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CASE REPORT

MANAGEMENT OF MAXILLOFACIAL TRAUMA FROM BEAR MAULING: CASE SERIES

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ABSTRACT

Background: The head, neck, and particularly the face are the most prominent and vulnerable parts of the human body. Consequently, these regions are often the primary targets in various types of attacks. In wildlife-related incidents, bear attacks account for a significant proportion and frequently involve the craniofacial region. Managing injuries in these areas, especially when both soft and hard tissues are affected, presents substantial clinical challenges. This case series highlights three instances of bear attacks reported to our institution and outlines the surgical interventions used.

Methods:A retrospective analysis was conducted on patients who sustained maxillofacial injuries due to bear attacks. Patients included in the study had presented to our department for treatment. Ethical clearance was acquired for conducting the study and informed consent was secured from all patients.

Results: All three cases presented with soft tissue injuries limited to the head and neck region. These injuries were treated with simple thorough debridement followed by primary closure. Bony injuries were treated using open reduction followed by internal fixation techniques. One patient experienced major soft tissue loss, and bony tissue loss was noted in two cases. Wound cultures revealed the presence of mixed microbial flora.

Conclusion: Prophylactic measures formed a key component of the treatment strategy. All patients received anti-tetanus prophylaxis and post-exposure rabies vaccination, which played a crucial role in improving treatment outcomes.

Keywords: Bear mauling, facial trauma, maxillofacial trauma, rabies prophylaxis, surgical management

1INTRODUCTION

The human head, neck, and facial region represent the epitome of physical identity and are central to our sensory experiences and social interactions [1]. Unfortunately, this prominence also makes these regions particularly vulnerable to various forms of traumatic injuries. Although animal attacks contribute to a relatively small percentage of trauma cases, their impact on victims can be severe and long-lasting[2]. Among such incidents, bear attacks are especially significant, accounting for a considerable proportion of reported wild animal encounters [3].

