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Original Research Article

INCIDENCE OF FRACTURE IN SMALL RUMINANTS: A RETROSPECTIVE STUDY

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Abstract *The availability of information or data regarding various affections forms a powerful tool for rendering appropriate treatment. The present study was designed to acquire data on fracture in small ruminants. This study will act as a base for policymakers to implement future projects in orthopedics for different species of animals. All the cases of bone affection at the indoor surgery clinic, Department of Veterinary Surgery, the University of Veterinary and Animal Sciences, Lahore, for four years from 2016 to 2019 were enrolled in the study. The diagnosis was based on the clinical history, signs, and clinical examination and by radiograph. Treatment as medicinal or surgical interventions was provided wherever feasible. The data concerning species, sex, age, bone, type of fracture, and cause were compiled and analyzed by using the Chi-Square test. The overall incidence of fracture was found to be 4.47%. Caprine was the most common (96.136%) subject exposed to bone fracture. The fracture incidence was highest between 7 and 12 months of age, 76.40% in goats and 67.857% in sheep. Furthermore, male subjects were more prone to fracture (69.617%) and (15.405%) than females (30.383%), and (6.527%) in goats and sheep, respectively. The metacarpal (43.953%) in goats was affected bone most commonly with fracture, followed by the metatarsal (28.319%), tibia fibula (14.159%), radius–ulna (11.504%), humerus (1.475%), femur (0.590%). While in the case of sheep, metacarpal (40.476%) was followed by metatarsal (22.619%), tibia-fibula (26.190%), and radius–ulna (10.714%). Moreover, in bovines, the overall incidence of fracture was 1.82%. Similarly, in equines, fractures were mostly of radius-ulna (16.66%) and metatarsal (23.33%). The most common site of the fractures was located in the mid-shaft of a bone. Trauma (46.018%) was the most common cause of a fracture in goats, while in sheep, it fell from a height (40.476%). It was concluded that the metacarpal bone fracture was the most common fracture in goats than other animals.*

Keywords*:* *Incidence, bone, fracture, caprine, ovine, equine*

Introduction

A fracture is a disruption in the continuity of the bone that may result from trauma, twisting due to muscle spasms, indirect loss of leverage, or due to any disease resulting in bone decalcification (Blood *et al*, 2007). Data regarding the fracture of long bones in goats is pivotal in rendering appropriate treatment and policy-making for the future (Doijode, 2018). Currently, it is difficult for policymakers to develop strategies regarding animal welfare (Singh *et al*, 2017). In veterinary practices, fracture incidence has increased manifolds (Aithal et al, 1999) due to the increase in auto vehicles leading to more chances of vehicular accidents (Singh *et al*, 2015). Due to their active nature, Goats often suffer from lameness (Mohsina *et al*, 2014). Long bones are exposed to physiological and non-physiological forces. Non-physiological forces can be imposed in unusual situations, such as automobile accidents, gunshot injuries, and falls. These non-physiological forces may easily exceed the bone's crucial strength, resulting in fracture (Singh *et al*, 2015).

Fracture of long bones is one of the major orthopedic conditions in sheep and goats (Awatif *et al*, 2006). In small ruminants, mostly femur is fractured which is followed by radius, ulna, metatarsus, and metacarpals (Kofler *et al*, 2017). Goats are among

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the small-domesticated ruminants that have served humanity earlier and longer than cattle and sheep (Singh *et al*, 2017). In frightened or weary goats, severe fractures may occur in the long bones of the limbs (Smith and Sherman, 2009).

Trauma is the major cause of long bone fractures in goats and sheep, mainly because of transportation or traffic accidents (Gahlot, 2000; Aithal *et al*, 2007). Fractures in goats also occur due to their curious and weary nature or trauma from dog attacks (Singh *et al*, 2015). Most fractures are present in the tibia, metacarpal, and metatarsal bones due to the less covering of muscles on the bone surface (Singh *et al*, 2001; Aithal *et al*, 2007; Mohiuddin *et al*, 2018). Therefore, the present study was designed to obtain data on fractures in goats presented at the Indoor Surgery Clinic, University of Veterinary and Animal Sciences, Lahore. This study will act as a baseline for the policymakers regarding implementing future projects related to orthopedic surgery in goats in Pakistan.

