Original Article

Pattern and Management of Missile Injury to the Oral and Maxillofacial Region: A 12-Year Experience During Boko Haram Insurgency in Maiduguri, North-Eastern Nigeria

Abstract

Introduction: Missile injury is a global public health problem, which occurs in both military and civilian settings. Boko Haram insurgency in North-Eastern Nigeria is one of the major violence the country experienced that resulted in many civilian casualties. This study was aimed at exploring the various patterns of the missile injuries to the maxillofacial region during Boko Haram insurgency. **Methods:** In this retrospective cross-sectional study, relevant information was retrieved from patient records including sociodemographic, causes of missile injuries, site of injuries, pattern of presentation, treatment, and the complications, and analysed using SPSS version 23. **Result:** A total of 526 patients with various maxillofacial injuries were seen during this 12-year study period, with age ranging from 4 to 65 years, the peak incidence in the age group 31–40 years, 89.5% were males, 92.9% of the injuries were allegedly inflicted by insurgents and comprised of 61.0% gunshot injuries, 24.5% bomb blast, and machete cuts 7.4%. Most of the injuries occurred in the lower third of the face, 39.8%, and mandible was the commonest fractured facial bone. **Conclusion:**Facial injuries commonly are associated with devastating consequences to survivors and, hence, may require long time monitoring and psychosocial rehabilitations.

Keywords: *Boko Haram, bomb blast, gunshot, machete cuts, maxillofacial, missile injury*

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Introduction

Missile injury is a global public health problem, which has significant mortality and profound morbidity, longstanding physical, mental, and economic disability of individuals, families, and communities as well as the countries affected.[1] These injuries happen in military and civilian settings[2] with a worldwide increase in incidence among civilians in the last 2 decades.[3] In Nigeria, since aftermath of the civil war in 1967–1970, armed robbery had been the major cause of civilian gun short injuries (GSI).[4-6] However, in a recent past, the rise in civilian gunshot and bomb-blast injuries had been reported in the southeastern region of this country from the activities of the movement for the Emancipation of Niger Delta agitators in late 2005[7] and in northeastern region by Boko Haram insurgency since 2009.[8] Boko Haram was declared the world's deadliest terrorist organisation in the mid-2010 when their activity in North-Eastern Nigeria was at its peak based on the number of people killed.[9] Maiduguri was an epicentre of this major violence throughout North-Eastern Nigeria since 2009.[8] In a recently published report, the head and neck region was found to be the most frequently injured area of the body (62.6%) among the victims of the insurgency in the North-Eastern Nigeria.[10] This study, however, did not explore the pattern of these maxillofacial injuries and their management that is why we carried out this study to explore the pattern of missile injury to the oral and maxillofacial region sustained during Boko Haram insurgency.

Patients and Methods

This is a retrospective cross-sectional study of missile injuries to the oral and maxillofacial region that presented to the Department of Oral and Maxillofacial Surgery, University of Maiduguri Teaching Hospital (UMTH) Nigeria between January 2009 and December 2021. Ethical approval was obtained from the research and ethical

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Table 1: Age and sex distribution of patients with missile injuries

Age	Male	Female	Total (%)
0–10 years	19	5	24 (4.56)
11–20 years	39	6	45 (8.55)
21–30 years	171	18	189 (35.93)
31–40 years	172	21	193 (36.69)
41–50 years	34	4	38 (7.22)
51–60 years	27	1	28 (5.32)
>60 years	9	0	9 (1.71)
Total	471	55	526 (100)

Table 2: Causes of missile injuries during Boko Haram insurgency in Maiduguri

Causes	Type of missile	Cases (%)
Insurgents	Gunshot (bullets)	321 (61.0)
	Bomb blast injuries (IED)	129 (24.5)
	Machete cuts	39 (7.4)
Unknown	Stray bullets	37 (7.0)
Total		526 (100)

IED: improvised explosive device

committee of University of Maiduguri Teaching Hospital (UMTH/REC/617).

The records of the cases were retrieved from the medical record Department of the hospital. Data were then collected in a prepared proforma to record variables such as demographic data, causes of missile injuries, site of injuries, pattern of presentation, treatment, and the complications. Data obtained were analysed using SPSS (Released 2015. IBM SPSS Statistics for Windows, Version 23.0. IBM Corp., Armonk, NY, USA) and presented in the tables.

Results

There were 526 patients with various forms of missile injuries to the maxillofacial region due to insurgency over the 12-year period of this study.

