International Journal of Research in Health and Allied Sciences
Journal home page: www.ijrhas.com
Official Publication of "Society for Scientific Research and Studies" [Regd.]
ISSN: 2455-7803

Original Research

Pattern, Etiology and Management of Mandible Fracture in the Lower Himalayas Region of State of Himachal Pradesh

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ABSTRACT
Aim:- The aim of this study was to analyze the pattern of mandible fracture in the region of lower Himalayas of state of Himachal Pradesh based on the mechanism of injury. **Material & Method**:-The records of the patients treated for their mandibular fracture were reviewed between time periods from august 2017 to December 2018. Age, Gender, Etiology, Anatomical site of mandible, multiple fractures within the mandible and Method of treatment were recorded and assessed. **Result**: Maximum incidence of fractures was observed among the individuals in 3rd decade (29.55%) followed by 4th decades (27.28%) of life. Male to female ratio was 10:1 suggestive of male predominance. Road traffic accidents (RTAs) were observed to be the predominant etiological factor responsible accounting for 40.90% of the total injuries followed by fall (39.77%) which is almost equal to RTAs, interpersonal violence (11.37%),sports injury (3.4%) animal injury (2.28%). Condyle exhibited the highest incidence (33.8%) amongst the anatomic sites, followed by parasymphysis (22.55%), angle (17.29%), body (13.55%), symphysis (7.52%), Dentoalveolar (3.75%), coronoid (1.5%) and ramus (0.76%). Single fracture site was noted in 56.82% cases followed by two anatomical sites in 35.23% then three anatomical sites in 7.95% cases. Fracture mandible mainly treated with open reduction and internal fixation in 73.87% of cases. **Conclusion**: High incidence of mandible was observed with male predominance in 3rd decade of life, RTAs and fall being the chief cause and the condyle was the most commonly involved site. Mandible can fracture at single, double or multiple sites. Mandible fracture can be treated mainly by open reduction with internal fixation with miniplates.
Key words: Mandibular fractures, Lower Himalayas region, road traffic accident, open reduction internal fixation

Received: 22 July, 2019 Revised: 19 September, 2019 Accepted: 20 September, 2019

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This article may be cited as: Rana SS. Pattern, Etiology and Management Of Mandible Fracture in the Lower Himalayas Region Of State of Himachal Pradesh . Int J Res Health Allied Sci 2019;5(5):122-129.

INTRODUCTION

The Mandible is particularly more prone for maxillofacial trauma and fractures due to its unique mobility, shape and chin prominence in the facial skeleton. It is the second, most frequent of the facial bones affected by traumatic injuries and shown to account for 15.5% to 59% of all facial fractures.[1] The mandible can be seen fractured alone or in combination with fracture of other bones in the maxillofacial region. A broken lower jaw is accompanied by pain, deranged occlusion and loss of masticatory function, speech impairment and aesthetic disfigurement with psychological effects apart from significant financial cost.[2,3] The etiology of mandibular fractures could be caused by road traffic accidents (RTAs), accidental falls, assaults, industrial mishaps, sports injuries and firearm injuries.[4]

Treatment planning and formulation of preventive measures against mandibular fractures requires adequate knowledge on etiological factors associated with their occurrence and the patterns of these injuries.

The way in which mandibular fractures are treated and repaired has undergone a gradual evolution. Over the years, many techniques for the repair of mandibular fractures have been introduced. The methods have ranged from maxillomandibular fixation (MMF) to combinations of MMF and wire osteosynthesis, lag screw, and plate

fixation. Today, rigid internal fixation using compression and noncompression plating systems has gained widespread popularity.[5-13]

Limited information is available on the etiology, pattern and management of mandible fracture in the lower Himalayas region of state of Himachal Pradesh (India). Himachal Pradesh as no previous study devoted to such topic has been undertaken up to now. The aim of the present study was to examine the age, gender, etiology, anatomical distribution, multiple fractures within the mandible and method of treatment of mandible fractures. The objective of the present study were to record the epidemiology of the mandible fracture in western Himachal Pradesh. The result may aid in identifying the etiological factor involved in planning subsequent prevention strategies.