Materials and methods

The study was planned according to the guidelines given by the Animal Care and Use Committee, University of Veterinary and Animal Sciences Lahore, Pakistan.

Case selection

The cases entered at the Indoor Surgery Clinic, Department of Veterinary Surgery, the University of Veterinary and Animal Sciences, Lahore, from January 2016 to June 2019 were studied. Out of the registered cases at the indoor surgery clinic, the lameness cases were examined for fracture studies.

Fracture diagnosis

The fracture diagnosis was based on the clinical history and clinical examination, which included palpation, inflammatory signs, and radiographic imaging (Arican *et al*, 2013).

Signalment of animals

The data regarding species, sex, age, bone, fracture type, and cause were compiled according to Singh *et al.*, (2017).

Incidence rate

Out of all registered cases, the animals with lameness were identified and examined for long bone fractures. The percentage of the total number of fracture cases in small ruminants was calculated and reported according to Singh et al., (2017).

Statistical analysis

The statistical analysis was made using Statistical Packages for Social Sciences SPSS Version 20.0. (SPSS for windows, Chicago, USA). The normality of the data was analyzed by the Kolmogrov-Simirnov test. Data for long bone fracture incidence was analyzed using the Chi-square test. The differences were considered significant at $p < 0.05$.

Results

Incidence

The fracture incidence was calculated from the total cases registered at the Indoor Surgery Clinic, Department of Veterinary Surgery, University of Veterinary and Animal Sciences, Lahore. During the study period (Jan 2016 to June 2019), 9832 cases were registered. Among these, 1830 cases suffered from lameness, which was 18.61% among the 440 cases recorded of fracture in different animals, accounting for an incidence of 4.47%, as mentioned in (Fig 1).

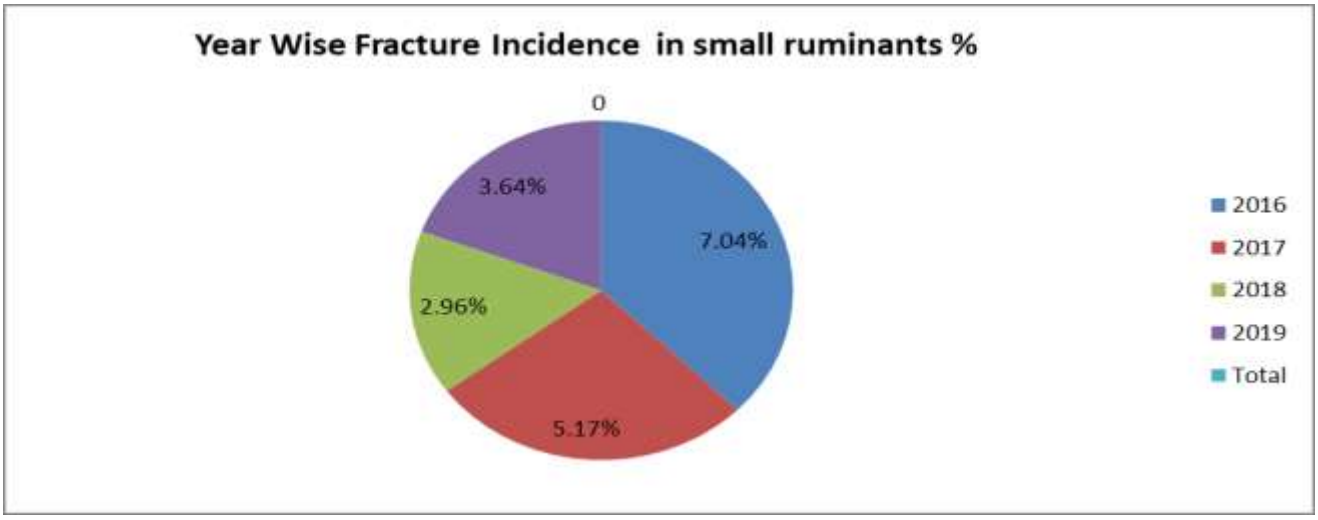

Fig. 1: Incidence rate of fracture in different species of animals

Animal Species: Among 440 cases, the highest number of fractures was recorded in caprine 96.14%, followed by bovine 1.82%, ovine 1.14%, and equine 0.91% (Table 1).