Demography

The age of presentation in this study ranged from 4 to 65 years, with the peak incidence (36.69%) in the age group 31–40 years. There were 471 (89.5%) males and 55 (10.5%) females. The age and sex distribution of patients are shown in Table 1.

Aetiology

Table 2 shows the causes of missile injuries, most of the injuries were allegedly inflicted by insurgents (92.9%); comprising Gunshot 321(61.0%), bomb blast 129(24.5%), and machete cuts 39 (7.4%).

Distribution pattern of injuries

The distributions of pattern of injuries sustained with gunshot, bomb blast and machetes were shown in Tables 3–5.

Table 3: Pattern of gunshot injuries during Boko Haram insurgency in Maiduguri

Anatomical site	Cases (%)
Upper 1/3 of the face	21 (6.1)
Middle 1/3 of the face	94 (27.3)
Lower 1/3 of the face	137 (39.8)
Multiple facial	76 (22.1)
Neck	16 (4.7)
Total	344[a] (100)
Type of injury	
Avulsion	102 (32.18)
Penetration	75 (23.66)
Perforation	86 (27.13)
Laceration	54 (17.03)
Total	317[a] (100)
Fractures	
Mandibular fracture	148 (48.05)
Midface fracture	83 (26.95)
Pan-facial fracture	77 (25.00)
Total	308[a] (100)

[a]Missing data: n = 358 (GSI + stray bullet)

Surgical procedure

Among all the fractures recorded, 256 patients had undergone closed reduction (CR) and immobilisation of their various fractures (predominantly using arch bar (194) and 142 patients had open reduction and internal fixation. Soft-tissue injuries were treated by either wound debridement and primary or secondary closure. Thirteen patients had tracheostomy during the surgical procedure.

Discussion

This study highlighted numerous injuries sustained by missile and circumstances surrounding the causes, which

Table 4: Pattern of bomb blast injuries (IED) during Boko Haram insurgency in Maiduguri

Bomb blast injury	Frequency (%)
Soft-tissue injuries	
Bruises	25 (19.4)
Facial lacerations	31 (24.0)
Avulsion	19 (14.7)
Combination	54 (41.9)
Total	129 (100)
Hard-tissue injuries	
Frontal bone	6 (7.7)
Midface	23 (29.5)
Mandible	30 (38.5)
Multiple facial	19 (24.4)
Total	78 (100)

Combination (bruises/lacerations/avulsion)

Table 5: Pattern of machete injuries during Boko Haram insurgency in Maiduguri

Machete injury	Frequency (%)
Soft-tissue injuries	
Laceration single	11 (28.9)
Lacerations multiple	19 (50)
Avulsion	8 (21)
Total	38 (100)
Hard-tissue injuries	
Frontal bone	3 (9.7)
Midface	9 (29.0)
Mandible	14 (45.2)
Multiple facial	5 (16.1)
Total	31 (100)

were recorded during Boko Haram insurgency in North-Eastern Nigeria from 2009 to 2021, and presented to Oral and Maxillofacial Surgery Department, University of Maiduguri Teaching Hospital. Missile injuries to the neck and maxillofacial region cause profound morbidity and significant mortality due to complex anatomy and the presence of vital structures in the region.[11] The severity varies depending on the calibre of the weapon, distance, mass, and velocity of the bullet, and, thus, can result in devastating facial disfigurement and disability in the survivors.[12] Head and neck region was found to be the most frequently injured area of the body among the victims of the insurgency in the North-Eastern Nigeria.[10]

In our study in this hospital, a total of 526 patients with various missile injuries to the oral and maxillofacial region were seen. Predominantly more male victims were seen in this study as was also reported in many local[3,5,6,10,13] and international[14,15] literature. This may be because the majority of insurgent's attacks is targeting major gatherings such as worship areas, markets, motor packs, schools, and commuters, where in most of these crowds, the majority are male gender. Also, military, civilian Joint task force, and other paramilitary personnel victims involved in the fight against Boko Haram insurgents are mostly male.