MATERIAL AND METHOD

Patients who had treated for their mandible fracture at the Department of Dentistry, Dr Rajender Prashad government medical college Kangra, Himachal Pradesh (India) from August 2017 to December 2018 were included in this study. Some patients did not turn back after primary diagnosis of mandible fracture due to fear of surgery or some other reason were excluded in this study. We included the personal data (age, sex), etiology of injury, pattern of mandible fracture and the type of treatment done.

Etiology of fracture were noted as i) Road traffic accident (RTA), includes person directly involved with vehicles or pedestrian, ii) Fall, includes person who fall on ground or road while walking, or fall from tree or roof or from any height, iii) Violence (interpersonal or assault) iv) sports injury, v) animal injury and vi) others

Detailed clinical examinations were done, and diagnosis was made on the basis of signs and symptoms, investigations including X-rays and computed tomography scans. Types of fractures were noted. Mandible fractures were recorded as i) symphysis, ii) parasymphysis,iii) body, iv) angle, v) ramus, vi) condyle, vii) coronoid and viii) dento-alveolar fractures.

There were four major strategies for treating mandible fracture. First, Dento-alveolar fracture of mandible was treated by splinting with Erich arch bar for 6 week. Second, the patient who had high positioned condylar fracture were treated conservatively with closed reduction with 3 week rigid maxillo-mandibular fixation (MMF) in adult and one week rigid MMF in children. Third, the patients with symphysis, parasymphysis, body, angle, ramus, and low positioned subcondylar fracture were treated by open reduction and internal fixation (ORIF) by bone plates. In fourth group, the patients who had bilateral condylar fracture with either body, parasymphysis, symphysis and angle region of mandible fracture were treated by open reduction and internal fixation (ORIF) by bone plate for body, parasymphysis, symphysis or angle region and rigid maxillomandibular fixation (MMF) for bilateral condylar fracture.

Two type surgical approaches were use for mandible fracture in our study. First, Mandibular vestibular approach for fracture symphysis, parasymphysis, body, and angle region of mandible. Second, Retromandibular approach for condylar fracture.

The mandibular fractures were compiled according to age, gender, etiology, anatomic site and methods of fixation.

RESULT

A total of 88 patients (80 men and 8 women) treated for mandible fracture in Department of Dentistry Dr Rajender Prashad government medical college Kangra, Himachal Pradesh during the study period. (Table 1)

TABLE 1 - Patient Demographics

S.No	Age/Sex	Etiology	Site of fracture	Surgical approach	Treatment
1	24/M	RTA	Right angle	Vestibular	ORIF
2	18/M	RTA	Left angle	Vestibular	ORIF
3	16/M	FALL	Left condyle		MMF
4	60/M	OTHER	Right body	Vestibular	ORIF
5	35/M	RTA	Right condyle		MMF
6	27/M	FALL	Left parasymphysis	Vestibular	ORIF
7	27/M	FALL	Right body	Vestibular	ORIF
8	29/M	SPORT INJURY	Right angle	Vestibular	ORIF
9	21/M	RTA	Symphysis	Vestibular	ORIF
10	31/M	RTA	Left angle	Vestibular	ORIF
11	40/M	RTA	Right body	Vestibular	ORIF
12	31/M	FALL	Right body	Vestibular	ORIF
13	42/M	RTA	Dentoalveolar		Splinting
14	55/M	RTA	Left condyle	retromandibular	ORIF
15	35/M	FALL	Right parasymphysis	Vestibular	ORIF
16	19/M	FALL	Right condyle		MMF
17	25/F	IPV	Right condyle		MMF
18	9/M	FALL	Right condyle		MMF
19	35/M	FALL	Left angle	Vestibular	ORIF
20	66/F	OTHER	Right angle	Vestibular	ORIF
21	55/M	RTA	Left parasymphysis	Vestibular	ORIF