Table 1: Species-wise distribution of fracture

Species	Number	Percent
Equine	04	0.91%

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Caprine	423	96.14%
Bovine	08	1.82%
Ovine	05	1.14%

Age

Among 432 cases of fracture in caprine, which was 96.4 % of total cases, the highest percentage of fracture was recorded in animals aged between 7 to12 months, 76.40% in goats, and sheep 7 to12 months 67.861%, followed by age group of below 7 months in goats 15.04%, in sheep above 12 months 20.24% and age group of above 12 months in goats 8.55% and sheep below 7 months (Table 2).

Table 2: Age-wise distribution of fracture in caprine

Age of animals	Number	Percent	Chi-sq
Goat			
below 7	51	15.04	674.65***
7 to 12 month	259	76.40	
above 12	29	8.55	
Sheep			
below 7	10	11.90	45.929***
7 to 12 month	57	67.86	
above 12	17	20.24	

Sex

The fracture was more common in male goats 69.62% and sheep 15.40% than in female goats 30.38% and sheep, 6.53% of animals (Table 3).

Table 3: Sex-wise distribution of fracture in caprine

Sex of the animals	Number	percent	Chi-sq
Goat			
Male (Bucks)	236	69.62	81.799***
Female	103	30.38	
Sheep			
Male (Rams)	59	15.40	13.762*
Female	25	6.53	

Involvement of different bones

Among different bones, the highest number of fractures was recorded in the metacarpal 43.95% followed by the metatarsal 28.32%, tibia-fibula 14.16%, radius–ulna 11.50%, humerus 1.48%, femur 0.59% in goats, and in sheep metacarpal 40.48% followed by tibia-fibula 26.19%, metatarsal 22.62% and radius–ulna 10.71% (Fig 2).

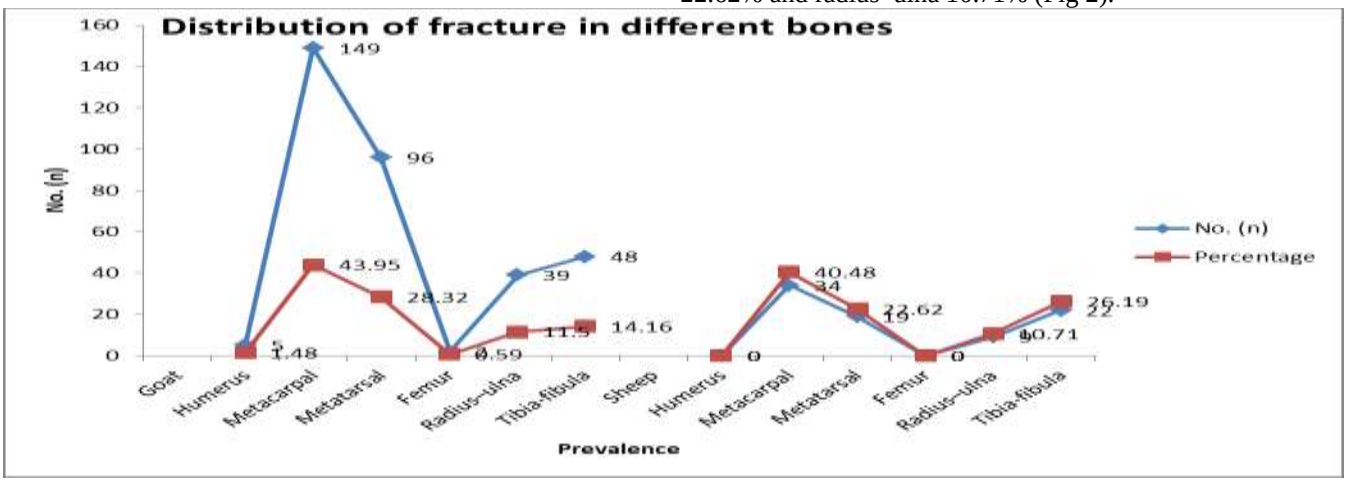

Fig. 2: Distribution of fracture in different bones

Types of fracture

Types of fracture observed during the study period were close in goats (87.02%) and sheep (89.29%) and opened in goats (12.98%) and sheep (10.71%) (Table 4).