The age of presentation in this study fall between 4 and 65 years, and the significant number of children and adolescent in this study (69 [13.11%]) is not coincidental due to the fact that children are considered a soft target by the insurgent who carry explosives as suicide bombers, thus making them more vulnerable. Both suicide bombers and their targets particularly in public places[9,16] indiscriminately suffer serious injuries, this is contrary to some reports that GSI involving children are usually accidental.[15,17] The age of peak incidence in this study is somewhat equal between the age group 21–30 and 31–40, which accounted for 72.6% of injuries. This implied that young adults bear to a considerable degree the burden of firearm violence[3] and loss of their life or sustaining serious injuries may cause a huge economic burden as a consequence of premature loss of productive workforce.[2]

Insurgent attack was responsible for the greatest proportion of injuries in this study accounting for 489 (93%) victims, with the use of various weapons including guns (61%), bombs (improvised explosive devices [IEDs] 24.5%), and machetes (7,4%). This is contrary to reports from other Nigerian cities where armed rubbery attacks were the predominant causes of missile injuries.[2-4,13] An equally disturbing observation in this study was the occurrence of bomb blast injuries that accounted for 24.5%. Injuries sustained from bomb blast usually have unique pattern, which can be multifocal and multisystemic from various sources: primary injury is caused by the blast, secondary blast injury is caused by projectiles, tertiary blast injury is caused by the force of the explosion and wind disruptive injury, and quaternary blast injury results from the fire and heat generated by the explosion.[18] The maxillofacial trauma usually results from secondary and tertiary blast injury[18]; hence, the highest proportion of soft-tissue injury incurred is the combination injury (bruises, laceration, and avulsion) [Figure 1] and isolated mandibular fracture for the hard tissues. IEDs are most frequently used explosives to the targeted public places, and the attack is carried out mainly by female suicide bombers forcefully recruited by the insurgents.[9]

Our study further revealed that among the GSI victims, lower third of the face was the predominantly injured region and mandible as the most common fractures facial bone; this finding was in consistent with Guevara *et al*.,[19] and Bede *et al*.[20] who also reported mandible as the commonest fractured site among the victims of GSI in their studies. This implies that survivors of the gunshot injuries in the head and neck region may likely get injured in the mandible due to its prominent or a missed target when the brain and vital structures in the neck are aimed.

Figure 1: (a) Bomb blast victim. (b) Intraoperative wound debridement. (c) One month postop

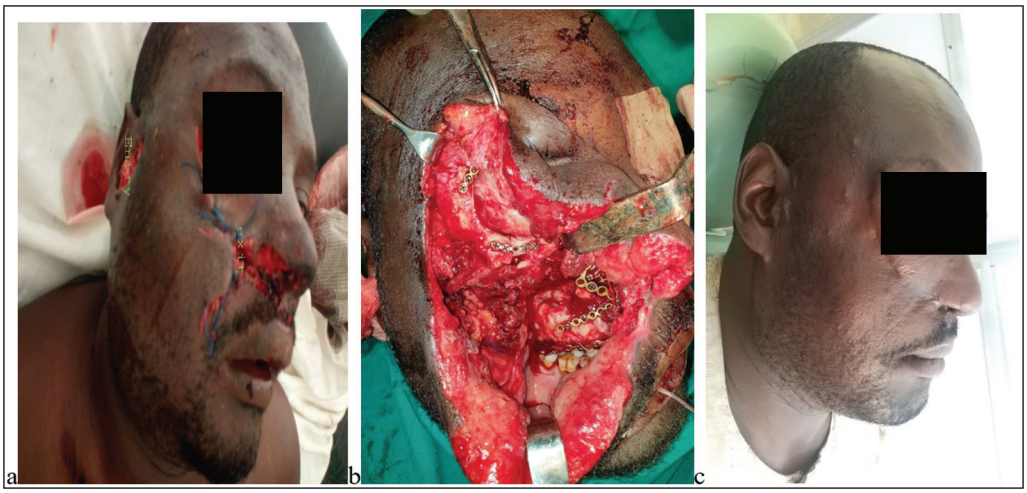

Figure 2: (a) Gunshot wound to the right side of the face (entry point at the preauricular region and exit point through the anterior facial region). (b) Wound debridement and ORIF were done. (c) Three months postop. ORIF = open reduction and internal fixation

Traditionally, GSIs are been categorised as penetrating, perforating, or avulsion injuries depending on the energy transfer from the missile and on the anatomical structure involved.[20] Penetrating wounds are caused by the projectile striking the victim but not exiting the body, perforating injuries have entry and exit wounds [Figure 2], whereas avulsive injuries have acute loss of tissue associated with passage of the projectile out of the victim [Figure 4c].[21] In this survey, we found avulsive injury as the most common pattern of presentation; this may be because the main type of weapon used by Boko Haram is the machine guns,[9] and the high energy and lethality of this wounding agent might possibly explain the preponderance of avulsive injury in this study.