22	7/F	FALL	Right condyle		MMF
23	38/M	FALL	Right condyle		MMF
24	34/M	SPORT INJURY	Left angle	Vestibular	ORIF
25	40/M	RTA	Left parasymphysis	Vestibular	ORIF
26	46/M	IPV	Left parasymphysis	Vestibular	ORIF
27	32/M	RTA	Left condyle		MMF
28	20/M	FALL	Left condyle		MMF
29	27/M	RTA	Left condyle		MMF
30	24/F	RTA	Right angle	Vestibular	ORIF
31	14/M	RTA	Symphysis	Vestibular	ORIF
32	31/M	FALL	Symphysis	Vestibular	ORIF
33	47/M	IPV	Right parasymphysis	Vestibular	ORIF
34	32/M	FALL	Right body	Vestibular	ORIF
35	19/M	SPORT INJURY	Right body	Vestibular	ORIF
36	19/M	FALL	Left body	Vestibular	ORIF
37	25/M	RTA	Left parasymphysis	Vestibular	ORIF
38	40/F	RTA	Left parasymphysis	Vestibular	ORIF
39	24/F	FALL	Left condyle	Retromandibular	ORIF
40	22/M	RTA	Left body	Vestibular	ORIF
41	56/M	FALL	Left parasymphysis	Vestibular	ORIF
42	21/M	RTA	Symphysis	Vestibular	ORIF
43	37/M	RTA	Left parasymphysis	Vestibular	ORIF
44	47/M	FALL	Left condyle	Retomandiblar	ORIF
45	10/M	FALL	Right condyle		MMF
46	44/M	IPV	Left angle	Vestibular	ORIF
47	40/M	RTA	Symphysis	Vestibular	ORIF
48	25/F	ANIMAL INJURY	Left angle	Vestibular	ORIF
49	30/M	FALL	Right angle	Vestibular	ORIF
50	19/M	RTA	Right body	Vestibular	ORIF
51	27/M	FALL	Right parasymphysis + Dentoalveolar	Vestibular	ORIF
52	19/M	IVF	Left body + Right condyle	Vestibular + Retromandibular	ORIF
53	19/M	FALL	Right angle + left coronoid	Vestibular	ORIF
54	32/F	RTA	Bilateral condyle		MMF
55	57/M	IPV	Bilateral body	Vestibular	ORIF
56	31/M	FALL	Bilateral condyle		MMF
57	30/M	IPV	Right body + Left angle	Vestibular	ORIF
58	25/M	FALL	Left body + Right coronoid	Vestibular	ORIF
59	36/M	RTA	Left parasymphysis + Right condyle	Vestibular + Retromandibular	ORIF
60	58/M	FALL	Left parasymphysis + Right condyle	Vestibular + Retromandibular	ORIF
61	65/M	FALL	Right body + Left angle	Vestibular	ORIF
62	20/M	FALL	Left parasymphysis + Left angle	Vestibular	ORIF
63	18/M	ANIMAL INJURY	Right parasymphysis + Left angle	Vestibular	ORIF
64	24/M	FALL	Left parasymphysis + Right condyle	Vestibular + Retromandibular	ORIF
65	20/M	FALL	Left parasymphysis + Right condyle	Vestibular + Retromandibular	ORIF
66	48/M	FALL	Right condyle + Dentoalveolar		MMF
67	31/M	FALL	Right parasymphysis + Left angle	Vestibular	ORIF
68	49/M	IPV	Right parasymphysis + Left condyle	Vestibular	ORIF+MMF
69	40/M	RTA	Symphysis + Right condyle	Vestibular + Retromandibular	ORIF
70	31/M	FALL	Right parasymphysis + Left angle	Vestibular	ORIF
71	25/M	IPV	Right body + Left angle	Vestibular	ORIF
72	26/M	IPV	Left angle + Left condyle	Vestibular + Ratromandibular	ORIF
73	17/M	RTA	Right parasymphysis + Left angle	Vestibular	ORIF
74	25/M	RTA	Left parasymphysis + Dentoalveolar	Vestibular	ORIF
75	34/M	RTA	Right parasymphysis + Left condyle	Vestibular + Retromandibualr	ORIF

76	26/M	RTA	Right parasymphysis + Left angle	Vestibular	ORIF
77	19/M	RTA	Symphysis + Left condyle	Vestibular + Retromandibular	ORIF
78	40/M	RTA	Right parasymphysis + Left angle	Vestibular	ORIF
79	50/M	FALL	Bilateral condyle		MMF
80	30/M	RTA	Left parasymphysis + Right body	Vestibular	ORIF
81	30/M	RTA	Symphysis + Left condyle	Vestibular + Retromandibular	ORIF
82	15/M	FALL	Bilateral condyle + Symphysis	Vestibular	ORIF+MMF
83	32/M	RTA	Bilateral + Left body	Vestibular	ORIF+MMF
84	11/M	FALL	Bilateral condyle + Left parasymphysis		MMF
85	55/M	RTA	Bilateral condyle + right parasymphysis	Vestibular	ORIF+MMF
86	42/M	FALL	Bilateral condyle + Symphysis		MMF
87	25/M	RTA	Bilateral condyle + Left parasymphysis	Vestibular	ORIF+MMF
88	24/M	RTA	Right parasymphysis + Right ramus + Dentoalveolar	Vestibular + Retromandibular	ORIF