Table 4: Types of fracture in different bones

Types of fracture	Number	Percent (%)
Goat		
Close	295	87.02
Open	44	12.98
Sheep		
Close	75	89.29
Open	9	10.71

Site of fracture

Based on location, in goats, the highest number of fractures was observed in diaphysis 50.15% followed by distal third 28.32% proximal third 20.65% and in sheep diaphysis 47.62%, followed by distal third 35.71%, proximal third 14.29% (Table 5).

Table 5: Site of fracture in different long bones

Fracture site	Number	Percent (%)
Goat		
Distal diaphysis	96	28.32
Diaphysis	170	50.15
Proximal diaphysis	73	21.53
Sheep		
Distil diaphysis	30	35.71
Diaphysis	40	47.62
Proximal diaphysis	14	16.67

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Etiology of fracture

Trauma 46.02% was the most common cause of fracture, followed by falling from height 29.50%, transportation 12.98% and automobile accidents 11.50% in Goats, and in sheep falling from height 40.48% was the most common cause of fracture, followed by trauma 35.71%, an automobile accident 13.09% and transportation 10.71% (Table 6).

Table 6: Etiology of fracture

Cause	Number	Percent
Goat		
Automobile accident	39	11.50
Falling from height	100	29.50
Trauma	156	46.02
Transportation	44	12.98
Sheep		
Automobile accident	11	13.09
Falling from height	34	40.48
Trauma	30	35.71
Transportation	9	10.71

Discussion

The incidence of fracture at the Indoor Surgery Clinic, Department of Veterinary Surgery, University of Veterinary and Animal Sciences, Lahore, was recorded to be 4.47% in different species of animals. Kumar (2016) reported a lower incidence of 0.82% compared to our study. Similarly, Rajhans (2013) and Singh *et al,* (2015) reported that the overall incidence of fracture was 0.90% and 0.95%, respectively, for all species of animals. However, Arora (1996) reported a higher incidence of fracture in animals, which was 12.23%. The variation in the incidence of fracture is attributed to changes in location and time, like before religious ceremonies such as Eid-ul-Adha (Anees, 2013).

During this study, the highest fracture incidence was recorded in caprine 96.14%, followed by bovines at 1.82%, ovine at 1.14%, and equines at 0.91%. These findings follow the findings of Ganesh *et al*,(1994), who observed a high incidence of fracture in sheep and goats, 62.60%, followed by cattle and buffalo. Species-wise variation in the incidence of fracture is due to the difference in the number of animals presented for treatment and their base population at the place of study. In the present study in caprine, the higher incidence of fracture may be due to the dense caprine population present in the Punjab province 32.6% followed by Baluchistan 30.6%, Sindh 20.6%, and Khyber Pakhtunkhwa 16.1% (Agricultural Census, 2006). The presence of these animals in urban areas is among the major causes of small ruminants' long bone fractures, as they are more exposed to trauma in road accidents due to the highly dense population.

In this study, the highest number of fractures was recorded in animals aged between 7 to12 months, 76.40% in goats and sheep 67.86% respectively, followed by an age group below 7 months in goats 15.04%, and in the sheep; age group above 12 months 20.24%, age group above 12 months in goats 8.55% then sheep in age group below 7 months 11.90%. These findings are in agreement with the findings of Patel (2014), Gupta (2015), and Kumar (2016), who also observed the highest incidence of fracture in goats below 9 months of age. The high incidence of fracture in young goats is because of their more population and activeness, which makes them more prone to fracture by either trauma or falling (Singh *et al,* 2017). Fractures were found to be more common in male than female animals. The sex-wise incidence rate in bucks was 69.62% compared to 30.38% in goats; similarly, in rams, it was 15.40% compared to 6.53% in sheep. These observations follow Philip *et al,* (1998), Gupta (2015), and Kumar (2016), who also reported a higher incidence of fracture in males compared to females. Higher incidence in males can be attributed to the fact that males are more active than females, predisposing them more to the factors causing fracture (Singh *et al,* 2017).

