

Pattern of bear maul maxillofacial injuries in Kashmir

Departments of Oral and Maxillofacial Surgery and ¹Oral and Maxillofacial Pathology, Government Dental College and Hospital, Srinagar, Kashmir, India

Ajaz A. Shah, B. A. Mir, Irshad Ahmad, Suhail Latoor¹, Ashaq Ali, Babar Ali Shah

ABSTRACT

Objective: Bears are strong and agile wild animals that defend themselves, their young ones and their territory, if they feel threatened. Conflicts between humans and bears are common in bear-prevalent areas of the world. Our valley, which is surrounded all around by forests, is a habitat for black bears (*U. thibetanus*) only. Maulings inflicted by these black bears are catastrophic events and such attacks have increased considerably in the recent past due to merciless deforestation. The rising incidences of such attacks, especially in maxillofacial region, have urged our department to undertake a study of such attacks and injuries. **Materials and Methods:** The present study is both a retrospective and prospective study of 200 patients of bear maulings who were admitted and treated in the Department of OMFS, Govt. Dental College, Srinagar, from January 2005 to October 2009. **Results:** Majority of the patients were from villages. Most of them belonged to fourth decade and majority was males. Black bears only were involved in all the encounters. Claws, paws and combination of both, were the used for attack. In majority of cases, no defense was used for the termination of attack. All the patients had soft tissue injury, deep lacerations, facial viscera, eyes, salivary glands and facial nerve commonly involved.

Key words: Bear, maul, sudden

Address for correspondence:
Prof. Ajaz A. Shah, Department of Oral and Maxillofacial Surgery, Government Dental College and Hospital, Srinagar, Kashmir, India.
E-mail: drajazshah@gmail.com

INTRODUCTION

Bears are strong and agile wild animals that defend themselves, their young ones and their territory, if they feel threatened. All bears are potentially dangerous, unpredictable and have the ability to inflict serious injury. Conflicts between humans and bears are common in bear-prevalent areas of the world. Such attacks have resulted in major human injuries as well as deaths, in addition to property damage. Three types of bears known are black bears, grizzly and polar bears. Black bears (*Ursus thibetanus*) range in color from blonde through brown to jet black, weighing about

55–135 kg (122–300 lbs), measuring in length from 1.2 to 1.5 m (4–5 feet) and about 60–100 cm (2–3.6 lbs) in height, but can easily reach up to 6 feet when standing on their hind legs. They can run at an average speed of 48 km/hour. They are the only variety found in Kashmir and are less aggressive. Bear encounters are categorized as sudden, provoked or predatory.

In *sudden* encounters, neither the person nor the bear is aware of each other's presence till they are in close range of each other. Such encounters are usually defensive in nature whereby the bears try to protect their young ones, their food cache or their territory. *Provoked* encounters are the second most common type of encounters. Such cases occur with bear hunters and wild life photographers. Hunters who either miss or place an inadequate shot can become a victim of their prey. *Predatory* attacks are defined as the ones where the bear clearly treats its victim as a food source.

Our valley, which is surrounded all around by forests, is a habitat for black bears (*U. thibetanus*) only. Maulings

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inflicted by these black bears are catastrophic events and such attacks have increased considerably in the recent past due to merciless deforestation. The rising incidences of such attacks, especially in maxillofacial region, have urged our department to undertake a study of such attacks and injuries. Reports regarding the pattern of injuries caused by bears in humans are scarce in literature, though much has been written on bears, their attacks and methods of prevention from such attacks.

MATERIALS AND METHODS

The present study is both a retrospective and prospective study of all the patients of bear maulings who were admitted and treated in the Department of OMFS, Govt. Dental College, Srinagar, from January 2005 to October 2009. Study consisted of 200 patients, of whom 125 belonged to retrospective group and 75 were from prospective group. All the details in both retrospective and prospective groups were evaluated as per the proforma.