Male to female ratio is 10:1. The age of the patients ranging from 7 to 66 years and a mean age of 32 (31.54) years. Most frequent being the ages between 21-30 years (29.55%) followed by age between 31-40 years (27.28%) then age between 11-20 years (19.32%).(Table 2)

TABLE 2- Age and gender distribution

S. No	Age group (in yrs)	Male	Female	Total (%)
1	0-10	2	1	3.40
2	11-20	17	0	19.32
3	21-30	22	4	29.55
4	31-40	22	2	27.28
5	41-50	9	0	10.23
6	51-60	7	0	7.95
7	61-70	1	1	2.27
		80	8	100

The road traffic accidents (RTAs) (40.90%) and fall (39.77) were the two main etiological factors in majority of mandible fracture followed by interpersonal violence (11.37%), sports injury (3.40%), animal trauma (2.28%) and others (2.28%). (Table 3)

TABEL 3- Distribution of trauma etiologies

ETIOLOGY	NUMBER OF PATIENTS	TOTAL (%)
FALL	35	39.77
ROAD TRAFFIC ACCIDENT	36	40.90
INTER PERSONAL VIOLENCE	10	11.37
SPORTS INJURY	3	3.40
ANIMAL TRAUMA	2	2.28
OTHERS	2	2.28
	88	100

Among 88 patients, 133 fracture lines were observed. The patients who had a single fracture line was 50 (56.82%), and there were 31 patients (35.23%) with two fracture lines and 7 patients (7.95%) with three fracture lines, respectively.(Table 4)

TABLE 4- Distribution of mandible fracture in relation to fracture line.

S.no	Fracture line	Patient
1	1	50
2	2	31
3	3	7
Total		88

According to site of mandible, Condyle fractures were the most frequent and were identified in 44 sites (33.08%). followed by Parasymphysis (22.55%), Angle (17.29%), Body (13.55%), Symphysis (7.52%), Dentoalveolar (3.75%), Coronoid (1.5%) then Ramus (0.76%). (Table 5)

TABLE 5- Distribution of Mandible fracture in relation to the fracture site

S.no	Site of fracture	N	Side		Total (%)
			Right	left	
1	ANGLE	23	6	17	17.29
2	RAMUS	1	1	-	0.76
3	CONDYLE	44	23	21	33.08
4	CORONOID	2	1	1	1.50
5	BODY	18	12	6	13.55
6	PARASYMPHYSIS	30	13	17	22.55
7	SYMPHYSIS	10	-		7.52
8	DENTOALVEOLAR	5			3.75
		133	56	62	100

Among the single site fracture of mandible the most involve site was condyle 14 out of 88 patients (15.9%) followed by angle 11 out 88 (12.5%), parasymphysis 10 out of 88 (11.33%), body 9 out of 88 (10.2%) Symphysis 5 out of 88 (5.68%).Amongst combination fractures (2 fractures), the most prevalent were parasymphysis with angle constituting 7 out of 88 (7.96%). This was followed by Parasymphysis with condyle in 6 cases (6.82%), Symphysis with condyle in 3 cases (3.4%), body with angle in 3 cases (3.4%), bilateral condyle in 3 cases (3.4%), followed by Parasymphysis and dentoalveolar in 2 cases (2.27%), bilateral body in 1 case (1.13%), body with condyle in 1 case (1.13%), angle with coronoid in 1 case (1.13%), body with coronoid in 1 case (1.13%) , parasymphysis with body in 1 case (1.13%), angle with condyle in 1 case (1.13%), condyle with dentoalveolar in one case (1.13%) and even in multiple fractures sites (more than two fractures in the mandible) bilateral condyle with parasymphysis constituting 3 out of 88 (3.4%) was the most commonly involved site. (Table 6)

TABLE 6 - Mandible fracture and site distribution pattern (single, double, more the two site)