Bear attacks constitute approximately 51.2% of all

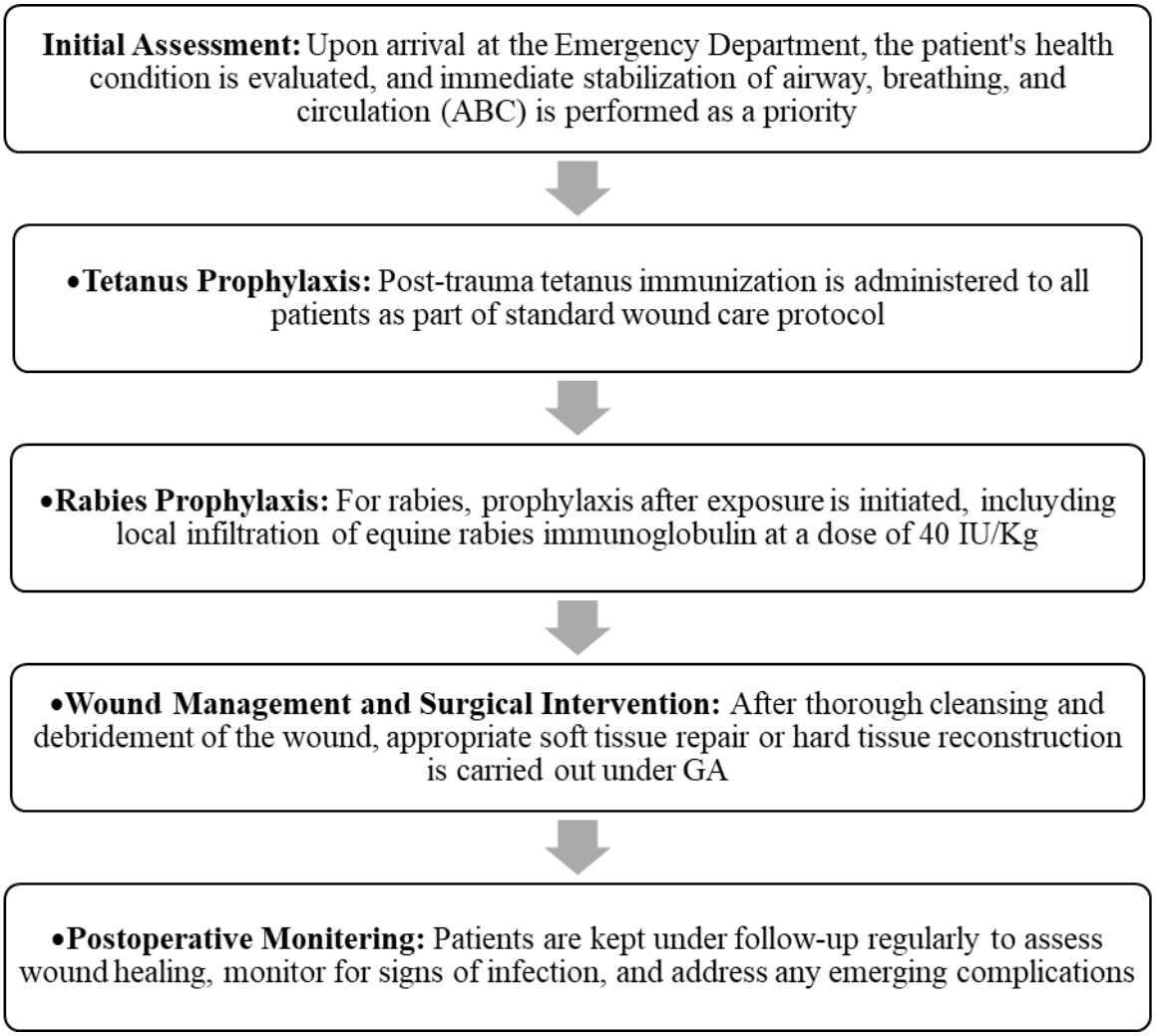
documented wild animal attacks and have drawn increasing attention from medical professionals due to the wide spectrum of injuries they cause [3,4]. All bear species are potentially dangerous, unpredictable, and capable of inflicting serious harm. These incidents are especially frequent in regions with dense bear populations. The Himalayan ranges, with their dense forests, serve as a natural habitat for bears and are consequently sites of common and recurrent human-bear conflicts. The bear's powerful five-digit paws, each equipped with long, non-retractable claws, can inflict injuries ranging from superficial lacerations to deep, mutilating trauma [5].

This study explores the clinical complexity of bear maul injuries, with particular emphasis on maxillofacial trauma. It presents a case series of patients treated in our department, examining the patterns of injury, methods of soft and hard tissue repair, and the surgical approaches used in their management.

MATERIALS AND METHODS

This case series aimed to assess all cases of craniofacial trauma which resulted from bear mauling incidents. All the patients who fit the inclusion criteria and treated in our institution were identified and the relevant data was collected from their medical records. Informed consent was obtained from all patients for the use of their clinical images in this case series.

Each case was carefully evaluated to determine the extent of both soft and hard tissue injuries. Assessments included documentation of tissue loss and any involvement of vital structures or organs. Special emphasis was placed on analysing the severity, anatomical location, and pattern of injuries to inform the selection of surgical and supportive interventions. The clinical workflow adopted for the management of these cases is illustrated in **Flowchart 1.**



Flowchart 1. Clinical Management Protocol for incidents of bear attacks

2.1 CASE SERIES

2.1.1 Case 1

A 48-year-old male presented with a history of a bear attack while working on his farm near Agumbe, Karnataka. The patient did not report any loss of consciousness, vomiting, or seizures. On clinical examination, gross facial asymmetry was observed, with tenderness noted over the right frontal bone, malar region, nasal area, and left preauricular region. Step deformities were palpable over the right frontal bone, infraorbital margin, and the depressed zygomatic arch area.

