

CASE REPORT

Crocodile Bite, A Toil And Snare Of Its Own Complexity – A Single Deep Bite With Multiple Rippling Impacts: A Case Report

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ABSTRACT

Crocodiles are ferocious creatures of the tropics. In East Malaysia, a total of 205 crocodile attacks were reported in 20 years. Most of these attacks occur in Sarawak (between 135 to 164 cases) and Sabah (70 cases) per annum (1). Though different species were found, reports have a common factor, attack on humans had led to significant morbidity and mortality. Crocodiles' bite causes fatal and non-fatal injuries. Once they lock their jaw, it is kept locked as its mouth-opening muscles are weaker. Another mechanism of destruction of the crocodile bite is the death roll – a rotating manoeuvre with the aim of dismembering their prey (2). The sheer force of this mechanism allows them to subdue victims larger than its own size. This case reports a victim of a crocodile attack leaving significant debilitation from its single bite. This paper also explores into understanding these creatures in its existence. A bite from the crocodiles leads to detrimental injuries especially to the extremities, giving the Orthopaedic Department a challenge to handle. Injuries from a crocodile bite has been recorded to range from extensive tissue damage, vascular injuries, fractures and even amputations (3). Once the injuries are dealt with, another obstacle to overcome is the severe bacterial infection that comes after the bite. Many bacterial species are found in the oral cavity of a crocodile, and most are polymicrobial with resistance to the common antibiotics used (4). We report our approach and management of this complex crocodile bite.

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INTRODUCTION

The tropical country of Malaysia is located in Southeast Asia, consisting of the Peninsula and parts of the Bornean Island – Sabah and Sarawak. The Bornean states are ecologically rich in rivers and estuaries which houses these apex predator – the crocodiles. In Sabah, its jurisdiction falls under the Wildlife Conservation Enactment and is under Appendix II of CITES, the Convention on International Trade in Endangered Species of Wild Flora and Fauna making the Sabahan crocodiles an endangered species and are threatened with extinction if its trade is not closely monitored (5). Due to this, wild crocodiles are protected species in Sabah and its hunting and egg and offsprings hunting activities are banned – a factor contributing to its increased in populations and sightings throughout the years. Only licensed establishments are allowed to trade crocodile meat.

Crocodile sightings in Sabah can be dated back to the 1990s, having sighting one in the Likas area, close to the city centre. According to the University Malaysia Sabah's Institute for Tropical Biology and Conservation, a nest was also once found in a residential area (1). The increase of its population is proven by the systematic crocodile survey done every 20 years since 1984. In 1984, the number of crocodiles were found to be 0.2 animals per kilometre which increased in tenfold in 2000, amounting to 2.2 animals per kilometre (6). There are 23 species of crocodiles worldwide and in the waters of Sabah, watch out for the *Crocodylus porosus*, *Crocodylus ranius* (also known as the Borneo Crocodile), *Crocodylus siamensis* and the Malayan gharials (7).

Unlike other Western countries, Malaysia only houses the crocodiles, and no alligators are found in the wild. Crocodiles are known to be less tolerant to colder climate while the alligators can tolerate lower temperatures and higher altitude. There are marked differences between the two reptiles. Crocodiles belong to the *Crocodylidae* family, and the alligators are from the *Alligatoridae* family. Their anatomic features are different – crocodiles have a narrower, v-shaped snout while the alligators have a broad, u-shaped snout. This is more obvious if viewed from the lateral aspect, where the crocodiles have 4 mandibular teeth exposed when their mouth is closed, and the alligators have none visible (8).

