VOLUME - 15, ISSUE - 04, APRIL - 2026 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Orthopaedics

PATTERN OF ROAD TRAFFIC ACCIDENT–RELATED ORTHOPAEDIC INJURIES AT A TERTIARY CARE CENTRE IN LUCKNOW, UTTAR PRADESH: A HOSPITAL-BASED DESCRIPTIVE STUDY

Dr. Ashutosh Yadav Senior Resident, Department of Orthopaedic Surgery, Maharishi Chyawan Govt. Medical College, Koriawas, Narnaul Haryana

ABSTRACT

Background: Road traffic accidents (RTAs) are a major public health problem in India and constitute a leading cause of trauma-related morbidity. Orthopaedic injuries account for a significant proportion of non-fatal RTA outcomes and contribute substantially to disability, healthcare utilization, and economic loss. Understanding the local pattern and severity of orthopaedic injuries is essential for trauma-care planning and targeted preventive strategies. **Objectives:** To assess the demographic profile, road-user characteristics, anatomical distribution, fracture patterns, and management of RTA-related orthopaedic injuries presenting to Balrampur Hospital, Lucknow, Uttar Pradesh. **Methods:** A hospital-based descriptive observational study was conducted in the Department of Orthopaedic Surgery, Balrampur Hospital, Lucknow, over a six-month period from January to June 2025. A total of 400 consecutive patients with orthopaedic injuries due to RTAs were included. Data were collected using a structured proforma covering sociodemographic details, accident characteristics, injury patterns, and management. Closed fractures were classified using the AO/OTA classification system, while open fractures were classified according to the Gustilo–Anderson system. Data were analysed using SPSS version 27, with results expressed as frequencies and percentages. Associations were tested using the chi-square test, and a p-value <0.05 was considered statistically significant. **Results:** Young adult males were predominantly affected, with the highest incidence in the 21–30-year age group. Two-wheeler users constituted the majority of injured patients (54%). Lower-limb injuries were the most common (49%), followed by upper-limb injuries. Among closed fractures, AO/OTA Type A (simple) fractures were most frequent (54.4%), while Type C (complex) fractures accounted for 16.1%. Open fractures constituted 25.5% of injuries, with Gustilo–Anderson Type II and III fractures forming the majority. Open fractures were significantly more likely to require operative management compared to closed fractures ($p < 0.001$). **Conclusion:** RTA-related orthopaedic injuries at Balrampur Hospital, Lucknow predominantly affect young male two-wheeler users and frequently involve the lower limbs. The substantial burden of open and surgically managed fractures highlights the need for strengthened trauma services, effective road-safety measures, and improved preventive strategies.

KEYWORDS : Road Traffic Accidents; Orthopaedic Injuries; AO/OTA Classification; Gustilo–Anderson Classification; Balrampur Hospital; Lucknow; Uttar Pradesh

INTRODUCTION

Road traffic accidents (RTAs) remain a major and growing public-health challenge worldwide, disproportionately affecting low- and middle-income countries where rapid motorization has outpaced infrastructure, policy, and emergency care capacity. Globally, road traffic crashes cause more than a million deaths annually and are a leading cause of death among young people aged 5–29 years, with many more survivors sustaining disabling injuries that place long-term burdens on individuals, families, and health systems (WHO, 2018; WHO, 2016). India, with its expanding vehicle fleet, varied road quality, and mixed road-user types, bears a substantial share of this burden; official and independent assessments repeatedly highlight high numbers of accidents, fatalities, and serious injuries despite policy efforts such as the Motor Vehicles Amendment Act and state road-safety initiatives (MoRTH, 2025; IIT Delhi, 2024; NCRB, 2023).

