

Original Research Article

Assessing the prevalence of various modes of injury and type of malleolar fractures based on Lauge-Hansen classification presenting at a tertiary care center

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ABSTRACT

Background: Ankle fractures represent approximately 9% of all fractures and are a common occurrence with an incidence of 138-169 per 100,000 per year. The mechanism of injury differs in terms of mode of injury in various age groups. The Lauge-Hansen classification is a pathologic-anatomic classification and emphasizes different stages of ligamentous injury, in addition to the fracture pattern, and provides options for fracture treatment.

Methods: A retrospective observational study, where the prevalence of various types of ankle fractures were classified according to the Lauge-Hansen Classification, in the period of 2018 onwards till date. The mode of injury and age group of the patient was also noted.

Results: A total of 84 patients were analyzed, supination-external rotation (48.7%) were the most frequently observed fractures in our study population, with no significant correlation between mode of injury and fracture pattern noted. There was a statistically significant association ($p < 0.05$) between the velocity of injury and the age groups suffering ankle trauma.

Conclusion: The Lauge-Hansen Classification continues to be an important tool in assessing the biomechanics of ankle fractures and the management options available, especially in a country like India where more expensive imaging modalities may not be available or affordable at times. Our study also highlights that high velocity fractures continue to be a major cause of morbidity in the younger age group, especially in developing countries such as India. Stringent traffic rules and public awareness need to be put into practice to reduce the toll of this problem.

Keywords: Malleolar fractures, Lauge-Hansen, Mode of injury

INTRODUCTION

Ankle fractures represent approximately 9% of all fractures and are a common occurrence with an incidence of 138-169 per 100,000 per year.¹⁻³ It is frequently encountered and can be managed by most orthopedic trauma surgeons. A good classification system for fractures not only facilitates clinical handoff but also guides management practices and treatment options for the patient. One of such fracture classification systems is the

Lauge-Hansen classification for ankle fractures. It is a pathologic-anatomic classification and emphasizes different stages of ligamentous injury, in addition to the fracture pattern, and provides options for fracture treatment.⁴ Compared to this, easier classification systems like the Denis-Weber classification and Association for Osteosynthesis/Association for the Study of Internal Fixation (AO/ASIF) were developed which are easier to use, purely radiographic classifications.^{5,6} The AO/ASIF classification provides valuable information to facilitate

communication between physicians, however, it doesn't accurately tell about the extent of ligament injury, an essential piece of knowledge which the Lauge-Hansen Classification system might provide. The original classification by Lauge-Hansen provides the mechanism of injury, on which the entire system is based.⁴ However, as evidenced by multiple studies done in the past, it does not have good reproducibility, with kappa values between 0.17 to 0.48, hence limiting its value.⁷⁻⁹

As the system is based on controlled cadaveric biomechanical studies conducted under physiological conditions, it is not possible to classify 5% of the fractures in in-vivo models.⁴ There is also a degree of dissociation between the soft tissue and ligament injury as interpreted by Lauge-Hansen classification vs magnetic resonance evaluation.¹⁰ Furthermore, as pointed out by several prior studies, there is poor interobserver and intra-observer reliability associated with this classification system.¹¹⁻¹⁴

Despite its caveats, the Lauge-Hansen classification remains one of the easiest to follow classification systems for ankle fractures and remains our basis for understanding the pathomechanics of ankle fractures. Using this study, we have tried to classify the prevalence of ankle fractures in a tertiary care center in India according to the aforementioned system. Additionally, the study has tried to find the prevalence of high or low-velocity trauma in classified fracture systems.

Aims and Objectives

To find the prevalence of various types of ankle fractures, based on the Lauge-Hansen Classification presenting at our institute over the past 2 years. To find out the mode of injury among all the cases of ankle fractures and their frequency. To classify the mode of injury as high or low energy among different fracture types. To find the prevalence of high and low-velocity ankle fractures among different age groups.

METHODS

The study is retrospective observational conducted from January 2018 to January 2020 at Dr. R.N. Cooper Municipal Hospital and HBT Medical College, Mumbai.

Inclusion criteria

All the cases of malleolar fractures above the age of 18, that have reported to our institute were included.

Procedure

The fracture pattern was classified by a senior orthopedic surgeon based on the pre-operative radiograph from patient records, using the Lauge-Hansen classification system (Table 1).⁴ The mode of injury was identified from patient records and classified as high or low velocity

(Table 2). The age of the patient to be included in the study was also noted in Table 3. The data was consolidated using Microsoft Excel 2016 and statistical analysis done using Statistical Package for the Social Sciences (SPSS).