S.No	Fracture site	Patients (n)	Total (%)
1	Symphysis	5	5.68%
2	Parasymphysis	10	11.33%
3	Body	9	10.2%
4	Angle	11	12.5%
5	Condyle	14	15.9%
6	Dentoalveolar	1	1.13%
7	Symphysis + Condyle	3	3.40%
8	Parasymphysis + Condyle	6	6.82%
9	Parasymphysis + Angle	7	7.96%
10	Parasymphysis + Body	1	1.13%
11	Parasymphysis + Dentoalveolar	2	2.27%
12	Body + Angle	3	3.40%
13	Body + Coronoid	1	1.13%
14	Bilateral body	1	1.13%
15	Body + Condyle	1	1.13%
16	Angle + coronoid	1	1.13%
17	Condyle + Dentoalveolar	1	1.13%
18	Bilateral condyle	3	3.40%
19	Bilateral condyle + Symphysis	2	2.27%
20	Bilateral condyle + Parasymphysis	3	3.40%
21	Bilateral condyle + Body	1	1.13%
22	Parasymphysis +Dentoalveolar +Ramus	1	1.13%
		88	100

Several methods of reduction and fixation were used in the treatment of mandible fractures as shown in table 7. Out of 88 patients 65 patients (73.87%) treated with open reduction and internal fixation (ORIF) with bone plate. 17 out of 88 patients (19.32%) were treated by closed reduction by maxillomandibular fixation (MMF). 5 patients were treated with both open and closed reduction (ORIF + MMF) and in one case of dentoalveolar fracture splinting were used as a treatment.

TABLE 7- Type of treatment of mandible fracture

S.no	Treatment	Number of cases	Total (%)
1	Splinting	1	1.13%
2	MMF	17	19.32%
3	ORIF	65	73.87%
4	ORIF + MMF	5	5.68%
		88	100%

DISCUSSION

The sheer pace of modern life with high-speed travel as well as an increasingly violent and intolerant society has made facial trauma a form of social disease from which no one is immune. Seemingly, divergent shifts in society may be responsible for recent changes in patterns of facial injuries, extent, clinical features, and so forth resulting in massive disfigurement of maxillofacial skeleton. Mandible is the only mobile bone of facial skeleton, and there has been significant increase in the number of cases in recent years. Mandible fractures if not identified or inappropriately treated may lead to severe consequences both cosmetic and functional. This study was undertaken with the view to review the incidence, commonest site, and combination of mandibular fracture sites; to study co-relation of site of fracture with etiology; to study correlation of number of fracture sites in mandible with age, sex, and etiology.

The incidence of mandibular fracture in this study increased with increasing age from 0 to 30 years then progressively decreased from 41 years of age. This could be explained as children till the age of 6 years are under parental care thereby prevented from sustaining severe injuries and the elasticity of bones makes them less prone to fracture. As the age progresses, they are more involved in physical activities, by the time they reach adulthood they are involved in fast and rash driving, interpersonal violence, alcohol abuse, contact sports, and so forth, while the people beyond 40 years of age lead a more calm, peaceful, and disciplined life. The low frequencies of very young and old age groups are due to the low activities of these age groups

As for age and sex distribution, males were more frequently affected, accounting for 90.9% (80), and females accounted for just 9.09% (8), almost attaining a male-to-female ratio of
10:1. This finding was similar to results from other domestic and international studies.[14,15] In this study, the incidence was highest in 21- 30 years of age (29.55%) followed by 31- 40years of age (27.28%); least being in 61-70 years and above (2.27%). These findings are similar with the results of previous studies[14, 16-18.]

This study showed that the most common cause of facial injuries was road traffic accidents,(40.9%) which was consistent with the observation in other studies in India and other countries.[16, 19-23.]In this region of lower Himalayas, fall from height appears to be the second most etiological factor for mandible fracture comprising 39.77%. This is similar to other studies from India.[23-25] Few international studies also reported fall as the second etiological factor.[16, 26-28]

In the present study it was found that most of the cases of fall from height like fall from tree. It is in common practice for male in this region of lower Himalayas to climb tree for cutting grass for their cattle and wood for domestic use.

The highest frequency of fractures was seen in age group of 21-30 years. It may because people from these age groups are mostly involved in sports, interpersonal violence industrial works and high speed transportation. In most of the cases, road traffic accident occurs in these groups during evening and late night hours under the influence of alcohol. Hilly terrain, poor condition of road, over speeding and overloading may be other contributing factors for RTA in this region of the world.