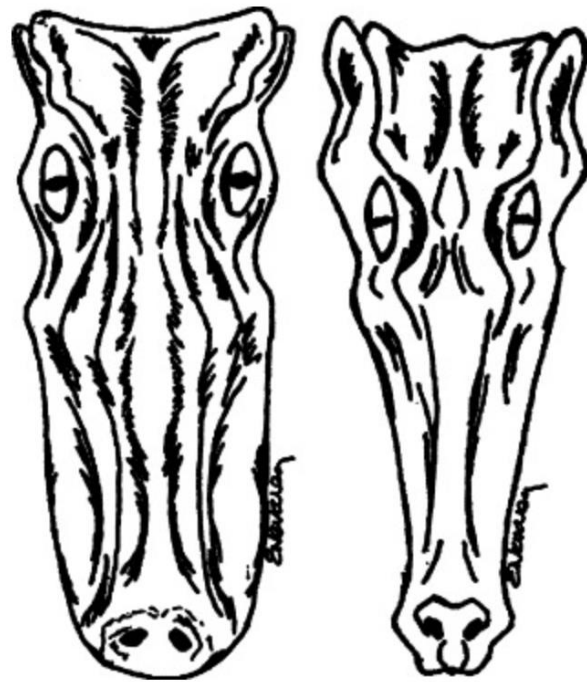


Diagram 1: Differences in snouts of crocodiles (right) and alligators (left).

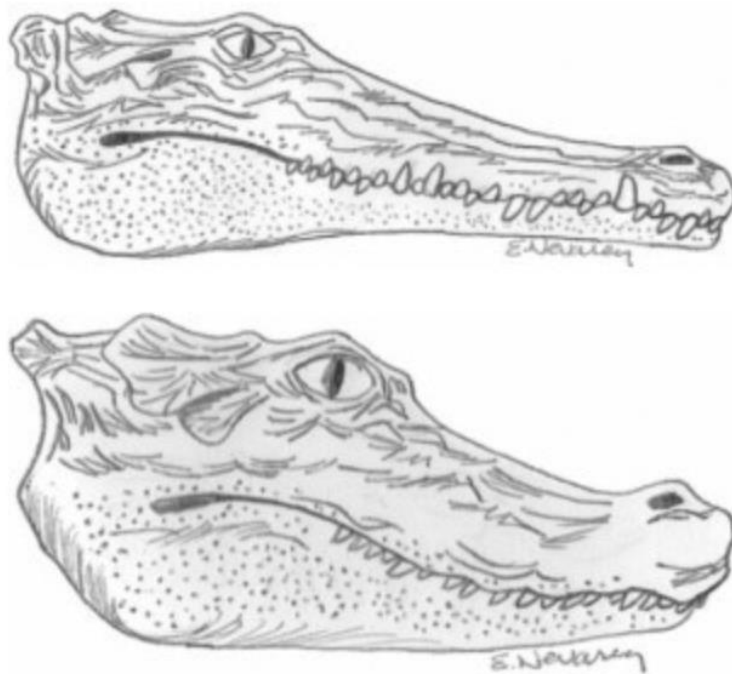


Diagram 2: Visibility of the mandibular teeth between crocodiles (top) and alligators (bottom).

The most common species in Sabah is the *Crocodylus porosus*, also known as the saltwater crocodile or in the native tongue, “Buaya Tembaga” (7). Do not be fooled by the moniker as the *Crocodylus porosus* can live and breed in both saltwater and freshwater. It is also known as the biggest crocodile species in the world, and the most aggressive.

It is reported that 205 cases of crocodile attacks in Borneo occurring between 2001 to 2020, out of which 70 cases were from Sabah. Out of the 70 cases, 52 cases were fatal and the remaining 18 cases were non-fatal but left with significant injuries (1). Comparatively, in its neighbouring state Sarawak, a whopping of 135 cases of crocodile attacks were recorded in which 83 of the cases has led to death (1). This indicates that the human-crocodile conflict is more severe in Sarawak as compared to Sabah. Another study reported 164 cases of crocodile attacks in Sarawak alone (9). This may be contributed by the higher number of crocodiles inhabiting its vast and long river ecosystem. The size of the Sarawak state is also comparatively bigger than Sabah.

It is found that the district with the highest number of cases is Lahad Datu, followed by Kinabatangan, Sandakan and Tawau. These districts are known to have extensive wetland ecosystem, accounting for most of the mangrove areas in Sabah. The mangrove provides suitable vegetation over the riverbanks for crocodile nesting and with the day-to-day lives of Sabahans revolving around their rivers, crocodile attacks are almost unavoidable. Beluran, Kota Marudu, Kudat, Kota Belud, Tuaran and Beaufort reported between 1 to 5 cases whereas the districts of Kuala Penyu, Pitas and Papar have little cases (6).