Orthopaedic injuries form a large proportion of non-fatal trauma following RTAs. Fractures, dislocations, soft-tissue injuries, and complex limb trauma not only account for immediate morbidity and hospital resource use — including operating theatre time, implants, blood products, and inpatient care — but also have significant sequelae: prolonged disability, loss of productivity, and requirement for rehabilitation and secondary surgeries. Several hospital-based series from tertiary centres across different Indian regions show that fractures, especially of the lower limb, are consistently the most frequent orthopaedic consequence of RTAs, followed by injuries to the upper limb and pelvis; open fractures and polytrauma cases present additional clinical complexity and worsen outcomes (Misra et al., 2017; Bezabih et al., 2022; Joshi et al., 2023; Rostom et al., 2024).

The epidemiology of RTA-related orthopaedic injuries is strongly shaped by road-user profile, vehicle type, and regional traffic patterns. Two-wheelers represent a dominant vulnerability in India: riders and pillion-riders often account for a high proportion of injured patients and are more likely to sustain lower-limb fractures and head injuries when helmet use is absent or inadequate (MoRTH, 2025; Sahu et al., 2021). Pedestrians and bicyclists remain particularly vulnerable in peri-urban and rural stretches where mixed traffic and insufficient pedestrian infrastructure increase exposure to high-energy impacts (NCRB, 2023). Young males of working age are typically over-represented in most Indian series, reflecting mobility patterns, occupational exposure, and risk behaviours such as speeding and alcohol use (Misra et al., 2017; Rostom et al., 2024).

State-level data indicate that Uttar Pradesh bears a significant burden of road traffic accidents, with national records consistently placing the state among those with the highest absolute numbers of road accident casualties in India (NCRB, 2023; MoRTH, 2025). Such state-specific context is critical for tertiary centres such as Balrampur Hospital, Lucknow, which serves as a major public-sector referral hospital for Lucknow and surrounding districts; referral caseloads, injury severity mix, seasonal peaks, and common crash mechanisms directly determine surgical workload, implant demand, blood-bank requirements, and rehabilitation referral patterns.

Beyond descriptive epidemiology, understanding the distribution of single-site fractures versus polytrauma, the prevalence of open fractures, and delays in definitive fixation are crucial. Timely orthopaedic management reduces infection risk in open fractures, shortens hospital stays, and improves functional outcomes; delayed presentation — common in areas with geographic or financial barriers — can lead to malunions, chronic osteomyelitis, and prolonged disability (Misra et al., 2017; Bezabih et al., 2022). Hospital-based surveillance that documents injury patterns alongside mechanism, road-user type, and safety-device use therefore provides actionable information for both clinical service planning and preventive policy.

In this context, a systematic description of orthopaedic injuries presenting to Balrampur Hospital, Lucknow, over a defined six-month study period (January–June 2025) will inform service provision, highlight high-risk groups for targeted prevention, and yield baseline data against which the impact of state and national road-safety measures can be evaluated. In this paper, we present the pattern, severity, and immediate in-hospital management of RTA-related orthopaedic injuries, and discuss implications for clinical services and injury prevention in North India.

METHODOLOGY

Study Design and Setting

This was a hospital-based descriptive observational study conducted in the Department of Orthopaedic Surgery, Balrampur Hospital, Golaganj, Lucknow, Uttar Pradesh – 226018, India. The objective was to analyse the pattern and severity of orthopaedic injuries sustained due to road traffic accidents (RTAs). Balrampur Hospital is a government tertiary care teaching institution and a major trauma referral centre serving Lucknow and the surrounding districts of Uttar Pradesh.

Study Period

The study was carried out over a six-month period from January 2025 to June 2025.

Study Population

All patients presenting to the emergency department or orthopaedic services at Balrampur Hospital with orthopaedic injuries resulting from RTAs during the study period were screened for eligibility.

Sample Size

A total of 400 patients were included using a consecutive sampling method. The sample size was determined based on the average monthly caseload of RTA-related orthopaedic injuries at the study centre and the feasibility of enrolment within the stipulated study duration.

Inclusion Criteria

- Patients of all age groups and both sexes.
- Patients sustaining orthopaedic injuries due to road traffic accidents.
- Patients providing written informed consent, or consent from attendants in the case of minors or unconscious patients.

Exclusion Criteria

- Injuries due to causes other than RTAs.
- Patients with isolated non-orthopaedic injuries without musculoskeletal involvement.
- Patients brought dead or those who expired before detailed evaluation.
- Patients refusing consent.

