cases these fish may become aggressive and lunge at a bather or diver employing the spines on their gill covers to land a sting (41).

In addition to erythema and edema, local signs of weeverfish stings may include ecchymoses, and occasionally regional lymphangitis and lymphadenitis, and one report of Raynaud's phenomenon (39,42). Systemic symptoms can accompany an envenomation and may include headache, nausea, vomiting, sweating, syncope, hypotension and respiratory depression (39,41). Deaths from weeverfish stings are extremely rare, and when they occur they have been attributed to respiratory failure (43).

### **Prevention of venomous fish spine injuries**

Prevention of venomous fish spine injuries requires a knowledge of which of these fish are likely to be found in a particular marine environment as well as some understanding of their habits and behavior. Most stingray envenomations can be avoided if bathers would shuffle their feet as they walk in the water. This action gives a warning to the ray and allows it to move out of the way. This approach may also decrease the chances of stings from other bottom-dwellers such as scorpionfish, stonefish and weeverfish. Cut-resistant protective reef boots may also afford some protection from these fish. In the case of catfish, protective mitts, fish-handling devices and a pair of pliers may help prevent a painful sting when removing these fish from a fishhook. Fishermen should avoid handling extremely dangerous species of venomous fish whenever possible. In many cases it makes more sense to simply cut the line or net than to risk a severe envenomation.

### **Treatment of stings from venomous fish spines**

The initial treatment of stings from venomous fish spines should be aimed at making sure the victim is stable and at reducing pain. Soaks in hot water (110–115°F) should be applied as soon as possible, as they often give significant pain relief. The temperature of the water should be tested by the caregiver to avoid a scald. This is necessary because the wounded area may be partially anesthetic, and the victim may be in too much pain to accurately judge for him or herself. Hyperthermic soak should be continued for 30–90 min or until the pain subsides (27). Local injection of the wound and the surrounding area with 1 or 2% lidocaine without epinephrine may also ease the pain and allow for vigorous cleansing, exploration and debridement of the wound (27,31).

The surgical approach to these wounds is consistent with the steps outlined earlier in the section dealing with deep nonvenomous puncture wounds and lacerations. Radiographs are highly indicated prior to surgical exploration in cases of stingray envenomations, because there is a high likelihood that a portion of the spine may be retained in the wound (Fig. 9).

The decision to suture a laceration from a stingray wound will depend on the size and location of the wound and other complicating factors. In many cases it is preferable to approximate the wound edges by tape stripping or loose suturing to allow for adequate drainage and to minimize the chance of infection or abscess formation. Tetanus prophylaxis should be administered if immunization status is not up to date. Antibiotic prophylaxis should be considered along the same lines as described previously for deep nonvenomous puncture wounds complicated by a foreign body.

In cases of severe stonefish envenomation it may be necessary to provide supportive care for systemic symptoms. The administration of antivenom should be considered, as it can also give prolonged and effective relief from the pain of these stings (44). The antivenom is available from the Australian Commonwealth Serum Laboratory in Melbourne and is supplied in 1.2 mL ampules (37). The schedule for administration is 1, 2 or 3 ampules intramuscularly for 1, 3 or more than 4 puncture wounds, respectively (37). Possible complications of administering antivenom can include immediate reactions and serum sickness.



**Fig. 9.** (A) A young woman returned to her home in Worcester, MA after a beach trip to the South Carolina Coast. She remembered a painful sting to her foot that occurred while she was in the water. The pain appeared to resolve without further sequelae, but several days later she presented to the emergency room with pain and swelling of the distal right foot. A presumptive diagnosis of cellulitis was made, but because of the history of a marine exposure, the author was consulted. (A possible entry wound can be seen on the lateral aspect of the 1st metatarsal head.) (B). This consultant suggested the possibility of a stingray envenomation and a radiograph of the foot was recommended. The stingray spine can be clearly visualized between the base of the 1st and 2nd metatarsal heads in the X-ray. (C). A surgical consult was obtained, and the wound was explored in the operating room. The tip of the forceps is directly under the spine in this picture. (D). The spine was removed and the wound was irrigated and cleaned. The spine measured approximately 2 cm in length.

Patients receiving antivenom should be premedicated with antihistamines, and epinephrine should be immediately available.

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