Another rare presentation of the victims of the Boko Haram insurgent is the varying degree of machete cut injuries [Figure 3 and Figure 4a]. Although machete cuts are rare in isolation to the face without a concomitant injury to the hand in defence of the face, this study reported a similar trend. The involvement of the upper limbs including the traumatic amputation at the wrist in addition to machete cuts on the face is pictured in Figure 3c.[22] Multiple facial lacerations are the commonest soft-tissue injury presentation in this study, similar to a study by Chukwudi *et al*.[22] These lacerations and associated facial skeleton fracture indicates the depth of the injury and may suggest a homicidal intent of the assailant.

The management of the victims of insurgent attack was based on our hospital and departmental protocol, injured patients registered to the hospital through either accident and emergency (A&E) department of the hospital, or direct referral to the department by either the military, nongovernmental organizations, government hospitals, or via outpatient clinic. The mass casualties are carried to the A&E department, and immediate triage of the

Figure 3: (a) Victim of machete cuts injury to the face and left-hand amputation. (b) Suture of the laceration. (c) One month postoperatively. (d) Left facial palsy and facial scarification

Table 6: Treatment

Hard tissue	**Frequency (%)**
ORIF	142
Closed reduction	256 (100)
Arch bar	194 (76.8)
Eyelet wiring	48 (18.8)
Direct wiring	14 (5.5)
No treatment	19
Soft tissue	**Frequency**
Wound debridement and primary closure	112
Wound debridement and secondary closure	80
Soft-tissue reconstruction	32

ORIF = open reduction and internal fixation

Table 7: Complications of missile injuries during Boko Haram insurgency

Complication	**Frequency (%)**
Blindness	12 (14.1)
Facial nerve palsy	11 (12.9)
Scar deformity	24 (28.2)
Trismus	14 (16.5)
TMJ ankylosis	8 (9.4)
Nonunion	2 (2.4)
Malunion	14 (16.5)
Total	85 (100)

TMJ = temporomandibular joint ankylosis

victims and appropriate multidisciplinary team will be summoned. Emergency maxillofacial injuries are sorted, and immediate surgical operation is carried out. Infected wounds or late presentation of the victims requires delayed primary treatment by wound debridement and stabilisation of the fracture with mandibulomaxillary fixation before definitive treatment is done. Victims

Figure 4: (a) Victim of matchete injury, multiple facial and scalp lacerations. (b) Victim of gunshot injury at the right orbital region with ruptured globe. (c) Victim of gunshot to the lower third of the face

commonly present late mostly due to lack of assistant from raided and deserted communities, unsecured roads and transportation, lack of medical facilities and personnels in their community, fleeing another attack, or being in captivity of the insurgents. Two hundred fifty-six patients had CR and mandibulomaxillary fixation predominantly using arch bar and 142 open reduction and internal fixation (ORIF) [Table 6], predominantly using CR and immobilisation was majorly due to lack of suitable appliances, late presentation, large soft-tissue defects, and concomitant other injuries contraindicating general anaesthesia.

Although, late presentation is presumed to contribute to some of the complications noticed [Table 7], recognition of vision-threatening injuries and prompt expert intervention may reduce the sight loss in some patients, although isolated globe injuries are managed by an ophthalmologist, maxillofacial injuries associated with orbital injuries are comanaged by maxillofacial and ophthalmologist. In this study, 12 patients lost their sight due to missile injury in the maxillofacial region [Figure 4b]; consequently, loss of sight is very devastating especially if bilateral resulting in dependency and a live long burden to other family members and the society.

Conclusion

Boko Haram insurgents strategically use different missiles to cause injury to their victims including the use of bombs, guns, and machetes. This resulted in a range pattern of facial injuries. The lower third of the face and associated mandibular fracture is the most commonly injured part of the face in all three types of weapons used. Young male individuals are the major victims of this violence. This has resulted in a reduced workforce and further deterioration of the economy in already impoverished communities. Survivors of the missile injuries to the oral and maxillofacial region may continue to suffer due to the noticeable disfiguring nature of the injuries from damaged eyes, nose, mouth, facial nerve, and soft tissues and, hence, may require long-term monitoring, secondary revision surgeries, and psychosocial rehabilitation.