Data Collection

Data were collected using a pre-designed, pre-tested structured proforma through patient interviews, attendants' history, clinical examination, and review of medical records. The following details were recorded: (i) sociodemographic variables — age and sex; (ii) accident-related factors — type of road user, mechanism of injury, and time of accident; (iii) injury characteristics — anatomical site, laterality, number of bones involved, and associated injuries; and (iv) type of orthopaedic injury — fracture, dislocation, fracture-dislocation, or soft-tissue injury.

Injury Classification

All fractures were classified using standard orthopaedic classification systems to ensure uniformity and comparability of findings. Open fractures were classified according to the Gustilo–Anderson classification based on wound size, extent of soft-tissue damage, contamination, and neurovascular involvement (Types I, II, IIIA, IIIB, and IIIC). Closed fractures were classified using the AO/OTA fracture classification system based on anatomical location, fracture morphology, and complexity; long bone fractures were categorized into Type A (simple), Type B (wedge), and Type C (complex) patterns. Pelvic and peri-articular fractures were categorized according to the relevant AO/OTA sub-classification wherever applicable.

Radiological Evaluation

Radiological assessment included plain radiographs in standard views for all patients. Computed tomography (CT) and magnetic resonance imaging (MRI) were performed when clinically indicated to assess complex fractures, intra-articular involvement, or associated soft-tissue injuries.

Management Details

Details of initial management were documented, including emergency stabilization, splintage, wound management, and definitive treatment. Treatment modalities were categorized as conservative or operative, with operative procedures including internal fixation, external fixation, or combined approaches.

Statistical Analysis

Data were entered into Microsoft Excel and analysed using SPSS version 27 (IBM Corp., Armonk, NY, USA). Categorical variables were expressed as frequencies and percentages. Continuous variables were expressed as mean ± standard deviation or median (interquartile range) as appropriate. The chi-square test was used to assess associations between categorical variables, and a p-value <0.05 was considered statistically significant.

Ethical Considerations

The study was approved by the Institutional Ethics Committee (IEC) of Balrampur Hospital, Lucknow (Ref. No. 18|18{-1}|HB|2023, dated 21/06/2023). Written informed consent was obtained from all participants or their legally acceptable representatives. Patient confidentiality and ethical standards were strictly maintained throughout the study in accordance with the Declaration of Helsinki.

RESULTS

A total of 400 patients with orthopaedic injuries resulting from road traffic accidents were included in the analysis during the six-month study period from January to June 2025. RTA-related orthopaedic injuries predominantly affected young adult males, with the highest burden in the 21–30-year age group; the gender difference was statistically significant (Table 1). Two-wheeler users constituted the majority of victims, reflecting their increased vulnerability in mixed traffic conditions (Table 2). Lower-limb injuries were most common, consistent with high-energy impacts in two-wheeler and pedestrian accidents (Table 3). Among closed fractures, AO/OTA Type A (simple) fractures were most frequent, while approximately one-sixth were complex injuries indicating substantial trauma severity (Table 4). Moderate to severe open fractures (Types II and III) accounted for a substantial proportion, reflecting the high-energy nature of RTAs in the region (Table 5). Open fractures were significantly more likely to require surgical management compared to closed fractures ($p < 0.001$) (Table 6).

Table 1 Demographic Distribution of RTA-Related Orthopaedic Injury Patients (n = 400)

Age Group (years)	Male n (%)	Female n (%)	Total n (%)
≤20	38 (9.5)	12 (3.0)	50 (12.5)
21–30	112 (28.0)	18 (4.5)	130 (32.5)
31–40	78 (19.5)	22 (5.5)	100 (25.0)
41–50	48 (12.0)	20 (5.0)	68 (17.0)
>50	32 (8.0)	20 (5.0)	52 (13.0)
Total	308 (77.0)	92 (23.0)	400 (100)

Note. The gender difference was statistically significant (chi-square test, $p < 0.05$).