Here we present a case of crocodile attack occurred in Banggi Island of the Kudat district.

CASE

Mrs S, a 65-year-old lady was bathing along the riverbanks of Banggi Island when a crocodile snared and bitten her. The reptile reported to have bitten her left lower limb and again over the left upper limb. She recalled almost being pulled into the river by the crocodile if it weren't for the villagers coming to the rescue.

Mrs S had sustained:

1. Open fracture of left medial plateau
2. Left knee dislocation (rotational type) with multiligamentous injury
3. Degloving wound over the left thigh communicating to the knee joint
4. Multiple laceration wounds over left lower limb
5. Open fracture left distal end radius
6. Open fracture left 1st metacarpal bone with extensor pollicis longus tear.
7. She was first brought to Hospital Kudat, a district hospital before being referred to our centre.



Image 1: Degloving wound over left medial thigh



Image 2: Left tibia fibula x-ray AP & lateral view



Image 3: Left radius ulnar x-ray AP view

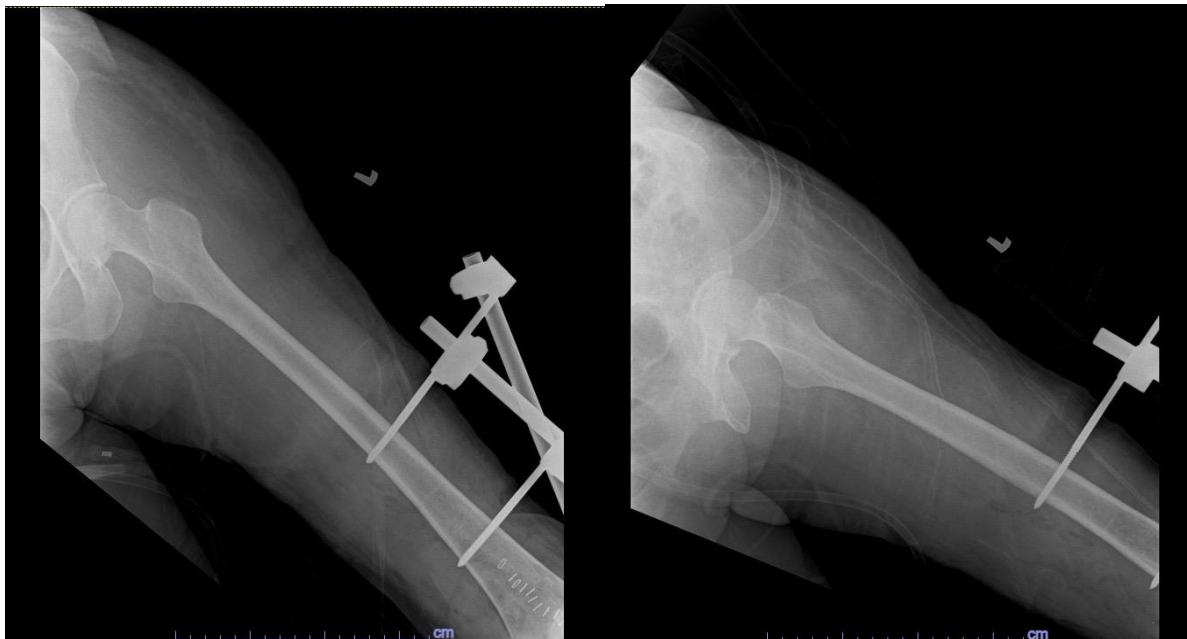
Mrs S has undergone wound debridement, extensor pollicis longus repair, k-wiring of left distal end radius, k-wiring of left 1st metacarpal bone, wound debridement of left proximal medial thigh, wound debridement of laceration wounds over left lower limb, arthrotomy washout of left knee and cross knee external fixation. Wounds over left lower limb were severely contaminated. Fortunately, there were no vascular compromise.