In the retrospective group, the case records were retrieved from the Department of Medical Records of this hospital. In the prospective group, a detailed history was taken from the patients/attendants, laying special emphasis on location of bear-human encounter (habitat of bear), circumstances which led to the encounter, single bear or sow with cubs, nature and duration of attack. Any deterrent measures used during the incident and any primary treatment received by the patient before reaching our hospital, were all noted down. On arrival in the casualty section of our department, a record of the vital signs was made. Any breathing problems or life-threatening complications were dealt with by instituting proper resuscitative measures, including tracheostomy (if needed). The patients were adequately evaluated for the presence of any head, chest, abdominal or skeletal injuries. A thorough clinical examination from head to toe was made to evaluate the site and type of injury inflicted. Details of wounds were recorded. Any bony fractures

were noted down. Any soft tissue or bony loss was also recorded. Routine investigations including radiographs were done in all cases besides special investigations such as ultrasonography (USG), computed tomography (CT) scan, magnetic resonance imaging (MRI), Doppler studies, etc., wherever indicated. Any fatalities among the injured were recorded and finally statistical analysis of all collected data was made.

RESULTS

Majority of the patients were from villages. Most of them belonged to fourth decade [Table 1] and majority was males [Figure 1, Table 2]. Highest number of cases was received in the year 2008–2009 [Table 3, Figure 2]. Black bears only were involved in all the encounters; majority of these encounters involved solitary bears and the rest by sow with her cubs. Majority were caused by sudden encounters from July to November. Claws, paws and combination of both, were the used for attack. In majority of cases, no defense was used for the termination of attack [Table 4]. Majority of them were hemodynamically stable (less aggressive black bears). All the patients had soft tissue injury, deep lacerations, facial viscera eyes, salivary glands and facial nerve commonly involved. Mortality in our series was 2.39% [Tables 5–10, Figures 3–8].

DISCUSSION

The incidence of bear maul attacks is on a rising trend since the last 6–7 years and more attacks have occurred near foothills and villages which are populated areas, rather than in the forests. This depicts migration of bears from forest areas toward the more populated areas. One of the reasons for bear migration could be deforestation of the areas, thereby the bears move down toward foothills, villages and towns. Injuries by bears were studied by Middaugh between 1900 and 1985,^[1] who also noted a rising trend during later period of his study which he attributed to rise in population and increase

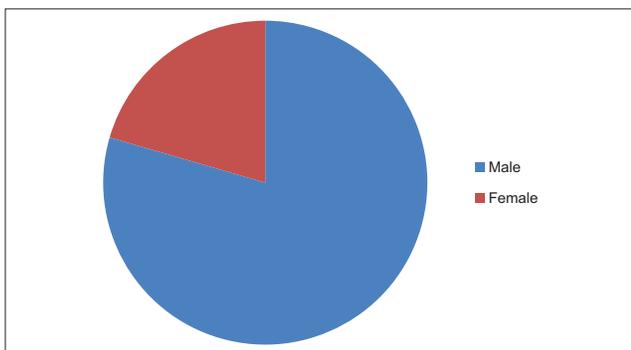


Figure 1: Sex distribution of patients

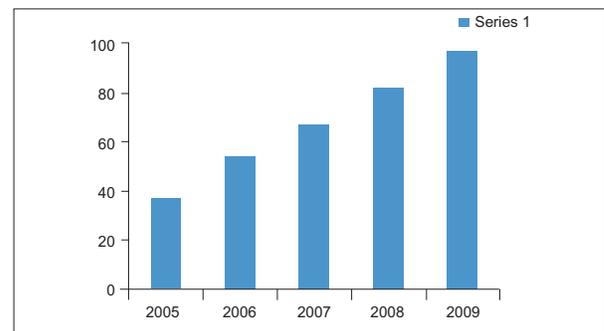


Figure 2: Shows that the highest number of cases was received in the year 2008–2009, with an increasing trend from 2005 onward

Table 1: Age distribution of patients

Age (years)	No. of patients
0-10	0
10-20	5
20-30	20
30-40	110
40-60	55
>60	14

Table 2: Sex distribution of patients

Sex	No. of patients
Male	159
Female	41

Table 3: Number of cases received from 2005 to 2009

Year	No. of cases
2005	37
2006	54
2007	67
2008	82
2009	97

Table 4: Distribution as per type of attack

Type of attack	No. of cases
Sudden	114
Provoked	65
Predatory	21
Total	200

Table 5: Distribution of cases as per bone involved in facial fractures

Site of fracture	No. of cases	Percentage
Zygoma	51	45.13
Nasal bones	38	33.74
Maxilla	37	32.74
Mandible	17	15.04
Orbital walls	13	11.50
Nasoethmoid areas	7	6.19
Miscellaneous palatal split	2	1.76

in tourism. Two hundred persons were injured during our study period from January 2005 to December 2009. This is the highest recorded series from our specialty so far in such a short duration of time and, that too, a hospital-based study.