Table 2 Distribution of Road User Category Among Study Participants (n = 400)

Road User Type	Number	Percentage (%)
Two-wheeler rider/pillion	216	54.0
Car occupant	92	23.0
Pedestrian	64	16.0
Heavy vehicle occupant	28	7.0
Total	400	100

Table 3 Anatomical Distribution of Orthopaedic Injuries (n = 400)

Region Involved	Number	Percentage (%)
Lower limb	196	49.0
Upper limb	128	32.0
Pelvis	24	6.0
Spine	18	4.5
Multiple regions	34	8.5
Total	400	100

Table 4 AO/OTA Classification of Closed Long Bone Fractures (n = 298)

AO/OTA Type	Number	Percentage (%)
Type A (Simple)	162	54.4
Type B (Wedge)	88	29.5
Type C (Complex)	48	16.1
Total	298	100

Table 5 Gustilo–Anderson Classification of Open Fractures (n = 102)

Gustilo–Anderson Type	Number	Percentage (%)
Type I	28	27.5
Type II	34	33.3
Type IIIA	22	21.6
Type IIIB	14	13.7
Type IIIC	4	3.9
Total	102	100

Table 6 Association Between Fracture Type and Requirement of Surgical Intervention (n = 400)

Fracture Type	Operative n (%)	Conservative n (%)	Total
Closed fractures	178 (59.7)	120 (40.3)	298
Open fractures	92 (90.2)	10 (9.8)	102
Total	270	130	400

Note. Chi-square test; p-value < 0.001 (statistically significant).

DISCUSSION

Road traffic accidents (RTAs) remain a leading cause of trauma-related morbidity in India, and orthopaedic injuries constitute a major share of this burden. The present study analysed the pattern of RTA-related orthopaedic injuries over a six-month period at Balrampur Hospital, Lucknow, and provides institution-specific and region-specific evidence relevant for trauma care planning and prevention strategies in North India.

Demographic Profile

In the present study, a clear predominance of young adult males was observed, with individuals aged 21–30 years forming the largest affected group and males accounting for more than three-quarters of cases (77%). This finding is consistent with multiple Indian hospital-based studies, including Misra et al. (2017), who reported that young males constitute the most vulnerable group for RTA-related injuries. Similar demographic trends have been reported internationally, reflecting increased road exposure, occupational travel, and higher risk-taking behaviour among young men (WHO, 2018; WHO, 2016). The loss of productivity and long-term disability in this economically active age group further amplifies the socio-economic impact of RTAs.

Road User Pattern

Two-wheeler users formed the largest group of injured patients in the present study (54%). This pattern closely mirrors national road safety data and hospital-based Indian studies, which consistently identify two-wheeler riders and pillion riders as the most vulnerable road users (MoRTH, 2025; IIT Delhi, 2024). The high dependence on two-wheelers for daily commuting in Lucknow and surrounding districts, coupled with inadequate use of protective gear, mixed traffic conditions, and high speeds, likely contributes to this finding. Alotaibi et al. (2021) similarly reported that motorcycle-related crashes accounted for a substantial proportion of orthopaedic injuries in a tertiary care setting. These findings underscore the urgent need for stricter enforcement of helmet use, speed regulation, and targeted road-safety interventions for two-wheeler users.

Anatomical Distribution of Injuries

The lower limb was the most commonly involved anatomical region, accounting for nearly half of all orthopaedic injuries (49%). This distribution aligns with several Indian and international studies, where lower-extremity injuries have been consistently reported as the most frequent outcome of RTAs, particularly among two-wheeler users and pedestrians (Misra et al., 2017; Bezabih et al., 2022; Alotaibi et al., 2021). Lower-limb injuries often result from direct impact or crushing mechanisms and are associated with prolonged hospital stay, delayed rehabilitation, and long-term functional impairment. The predominance of lower-limb trauma highlights the need for adequate infrastructure for fracture fixation, post-operative care, and physiotherapy services at Balrampur Hospital and similar tertiary centres (Joshi et al., 2023).