Multiple lacerated wounds were present on the face and scalp. Radiographic investigations revealed avulsed bony fragments due to a comminuted fracture of the right zygomaticomaxillary complex (ZMC). The diagnosis confirmed a right ZMC fracture involving the floor of the orbit, fracture of zygomatic arch, and fracture of nasal bone, along with associated injuries of soft tissue.

Initial management involved thorough wound debridement using normal saline, hydrogen peroxide, gentamicin, povidone-iodine (Betadine), and metronidazole (Metrogyl). Surgical intervention included reconstruction of the orbital floor using a 2 mm orbital mesh, fixation of the lateral wall, frontozygomatic (FZ) region, and supraorbital area with one 6-hole continuous plate and two 3-hole plates. Additional buttressing was achieved using a 5-hole L plate. The soft tissue wounds were closed primarily (Figure 1-8).

Figure 1. Pre-operative image

Figure 2. Pre-operative radiographic image

Figure 3. Intraoperative view (Left)

Figure 4. Intra-operative image (Right side)

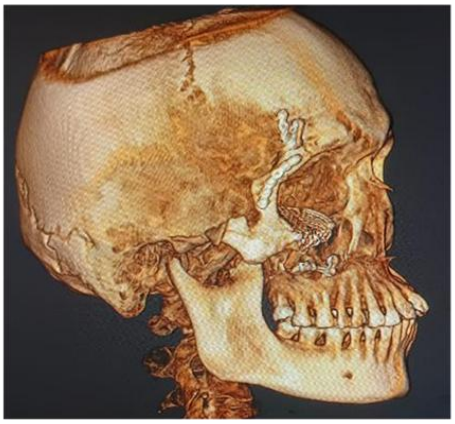


Figure 5. Post-operative radiographic image

Figure 6. Postoperative view

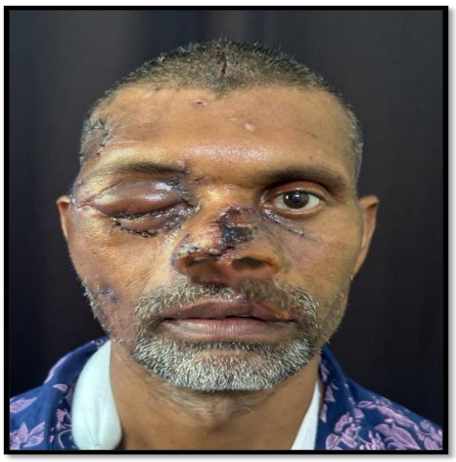


Figure 7. Follow-up (14 days)

Figure8. Follow-up after 1 month

2.1.2 Case 2

An 88-year-old male presented with traumatic facial injuries sustained during a bear attack near Shimoga, Karnataka. On examination, the patient exhibited gross facial asymmetry, multiple lacerated wounds, and a 6 × 5 cm open wound over the left malar region. Palpation revealed tenderness over the left frontal bone, malar area, and right mandibular angle. Step deformities were noted across multiple facial regions.

Treatment planning was further complicated by the patient's edentulous upper and lower jaws. A comprehensive evaluation revealed a complex injury pattern, including significant soft tissue loss, a left frontal bone comminuted fracture with involvement of the supraorbital rim, a left zygomaticomaxillary complex (ZMC) comminuted fracture including the zygomatic arch, and a right angle of the mandible displaced fracture.

Radiographic assessment showed avulsed bony fragments, highlighting the severity of the fractures. Surgical management of the right mandibular angle fracture was guided by orthopantomogram (OPG) imaging, and fixation was achieved using a 2 mm right-angled plate along with two 4-hole gap plates (Figure 9-17).