Himalayan ranges are habitats for Asiatic black bears (*U. thibetanus*) only and so injuries are inflicted by the black ones only (100%). In contrast, Middaugh^[1] reported that 80% of the injuries were caused by Grizzly bears, 18.1% by the black bears and 0.9% by polar bears. Solitary bears were responsible for 95.20% of injuries in the present study and the rest of the injuries were caused by sow with cubs.

Herrero^[2] reported that sow with her cubs were responsible for 71% of injuries among hikers, 19% among campers and 100% among provoked ones.

Table 6: Distribution as per body part involved in attack

Body part involved	No. of cases	Percentage
Head	109	54.67
Face	161	80.57
Neck	25	12.23
Chest	18	8.87
Abdomen	2	0.95
Upper limbs	47	23.26
Lower limbs	30	15.10

Table 7: Distribution of cases as per soft tissue injuries

Type of injury	No. of cases
Deep lacerations	174 (92.00%)
Flap lacerations(avulsions)	37
Loss of tissue	19
Puncture wounds	7

Table 8: Types of fractures

Type of fracture	Percentage
Comminuted	60.00
Compound	40.00
Simple	0.00

Table 9: Distribution as per bone involved in facial fractures

Bone involved	No. of cases	Percentage
Frontal	23	95.83
Parietal	5	20.83
Temporal	4	16.66
Occipital	2	8.33
Skull base	2	8.33

Table 10: Distribution of cases as per type of tissue involved

Tissue involved	No. of cases	Percentage
Soft tissue	200	100.00
Bone	63	31.41
Viscera	26	12.94

Middaugh^[1] reported sow with cubs to be responsible for 25 injuries (23.8%) with one fatality. Among the eight fatalities reported by Tough and Butt,^[3] sow with her cubs were responsible for two cases. Rose^[4] reported in his study that 20.96% injuries were caused by sow and her cubs. The attacks caused by sow with cubs in our series were less dangerous than the ones caused by solitary bears. This reflects the sudden encounter whereby the sow attacks and parts away soon. The brief duration of these encounters supports the view that the attacks were defensive, triggered by the sow's need to protect her cubs.

In the present series, majority of the patients (96.8%) were young to middle aged and extremes of age accounted for only 3.2% of patients. Increased incidence in young patients is probably because of increased outdoor activity by this group, as this is the group which manages to work in their fields and kitchen



Figure 3: Showing avulsion of lower lip and loss of upper lip, nose part of forehead Bilateral (B/L) cheek and both maxillae, exposing frontal bone, whole of nasal cavity and B/L maxillary sinuses

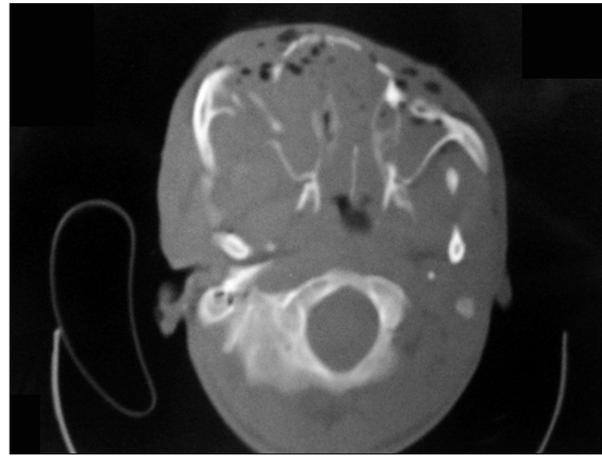


Figure 4: Axial CT of same patient showing multiple fractures



Figure 5: Showing resuscitated case of provocative bear maul injury



Figure 6: OPG of same patient showing mandibular and midface fractures

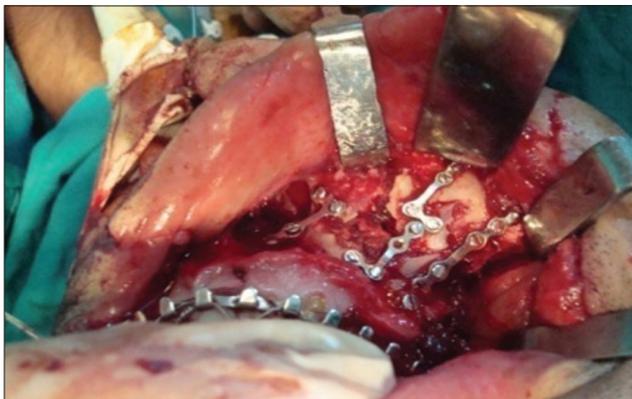


Figure 7: Showing intraoperative view of same patient.