Fracture Pattern and AO/OTA Classification

Among closed long-bone fractures, AO/OTA Type A (simple fractures) constituted the majority (54.4%), followed by Type B (wedge, 29.5%) and Type C (complex, 16.1%) fractures. This pattern is comparable with observations by Khadilkar et al. (2022), who reported a predominance of simple fracture patterns in RTA victims, with a smaller but clinically significant proportion of complex fractures. Although complex fractures formed a minority, they represent a disproportionate share of surgical workload, resource utilization, and complication risk. The use of the AO/OTA classification in the present study allows standardized reporting and facilitates meaningful comparison with other orthopaedic trauma series nationally and internationally.

Open Fractures and Gustilo–Anderson Classification

Open fractures constituted approximately one-quarter of all injuries (25.5%), with Gustilo–Anderson Type II and Type III injuries forming the majority (72.6% of open fractures combined). This proportion is comparable to findings reported by Bezabih et al. (2022) and other tertiary-care studies, where high-energy mechanisms and referral bias contribute to a higher prevalence of severe open fractures. The substantial proportion of Type III injuries reflects the high-velocity nature of RTAs on major roads and highways in and around Lucknow. Such injuries are associated with increased risk of infection, need for multiple surgeries, prolonged hospital stay, and long-term disability, emphasizing the critical importance of early wound debridement, timely skeletal stabilization, and multidisciplinary trauma care.

Management Pattern and Surgical Intervention

A significantly higher proportion of open fractures required operative management compared to closed fractures (90.2% vs. 59.7%, $p < 0.001$). This finding is consistent with established orthopaedic principles and corroborated by previous studies reporting operative intervention rates exceeding 85–90% for open fractures (Bezabih et al., 2022; Alotaibi et al., 2021). The high operative burden observed in this study highlights the need for well-equipped operating theatres, continuous availability of implants and external fixators, and adequately trained orthopaedic trauma teams at Balrampur Hospital.

Comparison with National and International Data

Overall, the injury patterns observed in this study closely resemble those reported in Indian tertiary hospitals and international studies from low- and middle-income countries (Misra et al., 2017; Alotaibi et al., 2021; Joshi et al., 2023). However, the relatively higher proportion of open and surgically managed fractures likely reflects referral bias inherent to tertiary care centres. National surveillance systems such as MoRTH and NCRB primarily capture crash and fatality data without detailed clinical injury profiling (MoRTH, 2025; NCRB, 2023). Hospital-based studies like the present one therefore complement national datasets by providing actionable insights into injury severity, management requirements, and healthcare resource burden at the institutional level.

Strengths and Limitations

The strengths of this study include a reasonably large sample size (n = 400), use of validated and internationally recognized fracture classification systems (AO/OTA and Gustilo–Anderson), and comprehensive documentation of injury patterns and management. However, the study is limited by its single-centre design and the short follow-up period, which precluded assessment of long-term outcomes such as functional recovery, implant-related complications, and infection rates. Referral bias inherent to a tertiary hospital may also have influenced the injury severity distribution. Future multicentric prospective studies with longer follow-up and formal outcome assessment are warranted.

Implications

The findings of this study reinforce the need for targeted road-safety interventions for young male two-wheeler users in Lucknow and Uttar Pradesh, and highlight the substantial burden of lower-limb and open fractures on tertiary care orthopaedic services. Strengthening pre-hospital trauma care, improving orthopaedic infrastructure, ensuring implant availability, and enforcing preventive strategies such as mandatory helmet use are essential to reduce the morbidity and long-term disability associated with RTAs in this region.