Figure 9. Pre-operative image (Frontal) **Figure 10.** Pre-operative image (Left)

Figure11. Preoperative view

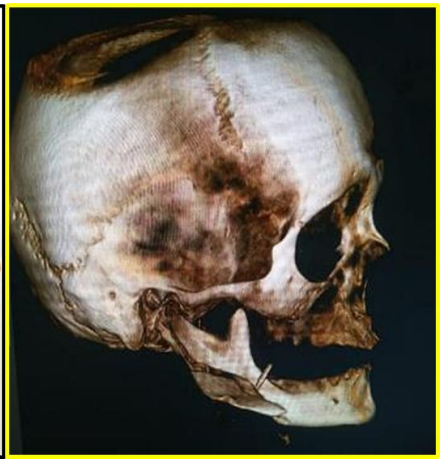


Figure 12. Preoperative radiograph

Figure 13. Intraoperative view

Figure 14. Postoperative radiograph

Figure 15. Postoperative view; **Figure 16**. Follow up14days **Figure 17.** Follow up 1 month)

2.1.3 Case 3

A 47-year-old male, previously operated for a zygomaticomaxillary complex (ZMC) and orbital wall fracture following a bear attack, presented with an exposed customized 3D implant. The patient had initially undergone extensive facial reconstruction at a private hospital, including orbital repositioning (relocation of the eyeball into the sinus), reconstruction of both upper and lower eyelids, and placement of a customized 3D implant.

Upon admission to our department, the patient complained of swelling along with pain over the right side of the face, localized to the area of the infected implant. A comprehensive treatment plan was initiated, including local and systemic antibiotics, followed by surgical management under general anaesthesia. Intraoperatively, the implant was found to be exposed in the right zygomatic arch and malar region, with associated oozing and complete ptosis of the right eye.

Given the extent of complications, a second reconstructive procedure was performed, where the exposed 3D implant was removed and the ZMC and orbital walls were reconstructed. Primary closure was done to manage the infection,

reduce pain and swelling, and restore both functional and aesthetic outcomes (Figure 18-25).

In all three cases, the outcomes were deemed satisfactory in terms of both function and appearance, based on assessments by the surgical team and patient feedback.

Figure 18. Immediately after the bear attack

Figure 19. Pre-operative image

Figure 20. Pre-operative Radiographic image

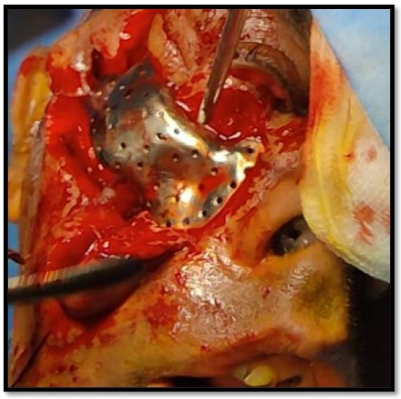


Figure 21. Intra-operative image

Figure 22. Postoperative view

Figure 23. Follow-up 14 days

Figure 24. Follow-up Lateral view 14days

Figure 25. Follow-up (month

DISCUSSION

The growing incidence of bear-human encounters is closely tied to habitat destruction due to deforestation, which forces wildlife to migrate toward populated areas in search of food sources [6]. This increased proximity elevates the likelihood of attacks, particularly among rural populations engaged in farming and manual labor which is an occupational pattern reflected in the patients presented in our case series.

Facial bite wounds caused by animal attacks, including bear maulings, are classified as complex injuries due to contamination with polymicrobial flora, commonly involving species such as Pasteurella. However, despite the inherent complexity of such wounds, the incidence of infection in facial wounds remains relatively low, owing to the region's rich vascular supply [4,7]. In our case series, all patients received prompt post-exposure prophylaxis (PEP), including anti-rabies treatment, and wounds were meticulously debrided using saline, hydrogen peroxide, gentamicin, povidone-iodine, and metronidazole. These measures proved effective in reducing infection rates and preventing rabies, consistent with previous reports that identified organisms like gram-negative aerobic bacilli, Enterococcus, and other anaerobes in similar injuries [8]. As such, broad-spectrum antibiotics remain a cornerstone in the treatment protocol for bear bite injuries.

Key factors influencing the prognosis of these injuries include bite location, timing of wound management, wound type, host immune response, and the quality of care given to the wound area[3,9]. In this case series, all patients presented with varying degrees of bony tissue loss, and one patient showed significant soft tissue loss. These were managed through a combination of debridement, primary closure, and, where necessary, open reduction and internal fixation.