Figure 8: One month post operative view of same patient

gardens and at times visits the forest areas for bringing the firewood for their household use. Activity of people has a direct relationship with the incidence of injury, as has also been noted by Middaugh in his report^[1] which says that hunters accounted for 49% of injuries between the years 1900 and 1979, but a shift was seen after 1980 when campers and hikers were more often

injured (31 and 35%, respectively). In Herrero's^[2] series, campers accounted for 61%, hikers for 31%, hunters and other groups accounted for 6 and 2%, respectively. Rose^[4] noted injuries in 6 hunters among the 10 cases he studied.

Males constituted 81% in our series and the results are

parallel with the results drawn by Rose,^[4] Tough and Butt^[3] and Dvivedi *et al.*^[5] This can again be explained on the basis of more outdoor activity of males in our society than females.

In the present series, majority of injuries (92.80%) were a result of sudden encounters attributed to the working areas close to the forests, 6.71% were provoked ones and 0.47% were from predatory encounters.

Majority of the injuries (76.96%) occurred between July and November in our series, in accordance with the results of Herrero,^[2] Rose^[4] and Tough and Butt.^[3] The reason for this is that bears, after a long snowy winter, come out of their caves down in search of food during this time when fruits, maize and vegetables are ripe, readily available and in their reach. In addition, people from nearby villages most frequently visit the forests for getting the wood and fodder, thus increasing the chances of encounters.

Also, 96.63% of the injuries in our series occurred during daytime (6 a.m.–6 p.m.) with more than half (53.95%) occurring from 12 noon to 6 p.m. in accordance with the results drawn by Dvivedi^[5] and Tough and Butt.^[3] High incidence of attacks during the daytime is attributed to people being more active and outdoor during this period, as has been noted by Rose.^[4]

It was observed in this study that 91.12% of the injuries were caused by the encounters which lasted for ≤10 minutes and almost all of these were sudden encounters. Long lasting encounters were provoked ones. The results of our study suggest that when attacks were provoked ones, some kind of defense method was always used and in sudden encounters, victim was unarmed and most often spontaneous termination occurred.

In the current study, it was observed that all the persons injured by bears were locals and only three of them were nomads, who move from one place to another with their livestock; the results are similar to that of other Asian studies like that of Vankataswami and Rajagopalan^[6] and Divedi *et al.*^[5]

Majority of the cases received in our casualty were hemodynamically stable and almost all were received within 12 hours of injury.

In the current series, face and scalp were the most commonly involved parts of the body affected by bear mauling. Face and jaws were affected in 97 (80.57%), scalp in 228 (54.67%) and upper limbs in 97 (23.26%) of the cases. Most of the case reports of bear maul injuries, as reported in the literature, belong to face and head only.^[6-11] Predominance of head and facial injuries in

bear mauling can be explained on the basis that head and face are the most prominent parts of body and there being multiple irregularities over the face due to bony projections, makes these parts easily available for bears paws/claws, resulting in severe injuries. Secondly, bears being highly intelligent animals, try to weaken their enemy by easily targeting their face so that they are unable to fight back and harm them. Facial attacks by the Asiatic bears are usually defensive as they themselves are weaker animals compared to Grizzlies whose attacks are much aggressive and fight back vigorously. Again, frontal bone and zygoma were the commonly involved bones. This again suggests the involvement of more prominent parts.

Scalp lacerations by grizzly bear were studied for bacteriology by Kunimoto *et al.*^[9] It was found that these wounds grew *Serratia marcescens*, *Aeromonas hydrophilia*, *Bacillus cereus* and *Enterococcus durans*, but no anaerobes. Among the registered diseases, the most common one is trichinosis, which is the most dangerous for humans. When it comes to endoparasites, bears are infected with *Tenia*, which they contract during the spawning season. In the present study, we did not encounter any type of postoperative infection.

