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Bone alterations caused by a sting ray spine in the vertebra of *Sotalia guianensis* (Cetacea, Delphinidae)

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Several cases of interactions between dolphins and sting rays (*e.g.*, *Mylobatis*, *Dasyatis*) are mentioned in the literature and usually involve species such as coastal killer whales, *Orcinus orca* (Castello 1977, Visser 1999, Duignan *et al*. 2000) and bottlenose dolphins, *Tursiops truncatus* and *T. aduncus* (McLellan *et al*. 1996, McFee *et al*. 1997, Walsh *et al*. 1988, Spanier *et al*. 2000). Most of these refer to serious wounds caused by serrated and poisonous spines from the base of the sting ray's tail and these wounds are usually stated as being the cause of the cetacean's death. However, because most of the spines are discovered during the necropsies of beached animals, it is difficult to establish if the cause of death is due to penetration of the sting ray spine into vital organs, the action of toxins or bacterial infection. Reports of ray spines that penetrate the bones of cetaceans are rare, and include vertebral trauma in a common dolphin, *Delphinus delphis* (Gallo-Reynoso and Aguilar 1989) and scapular trauma in a bottlenose dolphin (McFee *et al*. 1997).

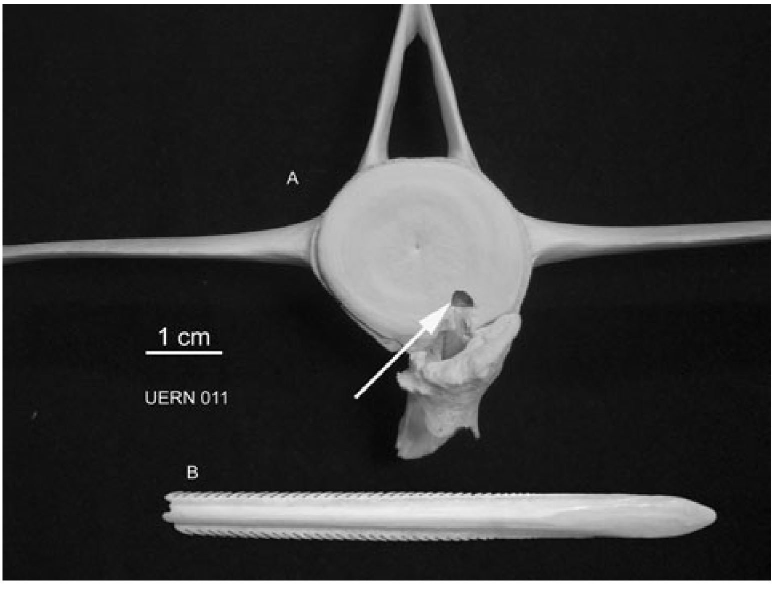

Figure 1. (A) General view of the affected vertebra with a fistula in the caudal epiphysis (arrow) and (B) fractured spine.

The case presented here is the first register of serious vertebral injury caused by a sting ray spine in the Guiana dolphin, *Sotalia guianensis*. The carcass of a female measuring 170 cm in length was recovered on 19 October 2006 from the beach at Galinhos (5°05′35″S, 36°16′29″W) on the northeast coast of Brazil, and deposited in the mammal collection of the Universiade do Estado do Rio Grande do Norte (UERN 011). The spine was discovered after skeletal preparation.

The sting ray spine, measuring 80.4 mm in length, was found imbedded in the vertebral body of the seventh lumbar vertebra (L_7). The tip of the spine perforated approximately 8 mm of the ventral portion of the vertebral body near the caudal epiphysis. The fractured spine tip (20.6 mm) remained imbedded in the vertebra. This possibly triggered an initial destruction of the vertebral body, generating a fistula in the caudal epiphysis to drain the purulent matter. Several other small draining tracts were observed in the ventral region of the vertebral body (Fig. 1). New bone formation was also found, generating a tubular bone capsule (length = 31.3 mm, width = 13.9 mm), which enveloped both the fractured spine tip and the veins of the *aorta descendens* (see Kastelein *et al*. 1997) as well as the nerve branches of the spinal nerves (Fig. 2).

The course of the spine to L_7 is unknown. However two hypotheses were proposed. The first considers that the sting ray was ingested and the spine pierced the small intestine wall, penetrating the base of the vertebra. A second hypothesis has the animal suffering a wound in the ventral region of the body and the spine penetrating the front of the genital opening, puncturing the *Musculis abdominis cutaneous trunci*, portions of the intestine and genital apparatus, and finally reaching the *Musculi hypaxialis lumborum* and the base of the vertebra.