Recommendation

1. Government should provide ballistic face mask (facial armour) to the combatant to protect them from facial injuries.

Declaration of patient Consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

References

1. Kalesan B, Adhikarla C, Pressley JC, Fagan JA, Xuan Z, Siegel MB, *et al*. The hidden epidemic of firearm injury: Increasing firearm injury rates during 2001-2013. Am J Epidemiol 2017;185:546-53.
2. Akinbolagbe AM, Hamilton OG, Ikem IC. Gunshot injuries in a Nigerian hospital. Niger J Orthop Trauma 2006;5:34-7.
3. Mohammed AZ, Edino ST, Ochicha O. Epidemiology of gunshot injuries in Kano, Nigeria. Nigerian J Surg Res 2005;7:296-9.

4. Chianakwana GU, Mbonu OO, Egwuonwu AO, Azike J, Eleweke N, Ekwunife C, *et al*. Missile and blast injuries in Nigeria—The southeast experience. J West Afr Coll Surg 2017;7:18-33.
5. Onuminya JE, Ohwowhiagbese E. Pattern of civilian gunshot injuries in Irrua, Nigeria. S Afr J Surg 2005;43:170-2.
6. Ojo E, Ibrahim A, Alabi S. Gunshot injuries in a North Eastern Nigerian tertiary hospital.Int J Surg 2007;16:1-8.
7. Allen M. Movement for the Emancipation of the Niger Delta (MEND). In: Chatterjee DK, editor. Encyclopedia of Global Justice. Dordrecht: Springer; 2011.
8. Wikipedia. Maiduguri[EB/OL]. Wikipedia. 2021-12-31/2020-07-11. Available from: https://en.wikipedia.org/wiki/Maiduguri. [Last accessed on 18 Dec 2022].
9. Olofinbiyi SA. Boko Haram insurgency. In: On the Crisis of Boko Haram Terrorism. 1st ed. New York: Routledge; 2023. p. 50-65.
10. Abubakar A, Bakari AA, Saad YM. Management of gunshot injuries due to insurgency in the North-Eastern Nigeria. Int J Rescue Disaster Med 2014;10:1-6.
11. Munishwar PD, Gupta A, Bajantri N. Ballistic trauma. J Indian Acad Oral Med Radiol 2016;28:184-7.
12. Vatsyayan A, Adhyapok AK, Debnath SC, Malik K. Reconstruction and rehabilitation of short-range gunshot injury to lower part of face: A systematic approach of three cases. Chin J Traumatol 2016;19:239-43.
13. Umaru H, Ahidjo A, Madziga A. Highway armed robbery: A major cause of extremity gunshot injury in northeastern Nigeria. Internet J Orthoped Surg 2005;3:6-11.
14. Ramasamy A, Harrisson SE, Stewart MPM, Midwinter M. Penetrating missile injuries during the Iraqi insurgency. Ann R Coll Surg Engl 2009;91:551-8.
15. Fowler KA, Dahlberg LL, Haileyesus T, Gutierrez C, Bacon S. Childhood firearm injuries in the United States. Pediatrics 2017;140:e20163486.
16. UNICEF. "Beyond Chibok: Over 1.3 Million Children Uprooted by Boko Haram Violence." 2015. Available from: http://files.unicef.org/media/files/Beyond_Chibok.pdf. [Last accessed on 01 Jan 2023].
17. Campbell NM, Colville JG, Van Der HY. Firearm injuries to children in Cape Town, South Africa: Impact of the 2004 Firearms Control Act. S Afr J Surg 2013;51:92-6.
18. Gataa IS, Muassa QH. Patterns of maxillofacial injuries caused by terrorist attacks in Iraq: Retrospective study. Int J Oral Maxillofac Surg 2011;40:65-70.
19. Guevara C, Pirgousis P, Steinberg B. Maxillofacial gunshot injuries: A comparison of civilian and military data. J Oral Maxillofac Surg 2015;74:795.e1-7.
20. Bede SYH, Ismael WK, Al-assaf D. Characteristics of mandibular injuries caused by bullets and improvised explosive devices: A comparative study. Int J Oral Maxillofac Surg 2017;46:1271-5.
21. Fonseca RJ, Walker RV, Barber HD, Powers MP, Frost DE. Oral and Maxillofacial Trauma. 4th ed. Elsevier Health Sciences. 2012.
22. Chukwudi OA, Rowland A, Uche O. Machete-cut injuries are occurring in the maxillofacial region in Zaria, Nigeria. Nigerian J Clin Pract 2015;18:569-72.