Previous literature suggests that roughly 75% of soft tissue injuries sustained from bear attacks can be managed by primary closure, whereas about 25% require reconstructive interventions [10]. The choice of reconstructive technique ranging from local to regional flaps is guided by size and complexity of the defect. Rotational and other such local flaps, are sometimes used for smaller scalp wounds but are limited by reduced tissue mobility and vascularity. More reliable outcomes have been reported with regional flaps, including forehead flaps supported by cartilage grafts [10]. Huang et al [11], utilized grafts from conchal cartilage in non-anatomic positions, whereas Fell et al. [12] favored rib cartilage for more extensive reconstruction.

In cases with large tissue loss, free tissue transfer has become an important advancement. Techniques like anterolateral thigh (ALT), radial forearm free flap (RFFF), and fibula-free flap have been successfully employed in bear attack victims [10]. These flaps offer advantages in size, flexibility, and tissue thickness. RFFF, in particular, has proven effective for reconstruction of mid-face, forehead, and scalp due to its thin, pliable tissue characteristics. The integration of microvascular techniques has further improved outcomes, offering good cosmetic appearance and function with less complications and low morbidity of the donor site.

Each case involved injuries exclusively caused by bear attacks. The affected patients were all male, ranging from middle-aged to elderly. All patients sustained combined soft tissue and skeletal injuries. Soft tissue wounds were addressed with careful debridement followed by primary closure, while fractures of the facial bones were treated with open reduction followed with internal fixation. One case presented with extensive soft tissue damage, and all three cases showed varying levels of bone loss.

An exceptional case involved a previously placed 3D implant which was customized and was used for reconstruction of both upper and lower eyelids. Due to postoperative infection, the implant had to be removed, and the area was managed with a secondary surgical procedure involving primary closure. Another case deviated from standard treatment by incorporating adjuvant ozone therapy, which aided in accelerating the healing process.

One of the cases in our study involved the use of adjuvant ozone therapy an emerging modality in wound management. Though well-established in over 16 countries with several decades of clinical use, ozone therapy is still underutilized in mainstream surgical care[13,14]. It has demonstrated multiple therapeutic benefits, including accelerated wound healing, immune modulation, and antimicrobial effects [15]. Clinical applications have shown promise in managing chronic, non-healing, or necrotic wounds, such as those resulting from compartment syndrome [16].

Ozone therapy works by generating reactive oxygen species (ROS) and oxidation products of lipids, which contribute to vasodilation and the activation of growth factors essential for tissue repair [17]. Its blood flow benefits increases oxygen transport to the oxygen-deprived tissues, while mild oxidative stress enhances activity of the antioxidant enzyme, helping to limit inflammation and reperfusion injury[17,18]. Topical ozone application has enhanced antimicrobial efficacy as it promotes wound healing factors [17,19]. However, careful dosing is essential, as excessive oxidative stress may result in tissue damage [20].

CONCLUSION

Maxillofacial trauma which results from bear mauling/attacks presents distinct challenges, demanding prompt and strategic intervention to ensure favourable functional and aesthetic outcomes.

The consistent use of antibiotics (broad-spectrum) is crucial in mitigating infection risk and should be integrated as a standard element of care, especially considering the polymicrobial contamination typically associated with such injuries.

While a significant number of cases can be managed with fundamental surgical techniques like thorough debridement and primary closure, approximately one-quarter of patients require more extensive reconstructive procedures. This variability in injury patterns highlights the need for a tailored treatment plan based on the severity and complexity of each case.

Successful management of these injuries often requires the collaborative expertise of multiple specialties, including oral and maxillofacial surgery, trauma care, and, when necessary, plastic surgery and neurology. Such a multidisciplinary approach ensures complete care, by addressing both immediate clinical and long-term rehabilitation needs for optimal patient outcomes [21].

DECLARATION

Conflict of Interest
None
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