The highest number of fractures was recorded in the metacarpal 43.95% followed by the metatarsal 28.32%, tibia fibula 14.16%, radius–ulna 11.50%, humerus 1.48%, femur 0.59% in goats; and in sheep metacarpal 40.48% followed by tibia fibula 26.19%, metatarsal 22.62%, radius ulna 10.71%. These findings agree with Gupta (2015) & Kumar (2016), who reported the highest number of fractures in the metacarpal compared to the metatarsal in goats. More fractures in the metacarpal than metatarsal may be attributed to animals' heavier weight on forelimbs than hind limbs. So, it may play its part in falling from a height; similarly, being an anterior part of the body, there are more chances of being affected by the trauma source.

The types of fracture observed in this study were close fracture in goats (87.02%), sheep (89.29%), open fracture in goats (12.98%), and sheep (10.71%). These findings are in agreement with Arora (1996), Patel (2014), and Kumar (2016). A plausible explanation of the high incidence of close fracture is that when a force less than the optimal braking force of bone acts tangentially on any object, it gets distributed un-proportionately with more force on the near cortex and less force on the far cortex leading to breakage of the close cortex and tear the distant cortex, thus producing an oblique fracture in goats. Based on location on bone, the fracture was observed highest in diaphysis at 50.15%, followed by distal third at 28.32%, proximal third at 20.65% in goats, whereas, in sheep at diaphysis at 47.62%, followed by distal third at 35.71% and proximal third 14.29%. These findings are following Arora (1996) and Gupta (2015). The maximum incidence of diaphysial fracture in goats is because legs are highly

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exposed during running and jumping, with less musculature covering them and becoming more prone to fracture (Singh *et al*, 2017).

Trauma 46.02% was found to be the most common cause of fracture in goats, followed by falling from height 29.50%, transportation 12.98%, and automobile accidents 11.50%. In sheep falling from a height, 40.48% was the most common cause of fracture, followed by trauma 35.71%, automobile accidents 13.09%, and transportation 10.71%. These findings follow the findings reported by Gupta (2015), who reported that falling from a height 37.50%, followed by an automobile accident 25.00%, hitting 25.00%, and a dog bite 12.50% were the causes of fractures in goats. These findings contradict Kushwaha *et al*, (2001), who observed that automobile accidents were 71.43% the leading cause of fracture, followed by falling from a height of 28.57%. An acceptable reason behind this might be due to the congregation of nomadic, semi-nomadic, and rural populations keeping goats towards the urban periphery with the availability of the least grazing area due to which movement of the animals takes place in the urban area and because of less availability of a place for keeping animals in the city, the goats get excited and exposed to trauma, leading to fracture of long bones. Moreover, goats' jumping nature may also be responsible for the fracture of long bones (Singh *et al*, 2017).

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Abdul Asim Farooq, Arif Khan, and Hamid Akbar conceptualized the study. The methodology was designed by Abdul Asim Farooq, Arif Khan and Maqbool Hussain Shah. Formal analysis was carried out by Muhammad Usman Saleem, Muhammad Arshad Javid, and Muhammad Abdul Basit. The original draft was written by Abdul Asim Farooq, Saima Inayat, and Shagufta Nasreen while Mushtaq Hussain Lashari, Muhammad Arshad Javid, Saeed Murtaza and Abdul Asim Farooq reviewed and edited the draft.

Informed consent

N/A

Ethical Approval

Current study is approved from concerned ethical review committee

Competing interests

The authors have no competing interests.

Data availability statement

All data has been given in manuscript.

Submission declaration and verification

The work is not been published previously, and it is not under consideration for publication elsewhere.