All the 200 (100%) patients in our series had soft tissue injuries in one or the other parts of the body. Bony injury (fracture and/or loss) was found in 31.41% cases. All the patients with bony injury had associated soft tissue injury as well. We tried to analyze the distribution of bony injuries among various parts of body and found face to be commonly involved site of bony injuries (27.09%), followed by skull (5.75%). No fractures were noted in trunk or spine, through various cases of extremity fractures occurred. Rose^[4] noted that only one patient had skull fracture and four others had extremity fractures with no facial fractures at all. In fatal bear maulings, as reported by Tough and Butt,^[3] only two patients had facial fractures while most of the victims had suffered cervical spine fractures. But almost all the cases of fractures noted by Dvivedi *et al.*^[5] involved facial skeleton. This explains the fact that attacks by the Asiatic bears are usually defensive as they themselves are weaker animals compared to Grizzlies whose attacks are much aggressive and fight back vigorously. In skull, frontal bone (95.83%) and in face, zygoma (45.13%), were the commonly involved bones. This again suggests that more prominent parts are predominantly involved.

Visceral injuries from bear maulings, in the form of injury to brain, eyes, salivary glands, lungs and abdominal organs, were reported from time to time by different authors. Viscera were involved in 54 (12.94%) cases in the present series. Brain was injured

in 8 (1.91%) cases, whereas facial viscera was involved in 37 (8.87%) cases. Ventakaswamy and Rajagopalan^[6] reported a case whereby there was avulsion of right eye. Rose^[4] reported one case of brain injury and fractures in 50% of his patients. He reported that neurovascular bundles, thoracic and abdominal cavities and facial structures were relatively spared. Among the fatal injuries recorded by Tough and Butt,^[3] two patients had punctured chest wound, while seven out of eight had fractures of one or the other bones. No visceral injury was noted by Dvivedi^[5] in any of his patients, but fractures involving orbit, zygoma, maxilla, nasal bones and even cervical spine were variously found in his patients. Brain injury was noted by Hayashi *et al.*^[8] and Voughouklakis *et al.*^[10] in their reported cases. From the reported literature and from the present series, it is thus evident that though extensive soft tissue injuries occur during bear mauling, there are only occasional cases of visceral injuries. The reason for this is that viscera are deeply seated and get involved usually due to puncture or when the patient has a fall during attack. On the other hand, bony injuries were associated with a major group of patients in almost all reported cases.

Among the injuries of soft tissue, deep lacerations were seen in more than 90% of cases, while puncture wounds were seen in 3.83% cases in the present study. Intermediary group includes flap avulsion (18.94%) and tissue loss (9.11%). Rose^[4] has given an injury account of soft tissues in his 10 patients and found deep lacerations to predominate and no tissue loss occurred in any of his patients. Multiple abrasions, scratches or contusions occur when the victim is dragged across or thrown upon the ground by the attacking bear.

Mortality due to bear maulings in our series was 2.39% (10 cases) only. This may be because the injuries were usually superficial in nature in our setting. Deep visceral and fatal injuries rarely occur and such attacks are usually defensive. This is in contrast to various reported series from Alaska and Alberta, whereby it is seen that Grizzly attacks are much aggressive and prove to be fatal. Floyd^[12] also reported that brown bear attacks tend to be severe and occur moderately without provocation, whereas black bear attacks usually result in minor injuries and tend to be predacious. In a study of bear maulings from Alaska by Rose,^[4] there were 28 fatal maulings by brown/grizzly bears

compared to only three by the black bears. Herrero has reported 500 black bear attacks, resulting in three fatalities. However, in contrast to the above studies, Middaugh^[1] reported a fatality rate of 21% in victims of black bear attacks and 18.8% in those attacked by grizzly bears. Mortality in our series occurred mostly in those patients who presented in hemodynamically unstable state to our hospital. Three patients had associated severe brain injury, five had extensive facial injury and two had penetrating neck injury. Among those with brain injury, two (one with acute Subdural Hemorrhage and the other one with extensive right fronto-temporal contusion) were operated by our neurosurgical colleagues, but the patients could not be maintain postoperatively and died on 10th and 12th days, respectively, after surgery. Those with extensive facial injury had either bleed profusely (two patients) or had aspirated (three patients) before reaching our hospital. One patient with penetrating neck injury was brought dead and the other one who died in the hospital had a common carotid artery injury on the left side.

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