CONCLUSION

Road traffic accidents continue to impose a substantial orthopaedic burden on tertiary care institutions in Uttar Pradesh. The present study, conducted at Balrampur Hospital, Lucknow, demonstrates that RTA-related orthopaedic injuries predominantly affect young adult males, with two-wheeler users being the most vulnerable road-user group. Lower-limb injuries were the most frequent, reflecting high-energy trauma mechanisms commonly encountered in motorcycle and pedestrian crashes. A significant proportion of patients sustained open fractures, particularly Gustilo–Anderson Type II and III injuries, indicating severe soft-tissue damage and increased surgical demand. The use of standardized AO/OTA and Gustilo–Anderson classification systems allowed objective assessment of fracture severity and facilitated comparison with national and international literature. The high operative intervention rate, especially among open fractures (90.2%), underscores the need for adequately equipped trauma services, trained orthopaedic trauma teams, and timely surgical care. Strengthening road-safety enforcement, improving pre-hospital trauma care, and enhancing tertiary-level orthopaedic infrastructure at institutions such as Balrampur Hospital are essential to reduce morbidity and long-term disability associated with RTAs in North India.

DECLARATIONS

Funding: None
Acknowledgements: None
Conflict of Interest: The author declares no conflict of interest.

REFERENCES

1. Alotaibi, F., Alqahtani, A. H., Alwadei, A., Al-Raeh, H. M., Abusaq, I., Mufrrih, S. A., Alqahtani, A. A., Alsabaani, A., & Alsulami, M. M. (2021). Pattern of orthopedic injuries among victims of road traffic accidents in Aseer region, Saudi Arabia. Annals of Medicine and Surgery, 67, 102509. https://doi.org/10.1016/j.amsu.2021.102509
2. Bezabih, Y., Tesfaye, B., Melaku, B., & Asmare, H. (2022). Pattern of orthopedic injuries related to road traffic accidents among patients managed at the emergency department in Black Lion Hospital, Addis Ababa, Ethiopia, 2021. Open Access Emergency Medicine, 347–354.
3. IIT Delhi TRIPC. (2024). India status report on road safety – 2024. Transportation Research and Injury Prevention Centre, IIT Delhi. https://tripc.iitd.ac.in/assets/publication/India_Status_Report_on_Road_Safety-20242.pdf
4. Joshi, P., Karmacharya, M., & Shrestha, S. K. D. (2023). Orthopaedic fractures among patients attending a tertiary care centre. JNMA Journal of Nepal Medical Association, 61(267), 856–860. https://doi.org/10.31729/jnma.8325
5. Khadilkar, M., Tawde, A. N., & Pundkare, G. T. (2022). Incidence of fracture and dislocation patterns in patients with extremity injuries reporting to a tertiary care hospital. Journal of Orthopaedics, Traumatology and Rehabilitation, 14(2), 109–114.
6. Ministry of Road Transport & Highways (MoRTH), Government of India. (2025). Road accidents in India – 2023. Government of India. https://morth.nic.in/sites/default/files/Road-Accident-in-India-2023-Publications.pdf
7. Misra, P., Majumdar, A., Misra, M. C., Kant, S., Gupta, S. K., Gupta, A., & Kumar, S. (2017). Epidemiological study of patients of road traffic injuries attending emergency department of a trauma center in New Delhi. Indian Journal of Critical Care Medicine, 21(10), 678–683.
8. National Crime Records Bureau (NCRB), Ministry of Home Affairs, Government of India. (2023). Accidental deaths and suicides in India (ADSI). https://www.ncrb.gov.in/accidental-deaths-suicides-in-india-adsi.html
9. Rostom, A. H., Suboh, D., Dweikat, T., Hindi, I., Farounyeh, Z., & Shawahna, R. (2024). Epidemiological pattern of injuries among road traffic crash victims: The first experience of a large tertiary care hospital in the West Bank of Palestine. BMC Emergency Medicine, 24(1), 229.
10. Sahu, M. R., Mohanty, M. K., Sasmal, P. K., Radhakrishnan, R. V., Mohanty, C. R., Shaji, I. M., Naveen, A., & Parida, M. (2021). Epidemiology and patterns of road traffic fatalities in India pre- and post-Motor Vehicle (Amendment) Act 2019: An autopsy-based study. International Journal of Critical Illness and Injury Science, 11(4), 198–203.
11. World Health Organization. (2016). Road traffic injuries: Fact sheet. World Health Organization.
12. World Health Organization. (2019). Global status report on road safety 2018. World Health Organization.