Table 1: The Lauge-Hansen classification system

Category	Stage
Supination external rotation	Injury of the anterior inferior tibiofibular ligament
	Oblique/spiral fracture of the distal fibula
	Injury of the posterior inferior tibiofibular ligament or avulsion of the posterior malleolus
Supination adduction	Medial malleolus fracture or injury to the deltoid ligament
	Transverse fracture of the distal fibula
Pronation external rotation	Vertical fracture of the medial malleolus
	Medial malleolus fracture or injury to the deltoid ligament
	Injury of the anterior inferior tibiofibular ligament
Pronation abduction	Oblique/spiral fracture of the fibula proximal to the tibial plafond
	Injury of the posterior inferior tibiofibular ligament or avulsion of the posterior malleolus
	Medial malleolus fracture or injury to the deltoid ligament
Pronation adduction	Injury of the anterior inferior tibiofibular ligament
	Transverse or comminute fracture of the fibula proximal to the tibial plafond

Table 2. Types of injury mechanism.

High energy	Low energy
Bike accident	Slipping on uneven surface
Fall from moving vehicle	Fall from stairs
Direct trauma to foot	Foot stuck in hole
Fall from height	
Hit and run	

Table 3. Age groups.

Group	Age (years)
Young age	>18 to <40
Middle age	40 to <60
Old age	>60

RESULTS

The total no. of cases included in the study were 84. 68 males and 16 females. The median age of the population was 40.5. The right ankle was fractured in 56 cases and the left ankle in 28 cases.

As per our observations, supination-external rotation (48.7%) were the most frequently observed fractures in our study population, followed by supination-adduction (22.61%), pronation-abduction (21.42%) and pronation-external rotation (9.52%) fracture patterns.

The most frequently observed mode of injury in our study population was slipping on uneven surfaces (26.19%) with the second most one being hit-and-run (16.67%). The least observed mode of injury was direct trauma (2.38%). There was no significant association ($p < 0.05$) between the groups in relation to the velocity of trauma and the pattern of ankle fracture sustained (Table 6).

The ratio of high: low-velocity injuries in the young age group was 2.8:1, in the middle age group, was 1.28:1 and in the old age group, it was 1:7. There was a statistically significant association ($p < 0.05$) between the velocity of injury and the age groups suffering ankle trauma.

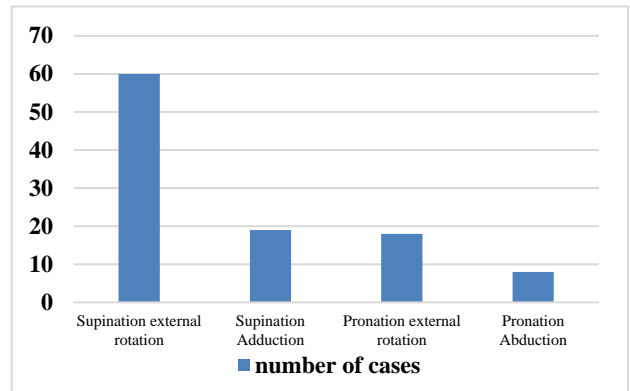


Figure 1: Fracture pattern.

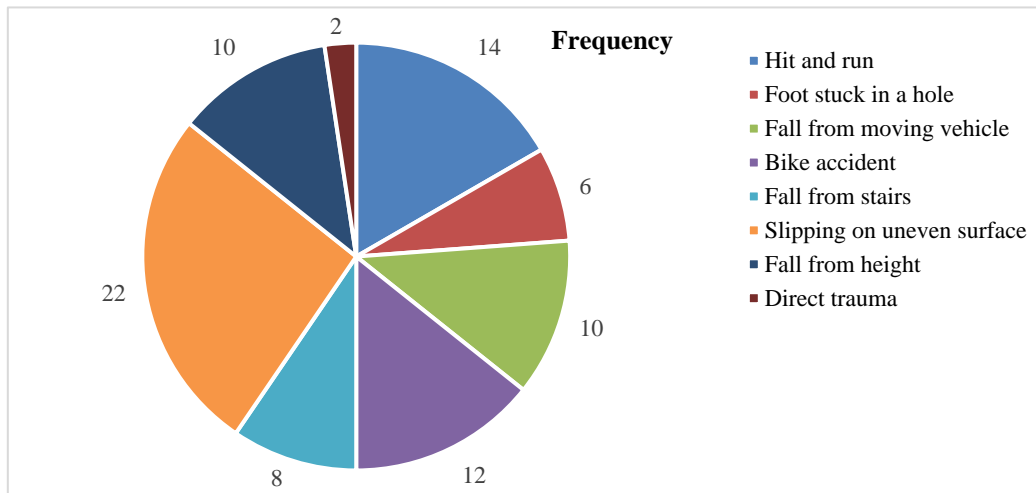


Figure 2: Mode of injury.