Condyle fracture accounts for approximately 30% and 37% of mandible fracture in dentulous mandible patients and edentulous mandible patients, respectively. The reason for a high incidence of mandibular condyle fracture is attributable to the binding of the mandibular ramus with high stiffness and mandibular condyle head with low stiffness.[29]

.In the present study, according to site of mandible, condyle fractures were the most frequent and were identified in 44 sites (33.08%). Condyle fracture were the most common site in other studies.[29-31] Followed by Parasymphysis (22.55%), angle(17.29%), body (13.55%), Symphysis(7.52%), dentoalveolar (3.75%), coronoid (1.5%) and ramus (0.76%)

The commonest combination of fracture in this study is parasymphysis with angle accounting for 7.96%, these often occurred as a result of RTA and fall, with the mandible presumably fracturing in areas deficient in strength. This is similar to the studies done by Dongas and Hall[19] and Malik and Singh.[32]

All mandible fracture patients were treated either by open reduction or closed reduction. Several different approaches were used for the treatment of mandibular fractures. Out of 88 cases in 65 cases (73.87%), open reduction and internal fixation (ORIF) were done using bone plates and screws. Out of the remaining 23 cases, 17 cases (19.32%) were treated conservatively using maxillomandibular fixation (MMF), 5 cases (5.08%) were treated with both open reduction and internal fixation and maxillofacial fixation (ORIF + MMF) and the remaining 1 cases (1.13%) were treated by splinting with enrich arch bar.

The introduction of bone plates as the implants for osteosynthesis has changed this facet of oral and maxillofacial surgery. The concept of bone plating has changed over time, with the introduction of various modifications. Sequentially, bone plates such as compression plates, dynamic compression plates, eccentric dynamic compression plates, miniplates and microplates have been introduced; but miniplates are the ones most commonly used.[33] Miniplates have been widely used during the past four decades, following the principles described by Michelet et al.[34]
and Champy et al.[8] We used miniplates in open reduction and internal fixation cases. For condylar fracture we use 1.5 mm titanium miniplates and for remaining sites such as Symphysis, parasymphysis, body, angle and ramus we used 2.0 mm titanium plates. For site Symphysis, parasymphysis, and body two parallel plates were placed according to the ideal osteosynthesis lines given by Champy et al to prevent torsion movements. First, the inferior plate was placed and later another plate was placed 4–5 mm above the inferior plate. In case of angle fracture single miniplate ventral to oblique line of buccal cortex of mandible was used through intraoral open reduction and fixation. Numerous authors have documented low complication rate with mono cortical miniplate fixation.[8,34]
We used two plate fixation technique in open reduction and internal fixation case of condylar fracture. The single-plate fixation technique does not provide sufficient strength to withstand the strains occurring in subcondylar fractures. Therefore, more and more authors advocate the use of a two-plate fixation technique, which seems to have the beneficial effect of restoring the tension and compression trajectories in subcondylar fractures. Ideally, two miniplates should be applied at the posterior and anterior border of the condylar neck in a triangular fashion with one plate below the sigmoid notch and another plate along the posterior border of the ramus.[35]

CONCLUSION

From our study, the etiology, pattern and distribution among 88 cases of mandible fracture in lower Himalayas region of state Himachal Pradesh, we have concluded that high incidence of mandible was observed with male predominance in 3rd decade of life, RTAs and fall being the chief cause and the condyle was the most commonly involved site. Mandible can fracture at single, double or multiple sites. Mandible fracture can be treated mainly by open reduction with internal fixation with mini-plates.

In India, road traffic accident still remains the major causes of facial fractures mainly young males. In hilly terrain, road traffic accidents can be minimized by better wide roads, use of parapet or guide walls, modern technology in vehicles on hill roads such as antilock braking system (ABS) and hill assist to prevent slipping on roads. Strict laws for over-speed and overload and to use seat belts while driving and use of helmet while riding two-wheeler are required. Also require strict law not to carry passenger in goods carrier vehicles such trucks, tractor-trolley, mini-trucks etc. Fall, the second most cause, mainly from tree, can be reduced only when better facility will be available to villages, such as use of cooking gas rather than wood, establishment of government fodder shops for cattle rather than grass fetching from the jungle.

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