Image 4: Pre-operative picture of left lower limb



Image 5: Intraoperative picture of left upper limb



Picture 6: Post operative x-ray of left femur in AP & lateral view



Picture 7: Post operative x-ray of left knee in AP & lateral view



Picture 8: Post operative x-ray of left tibia fibula in AP & lateral view



Picture 9: Post operative x-ray of left wrist

The patient then again went for 2 other procedures – second look wound debridement of left lower limb and arthrotomy washout of left knee in view of presence of persistent pus discharge. Pus culture and sensitivity grew multi-drug resistant ESBL *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* infection. Patient was referred to our infectious disease unit in which she was started on IV meropenem 2g STAT and 1g TDS for a total of 15 days and de-escalated to IV tazosin 4.5g QID completed for a total of 4 weeks.



Picture 10: Post removal of external fixation left knee x-ray



Picture 11: Post removal of k-wires left wrist

During her stay in our Orthopaedics Ward, we have teamed up with the Wound Care Team and Physiotherapy Unit to ensure rehabilitation for Mrs. S. With the ongoing intravenous antibiotic treatment and the stellar work from the Wound Care Team, Mrs. S's wound grew healthy granulation tissue and on day of discharge, the cross knee external fixator was removed. Patient was discharged well, after almost 2 months of treatment.

DISCUSSION

The conflict between mankind and animals have long been a worldwide issue leading to various morbidity and mortality. In Sabah, the human-crocodile conflict can be attributed to various factors.

Many of the villages in Sabah are found by the riverside and they are heavily dependent on these rivers as their only water source for everyday life. These parts of the waters are also the natural habitats of our crocodilians. One of the reported reasons of increasing number of attacks is the rising number of the crocodile population. While the case in Sabah is comparatively lower than its Bornean state counterpart, from the study done by Ruslan et. al., we can see the rising trend of crocodile attacks after the year 2007 (10). This can be explained by the recovery in the number of wild crocodiles after the enactment of state-wide protection of the reptile initiated in 1982. Based on the Sabah Wildlife Department, there are an estimation of 13,000 – 15,000 crocodiles in the wild in 2010 (6). With increase in number of crocodiles, there is a linear increase in the beasts' attack against mankind. Another hypothesis is the widespread of African Swine Fever affecting the population of the Bornean bearded boar, which is one of the most important food sources of the crocodiles (10). With its decline, the crocodiles have no choice but to look elsewhere for food.

A crocodile's bite is said to be one of the strongest in the world. One bite exerts pressure up to 16,000 Newton force and in comparison, human bite exerts pressure up to 500 Newton force only (11). It's no wonder a crocodile attack can lead to multiple severe injuries, especially to the limbs of humans. Another study also concluded that the bite force of the crocodiles relies heavily on the size of the crocodiles. Larger, mature crocodiles have stronger bite force and Sabah has abundant of the *Crocodylus porosus*, one of the largest crocodiles known to mankind. Other than its strong bite, the crocodile breaks apart large preys into chunks as the animal does not chew. This mechanism is known as the 'death roll' and attributes greatly to severe injuries if not, death of its prey (12).

Other than the bony injuries sustained by the victims, the highly contaminated wound poses serious morbidity and a challenge in treatment. Much like our patient with multi-drug resistant ESBL *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* infection, a study in Ethiopia where crocodile attacks are rampant in its southern parts found that a polymicrobial infection with multi-drug resistant bacteria worsens the outcome of wound healing following a crocodile bite. In the study, it is found that 72.7% of the

wounds are culture-positive, more than half found to be aerobic bacteria. Out of the 21 bacterial isolates, 85.7% are multi-drug resistant organisms and 55.6% of them are gram-negative (13). This shines light to the multi-bacterial colony found in the oral cavity of the crocodiles.

CONCLUSION

Crocodile attacks are increasing in Sabah, Malaysia. While they are endangered and protected species, there is no denying the serious injuries it imposes when attacking human beings. Many are living with the morbidity it brings, and numbers are expecting to rise. A state-wide awareness is important in ensuring the safety of the people of Sabah from these deadly creatures.

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