Table 4: Comparison of velocity of injury and fracture pattern.

Classification*	High velocity	Low velocity	Total	P value
Supination-external rotation	18	22	40	
Supination-adduction	12	6	19	
Pronation-abduction	10	8	18	0.4867
Pronation-external rotation	4	4	8	
			84	

*chi-square test used. Significant at 0.05 level.

Table 5: Comparison of age groups and mode of trauma.

Age Group*	High velocity	Low Velocity	P value
Young age 18-<40	28	10	0.000198
Middle age 40-<60	18	14	
Old age >60	2	14	

*chi-square test used. Significant at 0.05 level.

DISCUSSION

The impact of the deforming force on the ankle joint and the morphology of malleolar fractures can be adequately linked using the traditional Lauge-Hansen Classification, leading to the development of appropriate closed reduction techniques. However, the significance of the fracture classification lies not only in the management of orthopaedic trauma but also in forensic medicine as it helps us to deduce the mechanism of fracture. Moreover, with the evolved preference of open reduction and internal fixation methods, reduction manoeuvres proposed by Lauge-Hansen have taken a backseat in ankle trauma management.

The results of our study indicate that the most common fracture according to the Lauge-Hansen classification system is Supination-External Rotation (S-ER) injury (48.7%). This is in accordance with several studies done in the past, such as the study by Boszczyk et al where the reported frequency for S-ER fractures on X-rays was 79%, by Gardner et al who reported a frequency of 63% and by Viberg et al who reported the prevalence of S-ER in his study as 66%.^{10,15,16}

Our study did not show any correlation ($p=0.4867$) between the fracture type seen on the X-ray and the velocity of trauma as obtained on history taking of the patients. This is in non-concordance with the results by Briet et al who has shown a direct correlation between the velocity of trauma and the type of ankle fracture, where all the pronation abduction injuries and supination adduction injuries were exclusively found in those patients who suffered high energy trauma.¹⁷

The most frequently observed mechanism of injury in our study was found to be slipping on uneven ground (26.19%) which is lesser compared to the values obtained by Boszczyk et al where slipping on uneven ground was the most common mode of injury (49%).¹⁵ Second most common mode of injury in our study was Hit-and-run (16.67%), whereas as per the results obtained by Boszczyk et al, the second most common cause was falling down a flight of stairs (22%). This could be due to higher rates of traffic accidents in a country such as India due to liberal traffic rules and overpopulation.

As per our knowledge, this study is the first of its kind to assess the relationship between the velocity of trauma and ankle injuries in between different age groups. Our study has shown that there is a statistically significant association between high energy trauma and ankle injuries in younger age groups ($p=0.000198$) at $p<0.05$. The cause behind this can be speculated as a higher association of younger generation with road traffic accidents and rash driving habits. Similarly, the higher incidence of low-velocity ankle fractures in older age group could be attributed to the reduced bone density in this age group and also due to functional impairment in walking and balance that develops as the body ages.

Similarly, the higher incidence of low-velocity ankle fractures in older age group could be attributed to the reduced bone density in this age group and also due to functional impairment in walking and balance that develops as the body ages.

CONCLUSION

Ankle fracture classifications have continued to evolve over time and however dated it may be, the Lauge-Hansen Classification continues to be an important tool in assessing the biomechanics of ankle fractures and the management options available, especially in a country like India where more expensive imaging modalities like Magnetic Resonance Imaging (MRI) may not be available or affordable at times.

However, due to its poor reproducibility and poor interobserver and intra-observer reliability, we might see this classification method getting phased out in future, in favour of simpler and more efficient AO/ASIF or the Denis-Weber classification systems.

Our study also highlights that high-velocity fractures continue to be a major cause of morbidity in the younger age group, especially in developing countries such as India. Stringent traffic rules and public awareness need to be put into practice to reduce the toll of this problem.

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