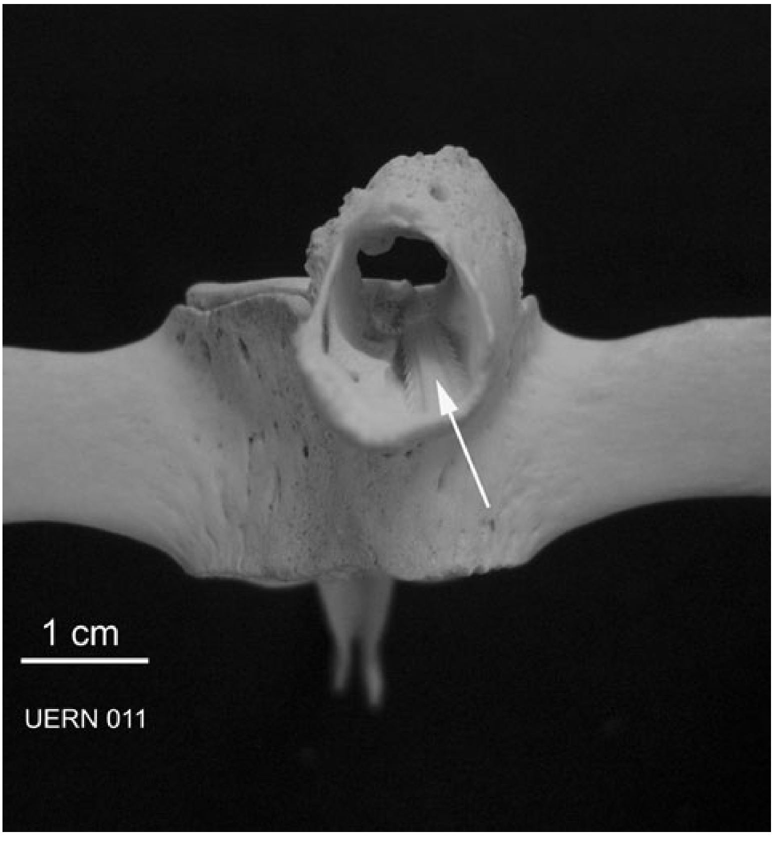

Figure 2. Detailed view of the tubular capsule with the tip of the spine (arrow) in ventral portion of the vertebral body.

The collected fragment corresponds to nearly half of the whole spine. This inference is based on the morphological pattern of lateral serrations in the studied fragment, which have homogeneous size and do not show any tendency toward increasing or decreasing size, as it usually does at the distal third and at the base of sting ray spines. Therefore, this indicates that it was broken proximally relative to the distal third and distally relative to the base. After comparing with complete spines, we estimate that the original length of the specimen would vary between 160 and 180 mm. The spine has seven lateral serrations per centimeter, totaling 35–37 in each margin. This character coupled with the estimated size allows us to assign the studied specimen to *Dasyatis* (Dasyatidae). In the northeast region of Brazil sting rays of the genera *Dasyatis* are common, but we could not determine the species in question in the present study.

McFee *et al*. (1997) suggest that the combined effect of the mechanical trauma of the spine and the physiological responses to the venom resulted in localized periosteal edema, which was responsible for bone necrosis in the scapula of *T. truncatus.* These authors consider that the injury must have occurred at the beginning of the dolphin's life, during bone development, and therefore, was not the cause of death. In the present case, the alterations were much more damaging, as described above, but there is no evidence that the resulting inflammatory response was associated with the animal death.

The only other case of vertebral trauma caused by a sting ray spine was reported by Gallo-Reynoso and Aguilar (1989), where the spine perforated a lumbar vertebra (L_{16}) of *D. delphis*. In this case, the spine punctured the epaxial muscle on the dorsal surface of the dolphin and migrated until perforating around 10 mm of the bone. In this sense, the two cases of vertebral trauma caused by a sting ray spine differ as to the origin of the spine, but the consequences were very similar.

Foraging for benthic prey and the ingestion of sting rays from the family Dasyatidae seems to be the most common explanation for the origin of sting ray spines found in dolphin carcasses (Walsh *et al*. 1988, Duignan *et al*. 2000, Spanier *et al*. 2000). The ingestion of a sting ray and subsequent perforation of the intestine by the spine is the most likely hypothesis for the case of the female estuarine dolphin described here, since this would imply a shorter trajectory and perpendicular penetration of the spine in the vertebral body. However, there is evidence of spine migration through cetacean bodies (Walsh *et al*. 1988, McLellan *et al*. 1996, Spanier *et al*. 2000) and this occurs due to muscle action against the backward-facing serration of the spine, but there is no evidence of passage through the abdominal cavity. In this sense, the second hypothesis, which considers a wound in the ventral region caused by a defensive reaction on the part of the prey, is less likely. It is also possible that the spine migrated subcutaneously and then *via* fascial planes without breaching the abdominal cavity but it was impossible to verify this possibility during necropsy.

Recently, Rossi-Santos and Wedekin (2006) presented evidence of benthic foraging in *S. guianensis*, though nothing is known about predation on sting rays (Santos *et al*. 2002, Di Beneditto and Siciliano 2007). This could explain the accident with an alien or uncommon prey as reported here, and highlights the need to improve investigations on food ecology of the species.

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